FEMA 125/June 1987
(Supersedes CPG 2-1A1 dated May 1982, which may not be used.)

# ATTACK ENVIRONMENT MANUAL

## Chapter 1

## Introduction to Nuclear Emergency Operations

FEDERAL EMERGENCY MANAGEMENT AGENCY

# FOREWORD

## WHAT THE EMERGENCY PLANNER NEEDS TO KNOW ABOUT THE NATURE OF NUCLEAR WAR

No one has gone through a nuclear war. This means there isn't any practical experience upon which to build. However, emergency management officials are responsible for preparing for the possibility of nuclear war. Intelligent preparations should be based on a good understanding of what operating conditions may be like in a war that has never occurred. If the planner lacks such understanding, the emergency operations plans produced probably won't make sense if they ever have to be used.

The Attack Environment Manual has been prepared to help the emergency planner understand what such a war could be like. It contains information gathered from over four decades of study of the effects of nuclear weapons and the feasibility of nuclear defense actions, numerous operational studies and exercises, nuclear test experience, and limited experience in wartime and peacetime disasters that approximate some of the operating situations that may be experienced in a nuclear attack. In short, it summarizes what is known about the nuclear attack environment as it could affect operational readiness at the local level.

The data on the effects of nuclear weapons used in this manual have been taken from the 1977 edition of "The Effects of Nuclear Weapons" (ENW), compiled and edited by S. Glasstone and P. J. Dolan and prepared and published by the United States Department of Defense and the United States Department of Energy. Copies are available for purchase from the U.S. Government Printing Office. The ENW is the most widely available authoritative source of weapon effects and is in many public libraries across the country. For these reasons it was chosen as the source data in this manual.

This Attack Environment Manual supersedes CPG 2-1A1 through 2-1A9.

LIST OF CHAPTER TITLES



*Chapter 3 will be published at a later date.

# PREFACE TO CHAPTER 1

This introduction to nuclear emergency operations is aimed at the reader who has no special knowledge of the subject. It does not rely on knowledge of the material in subsequent chapters of the manual. However, information in this chapter is referred to in subsequent chapters.

The information is presented in the form of "panels" each consisting of a page of text and an associated sketch, photograph, chart or other visual image. Each panel covers a topic. This preface is like a panel with the list of topics in chapter 1 shown opposite. If the graphic portion is converted into slides or vugraphs, the chapter or any part can be used in an illustrated lecture or briefing, if so desired.

The ordering of topics begins with two introductory panels, followed by four panels on current enemy capabilities. There are five panels on direct weapon effects, followed by one on fallout. The next nine panels discuss operating contingencies, leading to nine basic operating situations. Finally, two panels emphasize the generic nature of contingency planning and propose a concept of operations under nuclear attack. There is a list of suggested additional reading for those who are interested in further information on the general subject.

## CONTENTS OF CHAPTER 1

## INTRODUCTION TO NUCLEAR EMERGENCY OPERATIONS

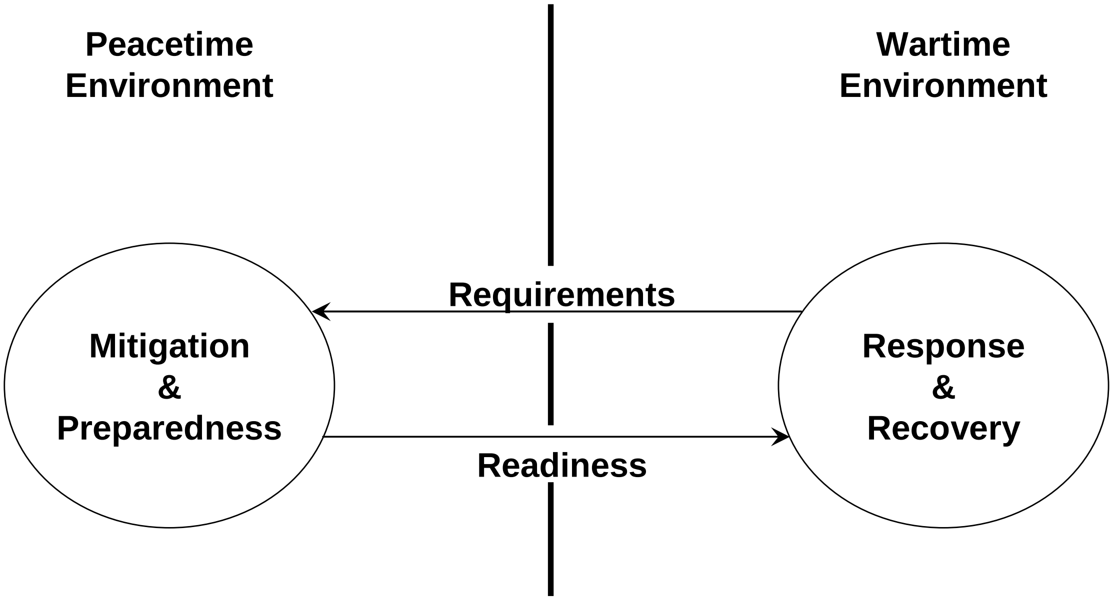
# NUCLEAR DEFENSE OPERATIONS

Nuclear defense operations are the activities and measures undertaken for the protection of life and property in the event of nuclear attack. A factor in ensuring that these operations occur is the ability of State and local government to function. Government officials will be overwhelmed in the face of escalating demands if attention is not paid to the components that constitute a crisis management capability. These components for continuity of government include succession of leadership; predelegation of emergency authorities; safekeeping of essential records; emergency operating centers (EOC's); emergency action steps; alternate headquarters; and protection of government resources, facilities, and personnel. Many of these components also are needed to save lives and property in peacetime emergencies. Accordingly, a strategy for developing capabilities and readiness which addresses attack preparedness should contain some features that will deal with a wide range of emergency situations.

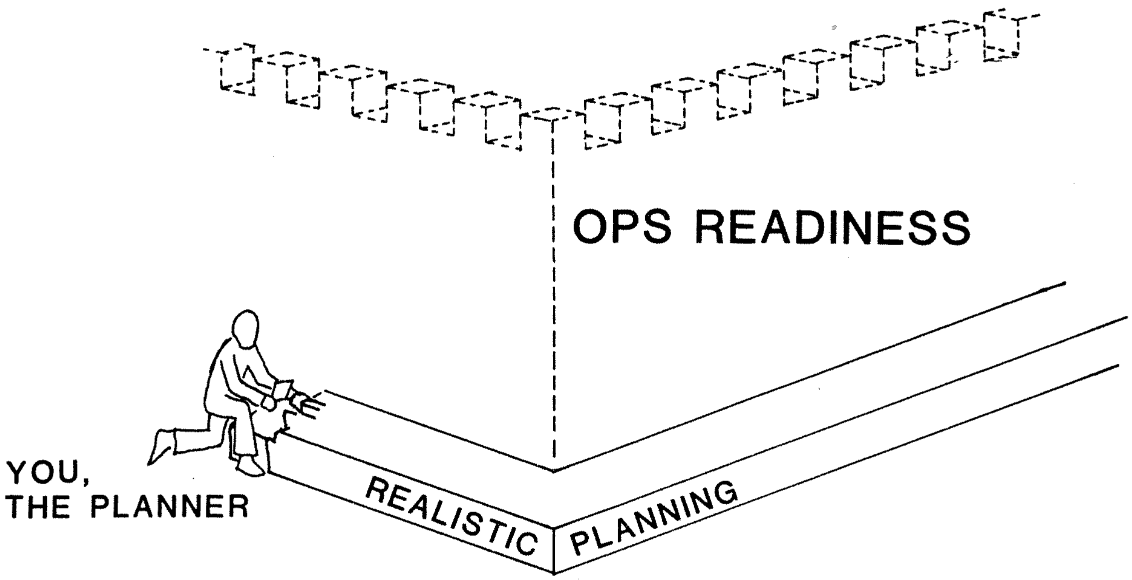
It is useful to view emergency management activities before, during, and after an emergency in terms of four phases: <u>mitigation</u>, <u>preparedness</u>, <u>response</u>, and <u>recovery</u>. A cardinal characteristic of nuclear defense is that response and recovery operations would occur in a wartime environment. Only by a careful study of the needed response and recovery operations and the attack environment that demands and constrains them can one understand the <u>requirements</u> for effective nuclear defense operations. This manual is intended to aid in this understanding.

Basic operational readiness, applicable to multiple hazards, is a significant and essential step toward readiness for nuclear defense. The nuclear attack hazard, however, is unique in its possible scope and intensity of impact and in many other characteristics as well. This manual will emphasize these unique aspects of the attack environment to provide a basis for the development of nuclear attack hazard-specific plan elements and operational capabilities.

Building local operational <u>readiness</u> is the basic purpose of emergency management programs in the precrisis (or normalcy) time phases. Realisitic <u>operational planning</u> is the foundation of operational readiness. Planning is the process by which the existing capabilities and resources of a community or area are organized in advance so that coordinated response is possible. Good planning also forms the basis for the development of additional capabilities needed to fulfill unmet requirements so as to improve local operational readiness.




EMERGENCY MANAGEMENT PHASES



## THE BASIS FOR OPERATIONAL PLANNING

Neither national defense policy nor local emergency operating plans for protecting the population against a nuclear attack can be based on experience. The expected effectiveness of any nuclear defense program or emergency action can be evaluated in a believable way only through simulation--hypothesizing various attack and defense combinations, and evaluating the consequences. In this way, meaningful insights can be developed as a substitute for the hard facts that do not exist from actual experience.

It is from such studies that the essential planning premises are developed. The extent of areas that probably would experience direct effects and severe fallout, the protection required, and probable shelter stay times are examples. The realistic planning of emergency operations under nuclear attack conditions places the most demanding requirement on the state of knowledge. Under what conditions will people survive blast and fire effects in ordinary buildings? How fast will fires develop and spread? How much radiation exposure can an emergency team receive without serious permanent injury or degradation of performance? Questions such as these are answered only partly or not at all by analysis of Japanese experience at Hiroshima and Nagasaki in World War II and the data from the nuclear weapons testing program. To fill in the most important voids in the information needed for planning and training has been the most important task of nuclear defense research during the past several decades.

Illustrations of the experimental techniques used to provide a basis for nuclear emergency operations are those shown here. At upper left is the blast tunnel facility (see chapter 2). At upper right is an instrumented building fire (see chapter 3). At lower left is a fallout shielding experiment using a scale model (see chapter 6).

The information in this manual depends heavily on the research base that has been built since the advent of nuclear weapons. Wherever appropriate, the basis for the facts will be described. But, first, in this chapter, we present the "big picture," without which the attack environment information would not be useful.

PANEL 2

# THE NUCLEAR THREAT

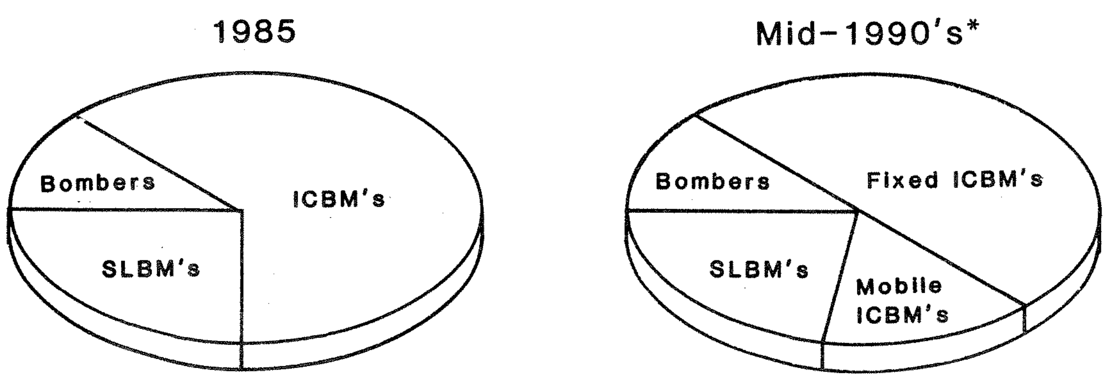
The dimensions of the nuclear threat can vary from a single "accidental launch" or terrorist weapon to a limited strike against our strategic offensive forces to an "all-out" attack against military, industrial, and leadership targets. The Soviet Union is the primary potential adversary with the capability to inflict major damage and loss of life in the United States. There are several significant measures of Soviet nuclear forces of interest to those planning nuclear defense operations. These include numbers of delivery vehicles, numbers of warheads and megatons of explosive yield. (A megaton is equivalent to a million tons of TNT.)

The table on the page opposite indicates estimates of some of the current characteristics of the Soviet strategic capability. Delivery vehicles are ballistic missiles and aircraft. The number of missiles, both land-based intercontinental ballistic missiles (ICBM) and submarine-launched ballistic missiles (SLBM) are limited at the numbers shown by mutual agreement. The number of aircraft is not limited. In the past decade, the Soviet Union has replaced its older missiles with new models carrying multiple "reentry vehicles" or warheads. Thus, the number of warheads has increased dramatically. The average ICBM now carries over four nuclear warheads; the SLBM nearly three. The trend toward multiple, independently targetable, reentry vehicles (MIRV's) is increasing. At the same time, the total explosive yield of the Soviet strategic arsenal is decreasing as several small warheads replace a single much larger weapon. The average warhead yield, expressed in megatons, is now approaching one-half megaton or 500 kilotons (KT) of TNT equivalent.

SOVIET STRATEGIC FORCES

1985

| | Delivery Vehicles | Warheads | Total Yield (MT) |
|---|---|---|---|
| Land-based Missiles (ICBM) | 1,396 | 7,300 | 8,000 |
| Sea-based Missiles (SLBM) | 944 | 2,700 | 1,000 |
| Aircraft | 722 | 1,400 | ? |
| TOTAL | 3,062 | 11,400 | 9,000+ |




SOVIET INTERCONTINENTAL ATTACK FORCES WARHEAD MIX

*Estimates based on current trends

# THE MIRV STORY

The Soviets have relied heavily on their land-based missiles in building up on their strategic nuclear strike forces. As a result, ICBM's account for over half their delivery vehicle total and about three-quarters of the Soviet warhead and yield totals. Modifications of each of the newest Soviet ICBM's--the SS-17, SS-18, and SS-19--carry 4, 10, and 6 warheads (MIRV's) respectively. The newest Soviet missile submarine carries missiles with 9 MIRV's, each with an estimated yield of 200 kilotons. Furthermore, it is expected that the next generation of ICBM's and SLBM's deployed by the Soviets also will be MIRV'ed.

The total yield of the warheads in a MIRV'ed ICBM is considerably less than would be the yield of that weapon if its throw weight had been committed to a single warhead. The geometry of the situation suggests that a 3-warhead missile will have only 60 percent of the single warhead yield and this divided equally among the three warheads. The total yield of a 10-warhead missile would be only one-third that of a single-warhead version. However, the damaging effects of explosions scale only as the cube root of the explosive yield (see chapter 2 for more details). As a result, the total area of physical damage caused by a MIRV'ed missile is much the same as that caused by the single-warhead version. What is gained is a greater flexibility in attacking specific targets.

Planners should be aware that the trend toward larger numbers of smaller-yield weapons has the following implications.

(1) More than one weapon may be launched to ensure that a target is destroyed if the destruction of that target is vitally essential to the strategic objective of the attack.

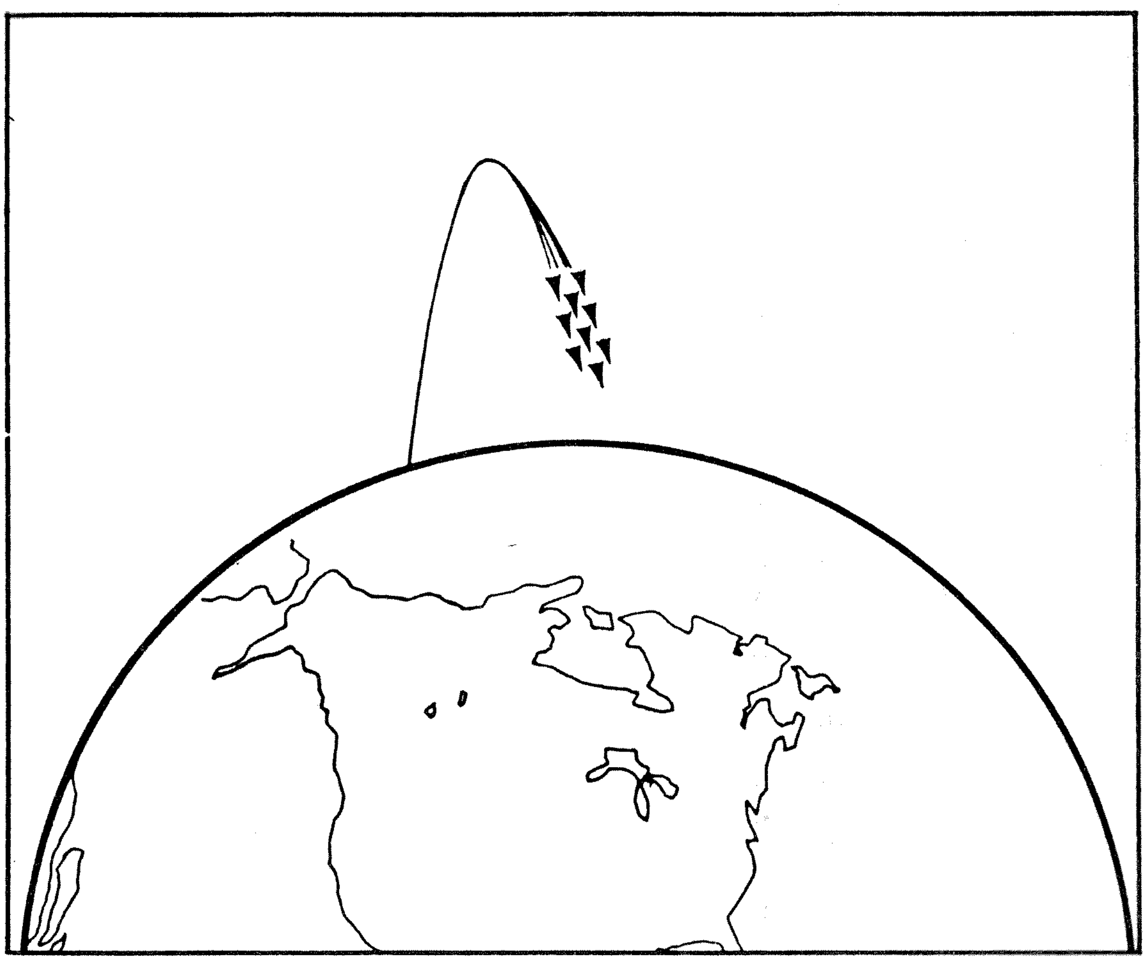
(2) The larger number of warheads suggests that more localities may experience the direct effects of nuclear weapons (blast, fire, and initial nuclear radiation) than if fewer large weapons existed.

(3) The smaller weapon yield suggests that less of the surrounding population will suffer injury and death when specific military or industrial facilities are attacked.

(4) Some attack effects, such as initial nuclear radiation, become more important to nuclear defense planning when small-yield weapons are used (see chapter 5 for more details).

The overall fallout threat decreases when multiple warheads are used on missiles. Also, as weapon size is reduced, the distance to which fallout is carried by the winds is reduced (see chapter 6 for more details).

PANEL 4



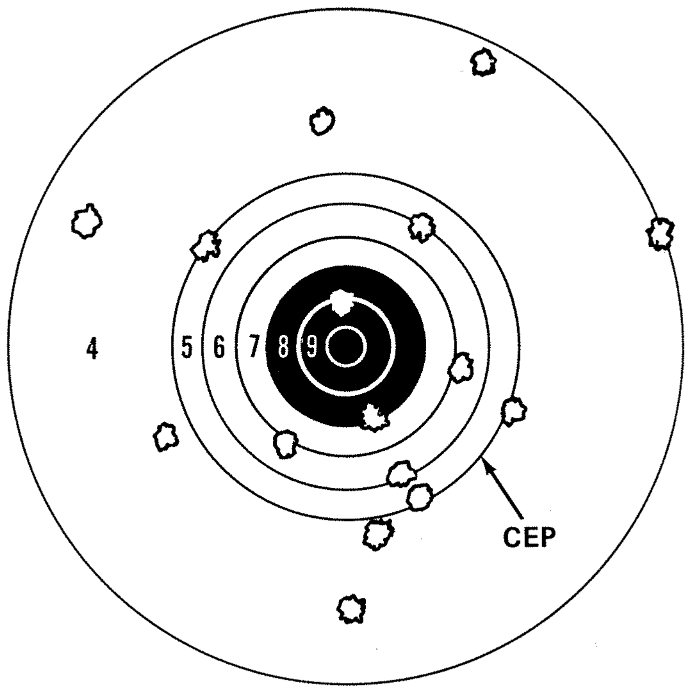
PANEL 4

# ACCURACY OF WEAPONS

How closely a missile or bomb can be delivered to an aiming point is measured by the CEP (circular error probable) of the weapon system. If a large number of weapons were to be aimed at a single aiming point, the CEP is the radius of the circle within which half of the resulting actual "ground zeros" or hit points would be expected to occur. In other words, half of the ground zeros would be closer than the CEP and half would be further away, as shown in the illustration. A single weapon, then, has a 50-50 chance of hitting within the CEP.

Modern strategic weapon systems have a reasonably high degree of accuracy. A CEP of one-quarter mile is a common assumption in unclassified discussions of this subject. Early Soviet missiles carried very large warheads because they were relatively inaccurate. Improved accuracy and MIRV's have greatly increased the Soviet capability to threaten military, industrial, and leadership (government centers) facilities instead of population centers.

TARGET AREA
Distribution of impact points around a target point




In this target, the ring between 4 and 5 turns out to be the CEP circle because half the shots are inside the circle and half are outside.

PANEL 5

# RELIABILITY OF WEAPONS

Most of the nuclear weapons that might be used to attack this country would be delivered by ballistic missiles, either land-based (ICBM) or sea-based (SLBM). These missiles have never been used in war. Since no mechanical contrivance works perfectly every time, reliability is an important factor both in planning an attack and in carrying it out. Estimates of reliability are developed in test firings and other operational checks. What the U.S. and U.S.S.R. believe to be the reliability of their own and the other's missiles is a closely-kept secret, but the general range has been described in congressional testimony.

There are various ways that a missile may fail to achieve its programmed objective. It may not be "ready" to be launched because of some malfunction that prevents a complete countdown. It may malfunction in the launch process. Finally, it may malfunction in flight. These various problems are multiplicative so that, even when great efforts are made to reduce the probability of failure at each stage, the combination of probabilities may result in limited overall system reliability. The table shows an example calculation, assuming that the probability of failure is only one in ten at each stage. The actual reliability of the missile force of the Soviet Union will never be known unless they are used in an attack.

The implication for nuclear defense planning is not limited to the recognition that only part of the Soviet capability described previously can be expected to be delivered on U.S. targets. It also implies that no one can be certain that destruction of a particular target will actually take place. No part of a city can be "written off." Emergency planning should consider all reasonable contingencies, including the possible use of multiple weapons used against a vital target to increase the probability of destruction.

MISSILE RELIABILITY

| DEGRADATION FACTOR | ASSUMED RELIABILITY |
| --- | --- |
| Missile Availability | 0.9 |
| Missile Readiness | x 0.9 |
| Launch Reliability | x 0.9 |
| In-flight Reliability | x 0.9 |
| Overall Reliability | 0.6 |

Under these assumptions, a missile would have only a 2/3 chance of arriving on target.

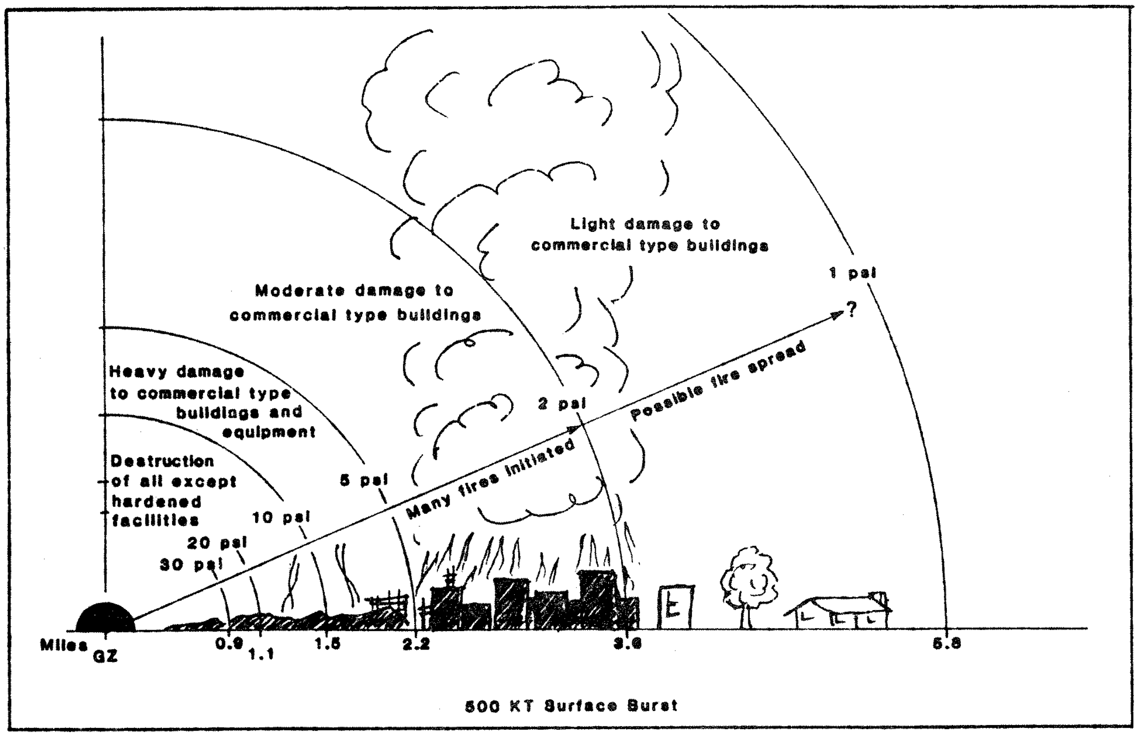
# DIRECT EFFECTS OF A 500-KT WEAPON

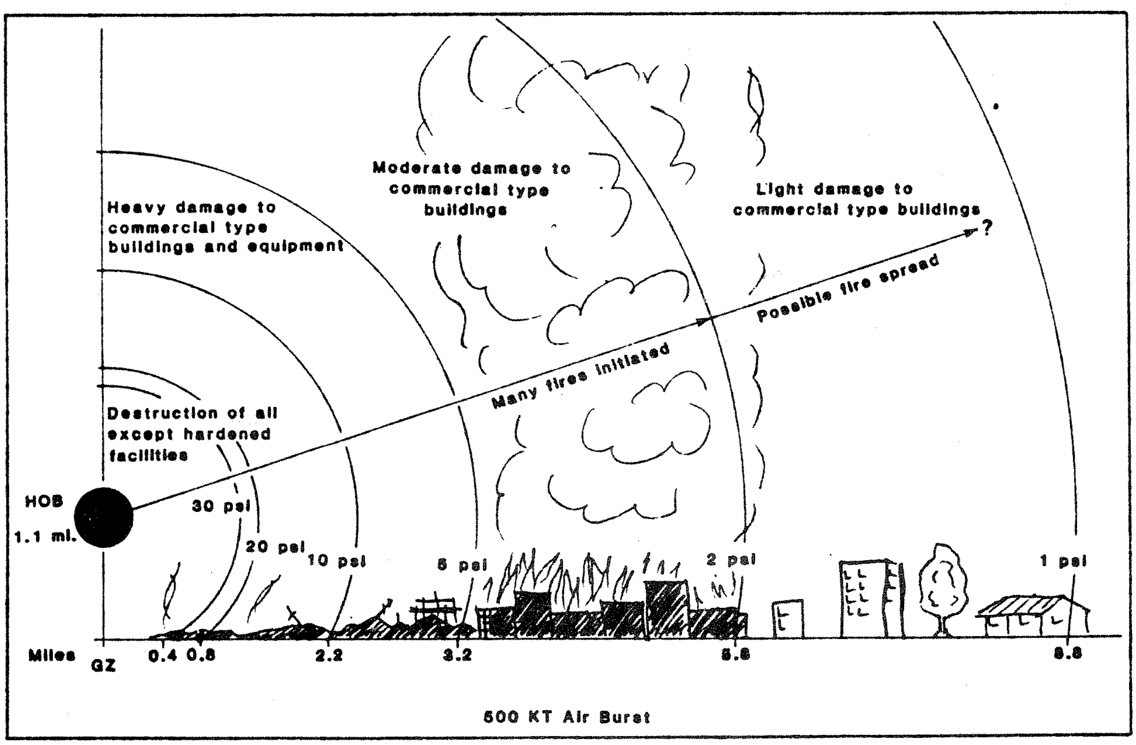
The energy released by a nuclear detonation alters the environment in a variety of ways. In the immediate region of the detonation, the main effects are due to the blast wave and the thermal pulse or heat flash. The blast wave can destroy or damage buildings, spread debris, and overturn trees. The thermal pulse can ignite exposed combustible materials, causing many sustained fires. These are the main direct effects of the detonation. The general reach of these effects for a 500-kiloton weapon detonated on the ground is shown in the upper illustration. The direct effects of a weapon of the same size detonated 1.1 miles above ground is shown in the lower illustration.

The strength of the blast wave is measured in pounds per square inch (psi) overpressure (see chapter 2 for details). Initially extremely strong, the blast overpressure weakens rapidly as it progresses outward at about the speed of sound. (A "sonic boom" is a low-pressure blast wave.) Note that damage of some significance extends to the region of 1 psi. The region where fires would be ignited by the thermal pulse is mainly within the region covered by 2 psi. Although people in the open can be burned by the thermal pulse and crushed by the pressure in the blast wave if it is quite strong, most immediate deaths and injuries will result from people being thrown about or struck by missiles formed by the destruction of buildings, trees, and other objects.

Surface bursts maximize the reach of high overpressures (and result later in radioactive fallout). It can be seen in the upper illustration that 30 psi extends nearly a mile from the detonation point. In an air burst, high overpressures are sacrificed to extend the range of lower overpressures. The lower illustration shows a detonation at a height that maximizes the extent of 10 psi overpressure. Note also that the extent of 2 psi and fires is nearly 6 miles as compared with less than 4 miles for the surface burst condition. Air bursts were used at Hiroshima and Nagasaki to end World War II. Of course, air bursts cause little radioactive fallout.

Additional direct effects not shown are initial nuclear radiation (INR) and the electromagnetic pulse (EMP). INR may be hazardous to unprotected people within about 1.5 miles of a detonation (see chapter 4 for more details). EMP is not hazardous to people but can damage electrical and electronic gear under many burst conditions (see chapter 5 for more details).


Light damage to
commercial type buildings
1 psi
Moderate damage to
commercial type buildings
Heavy damage
to commercial type
buildings and
equipment
2 psi
Possible fire spread
Destruction
of all except
hardened
facilities
5 psi
Many fires initiated
10 psi
20 psi
30 psi
Miles
GZ
0.9
1.1
1.5
2.2
3.6
5.8
500 KT Surface Burst


Moderate damage to
commercial type
buildings
Heavy damage to
commercial type
buildings and equipment
Light damage to
commercial type buildings
Possible fire spread
Many fires initiated
Destruction of all
except hardened
facilities
HOB
1.1 mi.
30 psi
20 psi
10 psi
5 psi
2 psi
1 psi
Miles
GZ
0.4
0.8
2.2
3.2
5.8
8.8
500 KT Air Burst

PANEL 7

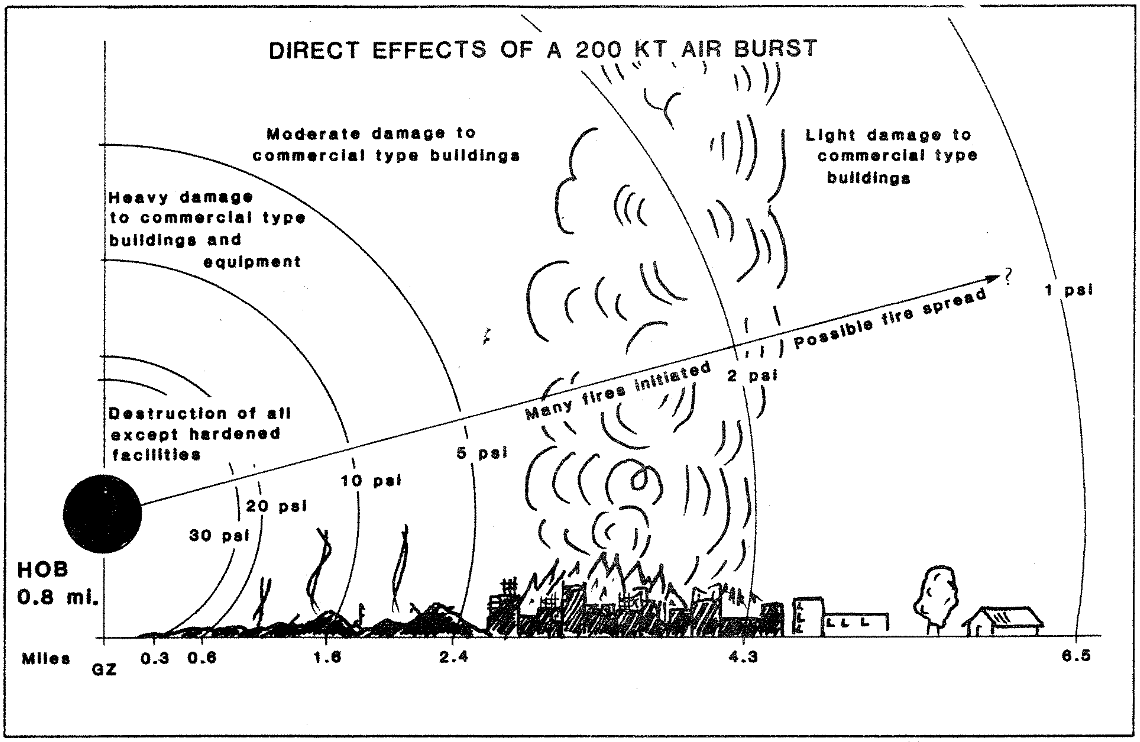
# DIRECT EFFECTS OF OTHER YIELDS

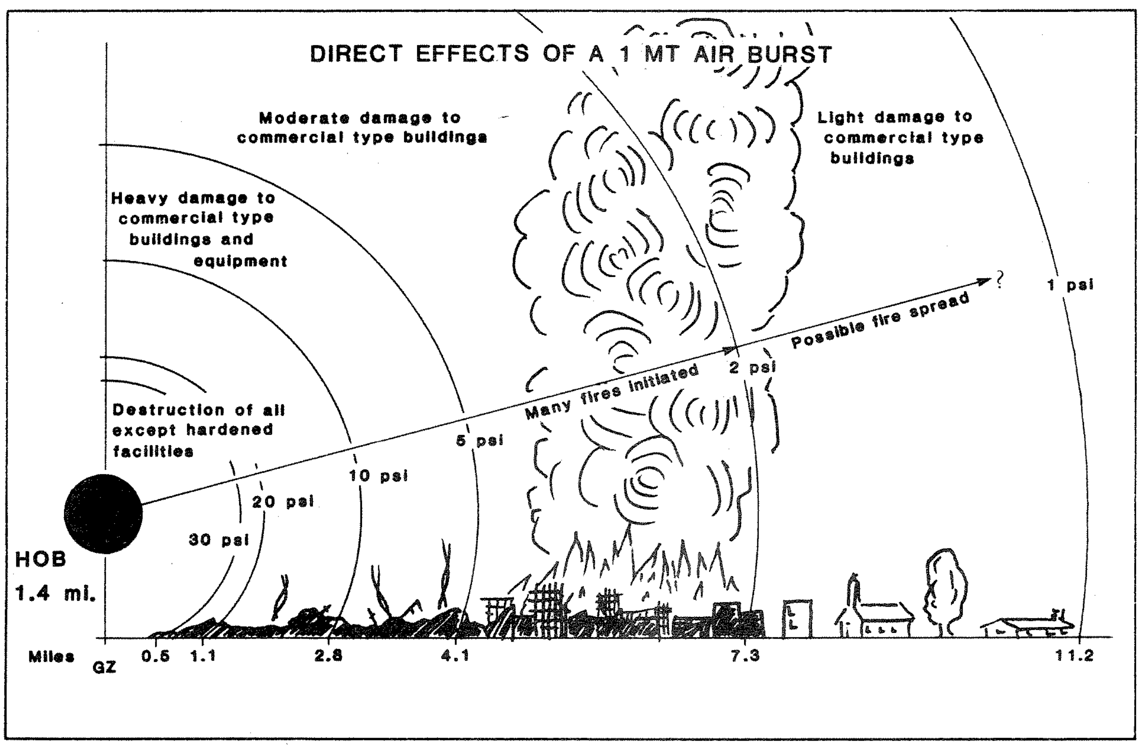
Shown here are the blast and fire consequences of 1-megaton and 200-kiloton weapons detonated at an altitude to maximize the range of 10 psi. This covers the yield range of most current Soviet missile warheads. Less than 100 of the nearly 8,000 warheads in the Soviet strategic forces have yields greater than 1 megaton and these may be phased out in the future. Additionally, there are about 140 older Soviet bombers capable of carrying a 5-megaton bomb or smaller yield air-to-ground missiles.

Note that the range of moderate damage and initial fires changes from 4.3 miles to 7.3 miles, an increase of about 70 percent for a yield increase by a factor of 5 (200 KT to 1,000 KT). This reflects the fact that, for practical purposes, the reach of blast and fire effects vary as the cube root of the weapon yield ratio. (The cube root of 5 is 1.71.) In other words, for the range of direct effects to double, the yield must be increased eightfold.

The air bursts shown here expand the diameter of the damaged area by about 50 percent over that of the surface burst. These increased effects are equivalent to increasing the weapon yield several-fold and are purchased at the price of elimination of the fallout hazard and the reduction of danger from high overpressures. Shelters designed for 30 psi blast overpressure would survive these air bursts at ground zero. Indeed, a detonation high enough in the air to maximize the reach of moderate damage (2 psi) would produce less than 15 psi at ground zero, leaving many survivors in ordinary buildings, just as there were in the attacks on Hiroshima and Nagasaki.

The areas of moderate damage and fire ignitions are large in this yield range; from nearly 60 square miles for a 200-KT air burst to nearly 170 square miles for a 1-MT air burst. The average U.S. city of 100,000 has an area of about 25 square miles. Thus, a community should be regarded as being involved in a situation of large extent if direct effects are experienced. Only the very large cities would be of such size as to contain the area of damage within its boundaries. In most cases, neighboring communities will experience similar damage and a concerted effort to reduce the resulting threat to life and property will be needed.


DIRECT EFFECTS OF A 200 KT AIR BURST
Moderate damage to commercial type buildings
Light damage to commercial type buildings
Heavy damage to commercial type buildings and equipment
Destruction of all except hardened facilities
Possible fire spread
Many fires initiated
1 psi
2 psi
5 psi
10 psi
20 psi
30 psi
HOB 0.8 mi.
Miles
GZ
0.3
0.6
1.6
2.4
4.3
6.5


DIRECT EFFECTS OF A 1 MT AIR BURST
Moderate damage to commercial type buildings
Light damage to commercial type buildings
Heavy damage to commercial type buildings and equipment
Destruction of all except hardened facilities
Possible fire spread
Many fires initiated
1 psi
2 psi
5 psi
10 psi
20 psi
30 psi
HOB 1.4 mi.
Miles
GZ
0.5
1.1
2.8
4.1
7.3
11.2

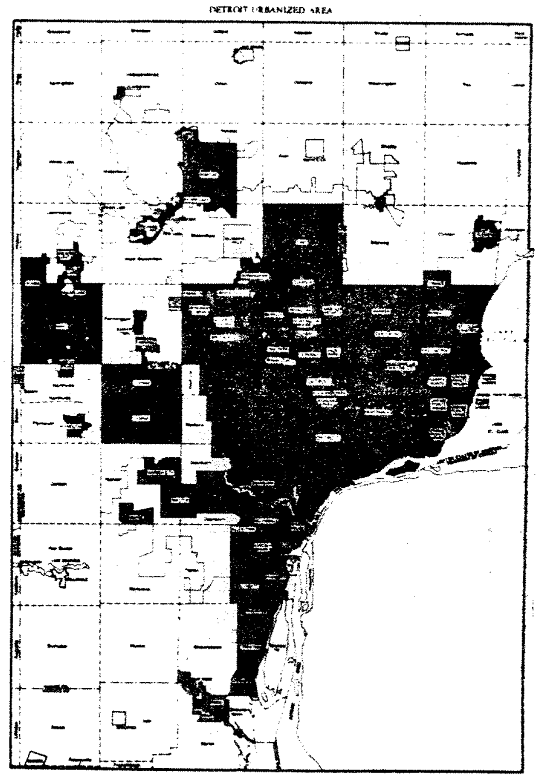
## AN EXAMPLE TARGET COMPLEX ATTACK

In the next few pages, we will present a picture of what might happen to the population of a city attacked by nuclear weapons because it represented a conglomerate of a vital militarily important industrial complex and port and transportation routes. The city is the Detroit metropolitan area. A census map of the Detroit area is shown in the upper figure. Below is a computer map of the same area, showing the night-time population distribution in 1975. (Detroit has lost some population since this map was made.)

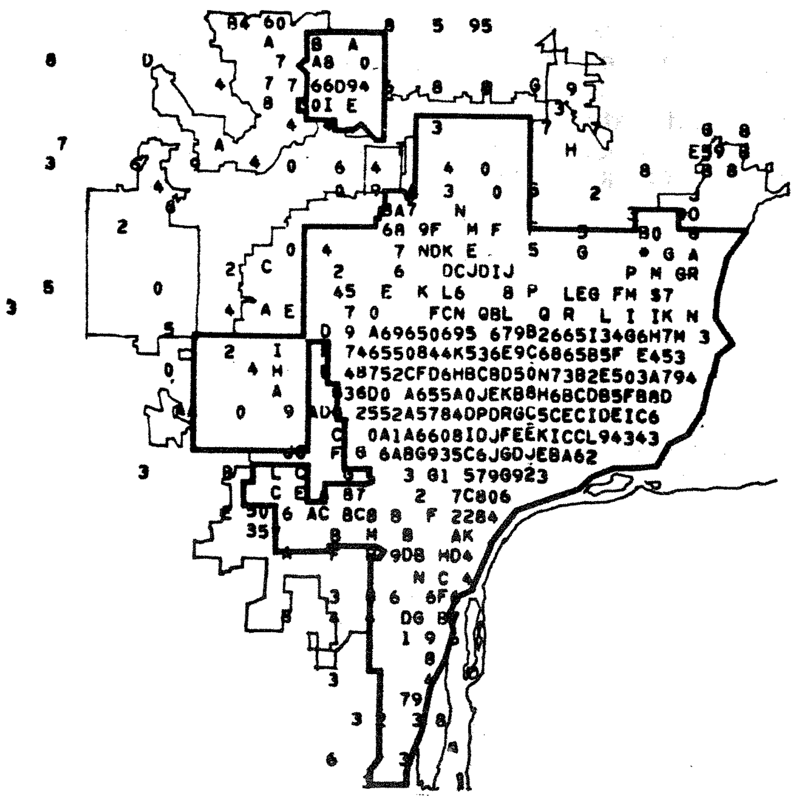
Each number (and letter) in the computer map represents the number of people in "squares" that are 1 mile in the north-south direction and six-tenths of a mile in the east-west direction. The number 1 represents 1,000 people or, more specifically, a population count between 500 and 1,499 persons. The numbers 2, 3, etc., represent populations of 2,000, 3,000, etc., within six-tenths of a square mile occupied by the number. The number 0 represents 10,000 people; the letter A represents 11,000; the letter B, 12,000, etc. Where a blank occurs, there are less than 500 people resident in the location. The most populous location on this map is represented by an "R".

This computer simulation was run in the early 1970's before the Soviet Union began to MIRV its missiles. A representative yield then was 5 megatons, which was used in the simulation. Today's representative yield is 500 KT, a factor of 10 less. Since the range of direct effects varies as the cube root of the yield ratio and the area of destruction varies as the square range of effects, it can be said that it would take nearly five 500-KT surface bursts (4.46, to be more exact) to cause the casualties of a single 5-MT burst.

CENSUS BUREAU MAP OF DETROIT URBANIZED AREA




MAP OF DETROIT 1975 NIGHTTIME POPULATION



PANEL 9

## SURVIVORS FROM TWO 5-MT WEAPONS

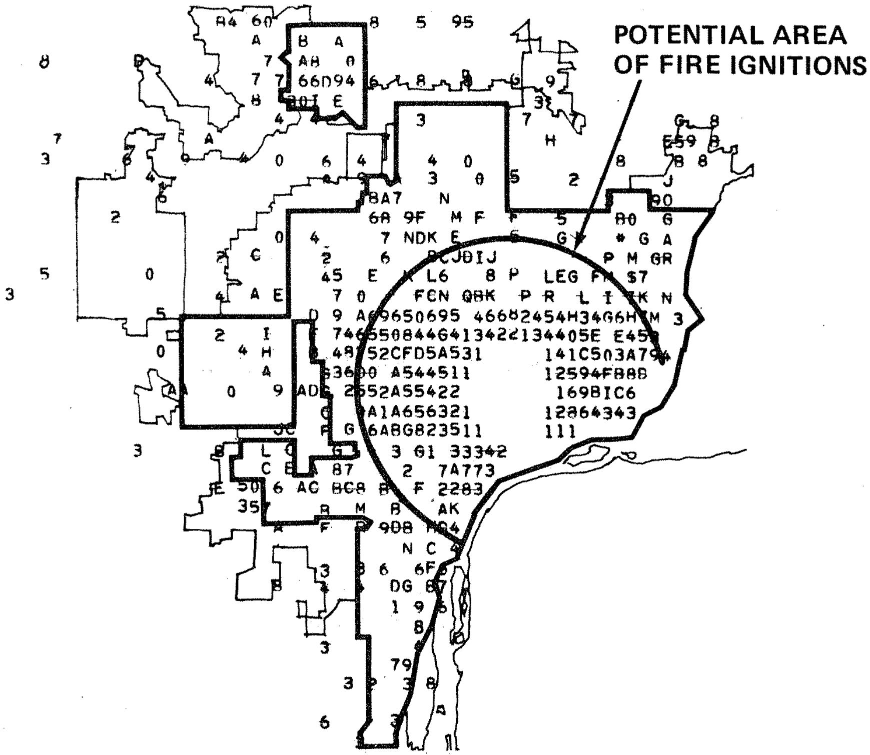
Suppose 5-MT surface-burst weapons were aimed to detonate where population densities were greatest. The weapon accuracy (CEP) is assumed to be one-half mile, and the missile reliability is assumed to be 0.75. The population is assumed to be at home in single-family residences, townhouses, apartment houses, and the like.

The upper map shows the survivors from a weapon aimed at the most densely populated area. A "hole" of about 3 miles radius has been created in the population map and the neighboring numbers of survivors are quite small. But overall, nearly 82 percent of the population of the Detroit metropolitan area survive the blast effects of this detonation.

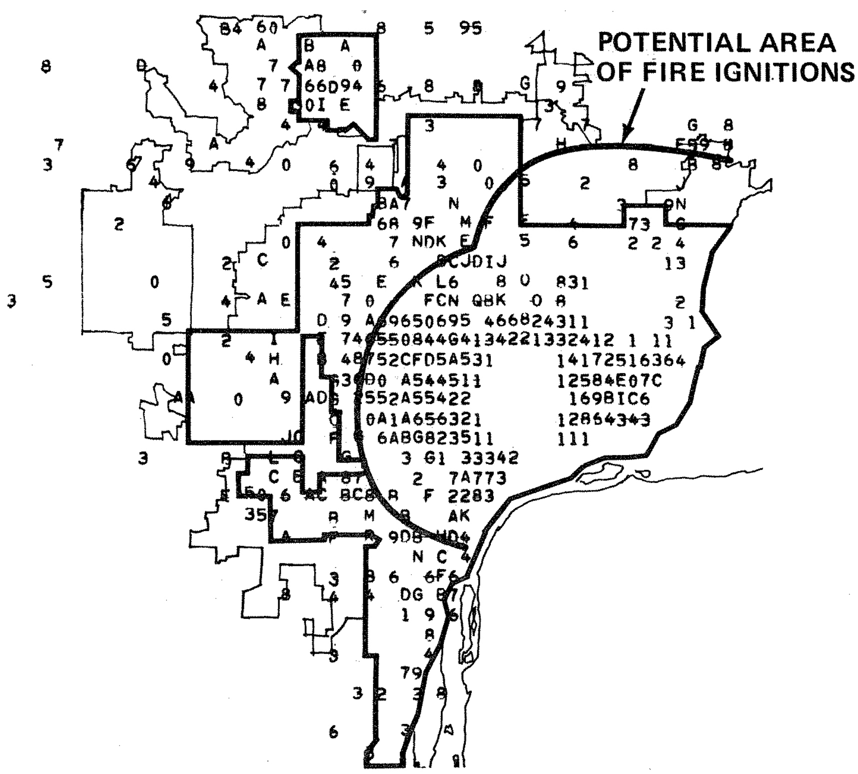
In either case, there are great numbers of survivors in the Detroit area. Nuclear emergency operations would be of great importance. Large numbers of these survivors would be injured and many trapped in wreckage. Although most of the dead are within a few miles of the detonations, fires ignited by the heat flash could be expected out to 8 miles. There would be much debris in this same area and then there would also be fallout. Fire suppression and rescue operations would be important--and difficult.

Regardless, what these charts show is that, despite the destructiveness of weapons of this size, the city and its people are not obliterated. It is not a case of "one bomb, one city" (unless the city is quite small). Emergency operations readiness can pay off, even in target areas. Note that the population was assumed to be at home in ordinary buildings and that no steps were taken to improve their protection.

SURVIVORS FROM SAMPLE MONTE CARLO RUN FOR A SINGLE 5 MT WEAPON ON DETROIT--81.5% SURVIVORS




SURVIVORS FROM SAMPLE MONTE CARLO RUN FOR TWO 5 MT WEAPONS ON DETROIT--68.3% SURVIVORS



# SURVIVORS FROM LARGER ATTACKS

Suppose a larger attack were made on the Detroit area. The upper figure shows the result of five 5-MT weapons aimed at Detroit. That is equivalent to about 23 500-KT surface bursts. Almost half of the population of the metropolitan area survive the blast effects of these weapons.

A comparison of this map with the earlier map of the night-time population will disclose only four holes in the population map. One of the weapons failed to arrive because the missiles are assumed only 75 percent reliable. In effect, the computer draws a number at random from 1 to 100. If the number drawn is 75 or less, the weapon is delivered. If greater than 75, it "malfunctions." In this particular case, weapon number four failed to arrive.

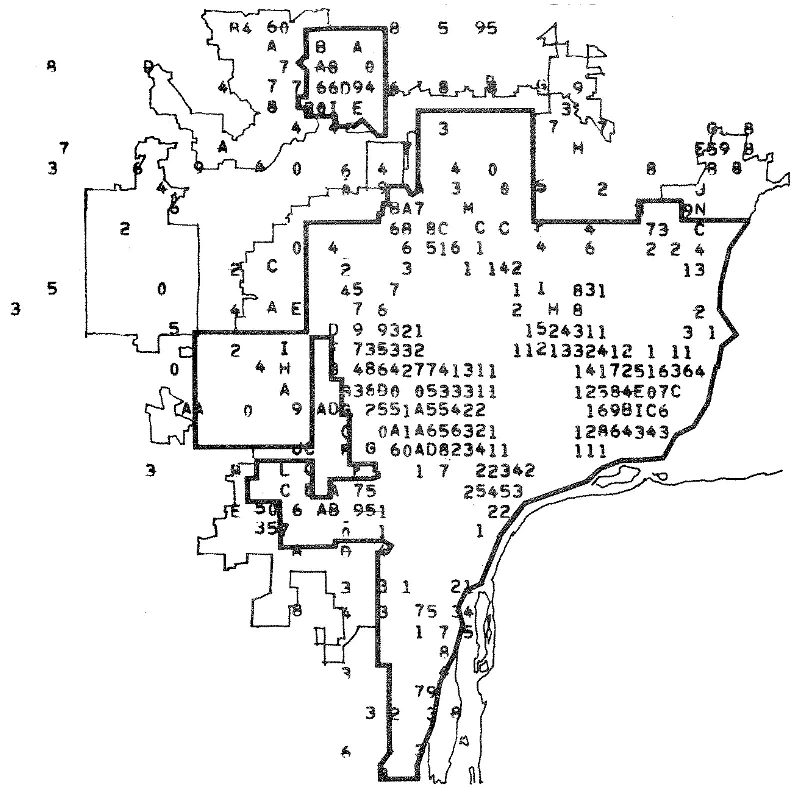
The lower figure shows the result for nine aimed weapons. About one-third of the population survive, partly because two weapons fail to arrive. Note the major "island" of survivors in a portion of downtown Detroit.

Fire suppression and rescue operations would remain crucial activities. As will be seen in chapter 3, as many as 15 to 20 percent of the survivors might be lost if the fire conditions became severe.

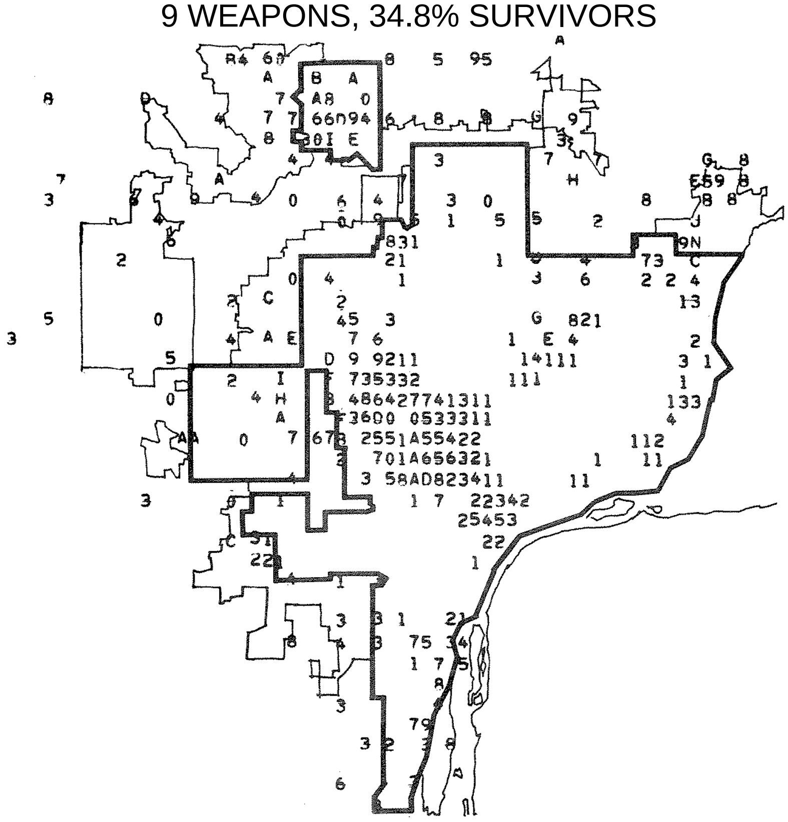
The important points for the planner are: (1) many targeted weapons will not arrive; (2) even fallout shelter will be useful in cities; and (3) very large attacks leave survivors in need of emergency aid. As was noted in panel 10, many of these survivors are injured and at risk from fire and fall out.

One final point. There is no reason to believe that an attack such as the one shown in this panel would ever occur. The vulnerability of the population, for example, was assessed as if they were in the aboveground parts of buildings. The number of survivors would increase substantially if people were sheltered in the basements of large buildings. If other more realistic attack assumptions are adopted and especially if it is assumed that rudimentary nuclear defense measures are taken, a significant percentage of the population could survive the initial direct attack effects. The chances for continuing survival and the possibility of reconstituting society would be dependent on many factors, some of them unknown at the present time; but the essential prerequisite for accomplishing any positive results in what would be a disaster situation would be prompt implementation of carefully and thoroughly planned response and recovery operations by the nearest surviving emergency management organizations.

SURVIVORS FROM SAMPLE MONTE CARLO RUN FOR FIVE 5 MT WEAPONS ON DETROIT--48.8 SURVIVORS



9 WEAPONS, 34.8% SURVIVORS



PANEL 11

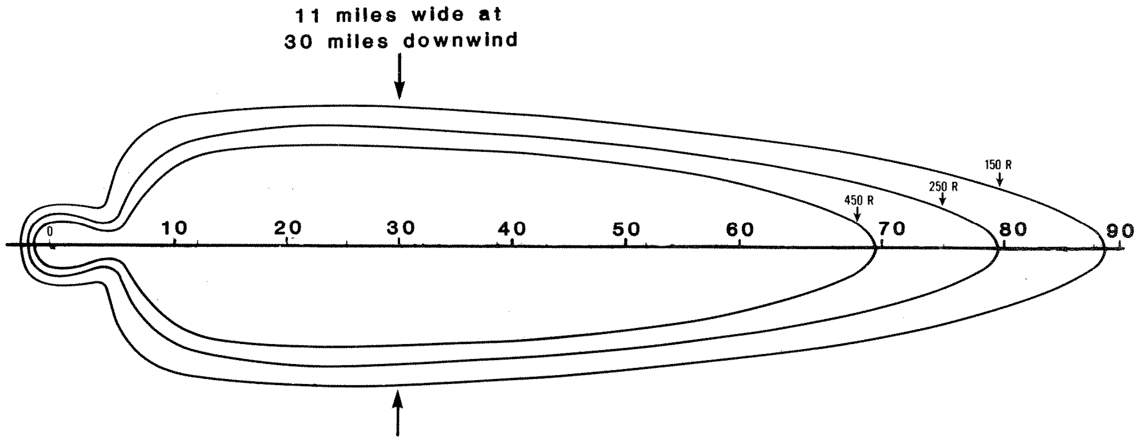
FALLOUT FROM A 500-KT SURFACE BURST

The upper figure shows the general extent of the fallout hazard generated by a single 500-KT surface burst (assuming a wind speed of 15 miles per hour blowing toward the right). The contours shown represents the 1-week dose to unprotected persons. See chapter 6 for information on the effects of wind on fallout distribution.

The table at the bottom provides information of the consequences of radiation exposure. To illustrate the meaning of the table, people receiving no more than a total of 150 Roentgens, as measured by a dosimeter, during a period of 1 week or less (1 hour, 1 day, 3 days, for instance) are not expected to need medical care or to become ineffective in work performance. Accrual of 250 Roentgens would cause some radiation sickness and reduction in work performance. A dose of 350 Roentgens over a period of 1 month would have a similar outcome.

Note that 1-week doses in the open above 150 R may extend nearly 90 miles downwind from ground zero. Overlapping fallout from many weapons would extend the hazard area much farther.

## UNSHIELDED ONE WEEK RADIATION DOSE CONTOURS (SCHEMATIC)




## RADIATION PENALTY TABLE

- The expected results of various radiation exposure doses, if received over various periods of time, are shown in the following table.

| Acute Effects \ Accumulated Exposure (R) in any | 1 Week | 1 Month | 4 Months |
|---|---|---|---|
| Medical Care Not Needed | 150 | 200 | 300 |
| Some Need Medical Care<br>Few if Any Deaths | 250 | 350 | 500 |
| Most Need Medical Care<br>50% + Deaths | 450 | 600 | * |

* Little or no practical consideration

Source: Adapted from NCRP Report No. 42

## TARGETING CONSIDERATIONS

Among the many uncertainties inherent in planning nuclear defense operations are those concerned with how the Soviet Union might use its present strategic forces to mount an attack on the United States. Most studies on the subject tend to dismiss the "bolt from the blue" attack as a lesser possibility than attack following a prolonged international crisis. Yet, Soviet writers usually emphasize the need to achieve strategic surprise. Regardless of the attack scenario, many observers have concluded that Soviet strategic policy is to target military, and war-supporting industrial facilities rather than population and may even plan strikes that try to avoid unnecessary loss of life. The Soviet objective would be to destroy the enemy government and to disarm and neutralize enemy military forces but would limit unnecessary damage to the general population, industry, and urban infrastructure.

There is, of course, some measure of congruence among the various approaches to targeting assumptions. Significant military and key industrial facilities often are located in large urban areas. Some important military targets also may be located in sparsely settled areas. From time to time, the Federal Government identifies areas deemed to be at higher hazard from direct weapon effects than other areas but these are <u>not</u> predictions of where warheads would land. Rather, they indicate locations where a policy of planning in anticipation of direct effects would appear prudent. A potential attack could be limited in various ways and, if an "all-out" attack, could vary considerably in its outcome.

The significance for emergency operation planning is:

(1) The potential threat area from radioactive fallout would include the entire land area of the United States. All localities need plans to deal with this possible contingency.

(2) About one-third of the population would be involved in direct weapons effects. Localities near important military and key industrial facilities need plans for this contingency as well.

PRINCIPLES OF SOVIET TARGETING STRATEGY

- Destroy "most threatening" enemy forces.
- Select main links and nodes in target sets (such as the National Command Authority).
- Use minimum weapon yields necessary.
- Prepare to strike most important targets twice.
- It is not possible nor desirable, nor necessary to attack and destroy all targets (In the operational zone).
- Do not destroy large areas or create radioactive deserts.

Targeting considerations according to the above doctrine would include ICBM silos and launch control centers, other military facilities and complexes, key military support industries, political infrastructure, ports and port facilities, petroleum refineries, electric power generating facilities, and chemical industry facilities.

# WHAT IS A CONTINGENCY?

It is not possible to be sure in advance that any hazardous conditions will or will not occur at any given place. It is necessary to develop nuclear defense readiness for the major contingencies or attack environments that could reasonably occur.

As a result of nuclear detonations, a community could find itself in any of the four conditions shown in the figure.

- Radiation free or undamaged areas would be those not affected at all or affected only by fallout radiation of limited intensity. Movement in free areas would not be restricted nor would protective measures be required. But, as we have seen, communities in free areas would generally be within a hundred miles of damaged areas and generally much closer. The effectiveness of emergency operations in saving lives and property could well depend on the carrying out of plans for aid to stricken areas, as is the case in response and recovery from natural disasters. (See the "free" box in the panel opposite.)

- Other areas would be affected by fallout only. Depending on the peak level of fallout radiation that occurs, the fallout radiation hazard could represent a minor impediment to emergency operations or could make any outside operations very hazardous. (See the "Radioactive" box in the panel opposite.)

- Some areas may be affected by blast damage caused by overpressures in excess of 1 psi or both by damage and ignited fires, but not affected by fallout radiation. This could occur as a result of air burst weapons or in some crosswind and upwind parts of the area of damage from a surface burst. (See the "impact" box in the panel opposite.)

- Some areas would be affected by both damage from blast and fire and fallout radiation. Emergency operations in such areas would be the most complex and difficult. (See the "radioactive-impact" box in the panel opposite.)

These conditions, which are combinations of the presence or absence of direct weapons effects (blast, fire, and initial radiation) and fallout, are the main attack environments for which contingency plans are needed. These plans are "contingency plans" because it will not be known until an attack occurs which of the plans will be needed.

| | NEGLIGIBLE FALLOUT | 0.5R/hr | FALLOUT |
|---|---|---|---|
| NEGLIGIBLE DAMAGE OR FIRE | FREE | | RADIOACTIVE |
| 1 psi | | | |
| DAMAGE OR FIRE | IMPACT | | RADIOACTIVE IMPACT |

EMERGENCY OPERATIONS

A useful definition of an "emergency" is a situation in which the routine ways of coping with problems no longer work. If this were not true, a good deal of the need for "emergency readiness" would vanish. Most people have a general idea of the kinds of actions likely to be needed in an emergency. A list of emergency functions is shown, together with an explanatory statement of the purpose of each. You will note these statements are phrased to apply to all kinds of emergencies.

Many of these emergency functions are needed in peacetime and most have been required in various natural disasters. This peacetime familiarity and experience can be a trap for the unwary planner who is unfamiliar with the nuclear attack environment described in this handbook. The common practice of assigning responsibility for emergency functions to local departments and agencies whose peacetime functions are similar, although entirely reasonable, often compounds the operational readiness problem because operating officials tend to assume that their usual methods and procedures will be effective.

As an example, consider the function of firefighting. Accidental fires and arson are everyday threats in peacetime. Professional fire departments, both aid and volunteer, are organized, trained and equipped to deal with peacetime fire threat. But, as we have already seen, the wartime fire threat will exist almost entirely in areas of damage where debris may litter the streets, water pressure may be lost, and fire trucks may be trapped in the station house. Even if this were not so, the number of simultaneous building fires in an area serviced by a single fire company could number in the hundreds--far beyond the capability of the professional forces. Just a World War II firefighters had to rely on stirrup pump and sand bucket, every able-bodied person must be a firefighter in nuclear attack. More important, the real payoff in fire defense lies in preventing as many ignitions as possible before the attack occurs. That is why the firefighting mission is stated as it is. The professionals of the fire department must rise to be builders, leaders, and controllers of this "emergency firefighting" capability.

The information needed to develop a real operational readiness to combat fire is contained in chapter 3. But almost none of the other functions can be carried out effectively without use of the information in some part of this handbook.

# RESPONSE AND RECOVERY FUNCTIONS

| | FUNCTION | MISSION |
|---|---|---|
| 1. | Direction and Control (D&C) | To coordinated and control emergency operations on the basis of environmental and readiness information. |
| 2. | Communications | To maintain and augment the capability to exchange information between operating forces and D & C. |
| 3. | Warning | To alert operating forces and the general public and to inform them of imminent hazards |
| 4. | Emergency Public Information | To increase public awareness of hazards and to inform and advise them on appropriate actions before, during, and after emergencies. |
| 5. | Evacuation | To move people to where they would be safer or better protected than where they are. |
| 6. | Reception and Care | To provide housing, food, clothing, and other essentials to people displaced by hazards or hazard threats. |
| 7. | In-place Protective Shelter | To shield against hazards and to provide a viable environment for shelter occupants. |
| 8. | Health and Medical | To minimize death and disability from illness or injury and to minimize the spread of disease. |
| 9. | Law Enforcement | To maintain civil order under emergency conditions and to suppress illegal acts. |
| 10. | Public Works | To repair or replace utilities and facilities vital to the survival of people, to clear debris, and to decontaminate facilities and areas. |
| 11. | Firefighting | To prevent fires from occurring insofar as possible and to suppress or control those that occur. |
| 12. | Rescuing | To locate people trapped or in hazard and move them to a place of lesser hazard. |
| 13. | Radiological | To control population exposures from environmental and other sources of radioactivity. |
| 14. | Human Services | To provide material aid and counsel to survivors and those displaced by hazard threats. |
| 15. | Resources Management | To coordinate the use of personnel, equipment, supplies, facilities, and services during emergencies. |

PANEL 15

## THE NEED FOR DIRECTION AND CONTROL

The general nature of nuclear defense operations that has been presented in this chapter should indicate the need for effective direction and control of emergency operations. Time is of the essence in emergency operations. Measures tardily taken will probably be ineffective. The operating situation must be assessed quickly so that coordinated actions can be carried out expeditiously. Local organization and training must reflect the reality of the probable contingencies.

Direction and control functions, which span those shown here, are best centered in an Emergency Operating Center (EOC) where the decisionmakers can be provided with all of the relevant information on direct effects and the condition of emergency forces and the population. Operating in radioactive areas, for example, requires information on fallout conditions that can be obtained only by special monitoring equipment, the use of which is discussed in chapter 6. Radiological protection functions provide essential support to direction and control.

Because nuclear weapons effects cover large areas and are no respecter of jurisdictional boundaries, a network of EOC's is needed. No community can afford to plan to "go it alone" as if the war stopped at the city limits. In many instances, mutual aid will make the difference of life or death for large numbers of people.

Similarly, each community will need subordinate direction and control nodes for the operating services and the sheltered population. In subsequent chapters, the planner will be reminded of the usefulness of staging areas and shelter complex headquarters for carrying out emergency operations.

# DIRECTION AND CONTROL

| | CONTROL | MISSION |
|---|---|---|
| 1. | Organizing | To control the employment of available staff, facilities, equipment, and supplies so as to maximize system readiness to use its remaining capability in the real emergency environment. |
| 2. | Planning | To define the problems existing in the situation and to inform the executive as to the courses of action available to him and probable results and risks expected for each. |
| 3. | Informing | To acquire data, process them into the required form, store and retrieve them, and communicate them to the persons who need them when they need them. |
| 4. | Deciding | To judge the relative worth and desirability of alternative courses of action and to select the course of action to be taken. |
| 5. | Commanding | To require that a selected course of action be taken and to review the effects of taking it. |
| 6. | Coordinating | To ensure that the various resources or operating units work together in a complementary, mutually supportive way to accomplish overall objectives and do not inadvertently interfere with one another's operations. |

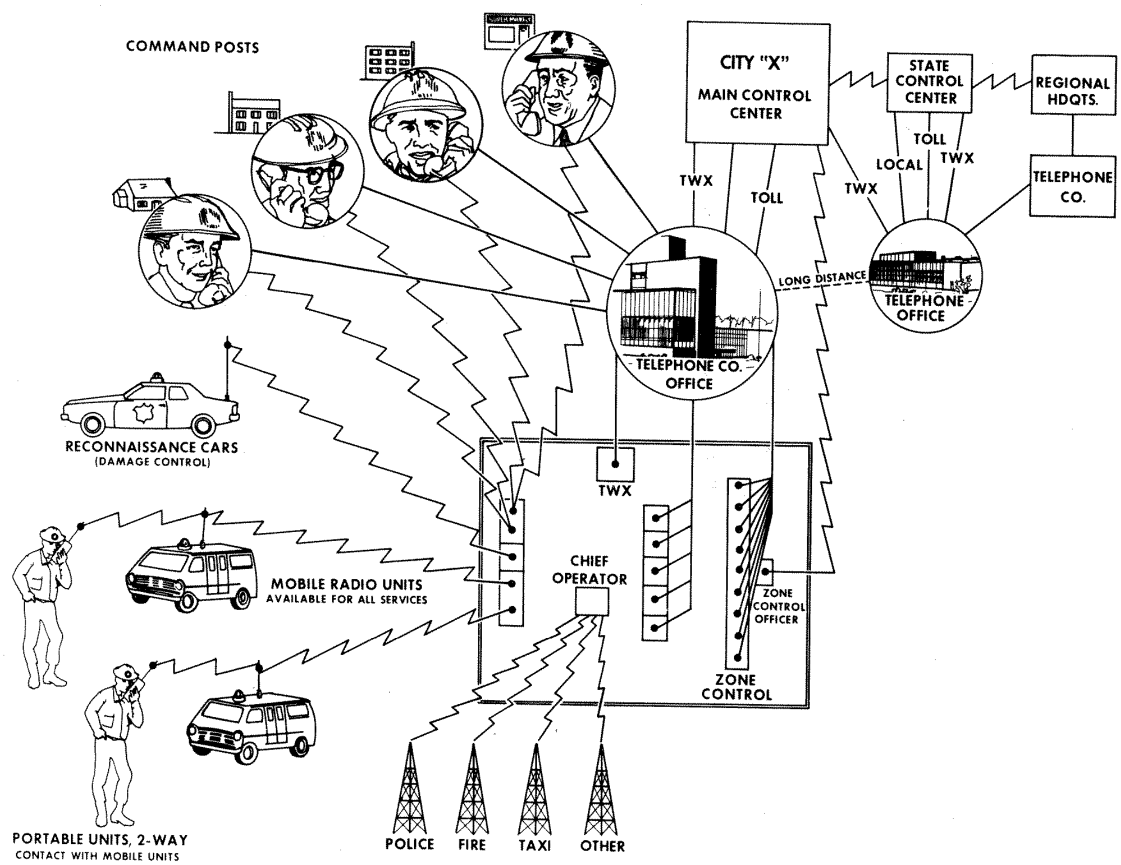
# THE IMPORTANCE OF COMMUNICATIONS

Organized and coordinated emergency actions require communication of essential information throughout the emergency operating system. Public safety in peacetime depends on police, fire, and public works communication nets. The disruptive effects of natural disasters on communications have often been a major impediment to effective emergency operations. The nuclear attack environment will place additional strains on communication capabilities. Some of the threat to continued communication, such as the electromagnetic pulse (EMP), are peculiar to nuclear attack and not well understood by most people. This problem and the practical ways to deal with it will be outlined in chapter 4 of this manual.

Some essential parts of the emergency operating system do not have well-developed emergency communications. Notable examples are the medical services and the shelter system. Planners must pay particular attention to improving operational readiness in these areas.

Despite the best efforts of all concerned, communications outages must be expected under nuclear attack conditions. Plans must be laid to permit operations to "degrade gracefully" in face of communications difficulties. Through training and exercises, the basic concepts of emergency operations must be instilled at all levels of operation so that direction and control can become decentralized as necessary to meet the situation. If this is not done, communications losses can lead to catastrophic failure of organized action.

# COMBINED WIRE AND RADIO COMMUNICATIONS



## OPERATIONS IN VARIOUS CONTINGENCIES

Not all emergency functions will be needed in every contingency. Indeed, one might conclude that no emergency functions would be required at all where the community found itself free of weapon effects following an enemy attack. The table shown here indicates that such is not the case. Widespread loss of electric power because of attack effects elsewhere and the disruption of normal supply channels could precipitate health and feeding problems. The normal livelihood of many individuals would have been jeopardized. Refugees from stricken areas, many injured, may need care. And, in any event, the population must be sheltered until it becomes clear that the local area will remain free of attack effects. Thus, a plan for the free contingency is needed.

Although the table indicates the general applicability of emergency measures in the various contingencies, it leaves important issues unresolved. Sheltering and many other functions are of a different character in radioactive areas than they are in impact areas. The presence of fallout radiation in impact areas presents problems in fighting fires and rescuing people. (Accidental fires can occur outside impact areas, but these can be dealt with more or less routinely, as in peacetime.) And what if fires rage out of control, despite the best efforts of the defenders?

Questions like these suggest that what is needed for emergency operational planning is an indication of the relative priorities among the various emergency functions and the ways they should be grouped into coordinated activities.

ASSESSMENT OF CRITICAL OPERATIONAL NEEDS

| | FUNCTIONAL ACTIVITIES | ATTACK CONSEQUENCES | | | |
|---|---|---|---|---|---|
| | | Impact | Radioactive + Impact | Radioactive | Free |
| 1. | Direction & Control (D & C) | Yes | Yes | Yes | Yes |
| 2. | Communications | Yes | Yes | Yes | Yes |
| 3. | Warning | Yes | Yes | Yes | Yes |
| 4. | Emergency Public Information | Yes | Yes | Yes | Yes |
| 5. | Evacuation | Yes | Yes | No*** | No |
| 6. | Reception and Care | ** | ** | Yes | Yes |
| 7. | Protective Shelter (Direct Effects) | Yes | Yes | No | No |
| 8. | Fallout shelter | Yes | Yes | Yes | * |
| 9. | Health and Medical | Yes | Yes | Yes | Yes |
| 10. | Law Enforcement | Yes | Yes | Yes | Yes |
| 11. | Public Works | Yes | Yes | Yes | No |
| 12. | Firefighting | Yes | Yes | No | No |
| 13. | Rescuing | Yes | Yes | No | No |
| 14. | Radiological Protection | No | No | Yes | No |
| 15. | Human Services | Yes | Yes | Yes | Yes |
| 16. | Resource Management | Yes | Yes | Yes | Yes |

*At least until threat of attack is over.
**Only in areas of minor damage and little radiation.
***Evacuated only if shelters lack adequate protection from extremely high levels of radiation.

## BASIC FIRE SITUATIONS

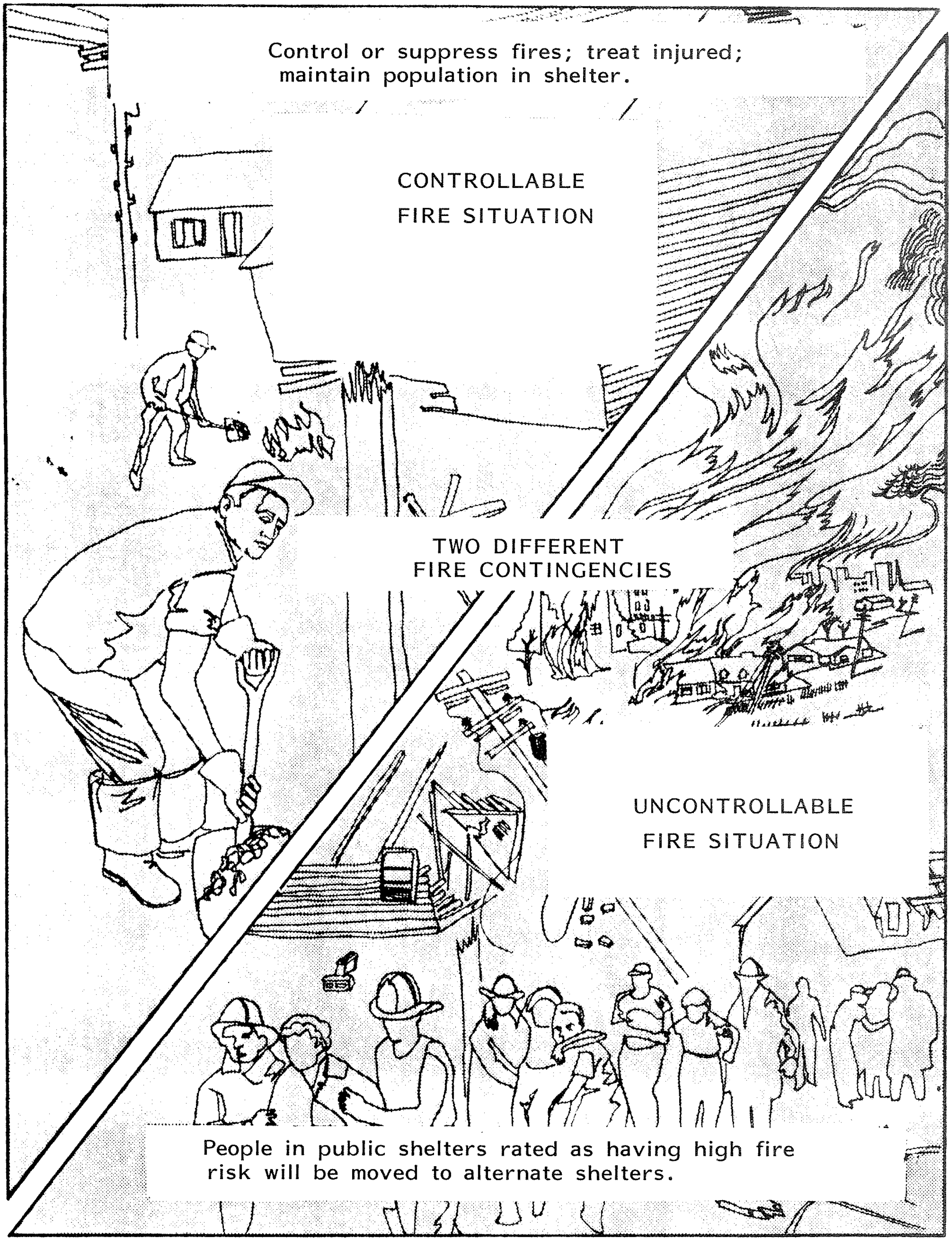
As we have seen, sheltering is the basic measure that shields the population against weapon effects, both direct effects and fallout. This is true whether special-purpose shelters are constructed, best available space in existing structures is used, or people are evacuated from cities to the hinterland where existing or "expedient" protection is sought.

In impact areas and radioactive-impact areas, the basic goal of emergency operations must be to preserve the population in their sheltered condition. Fire developing from ignitions caused by the blast and thermal pulse will be the major continuing threat to the sheltered population. Therefore, emergency operations in these areas will necessarily focus on and be determined by the emerging fire threat.

As will be seen in chapter 3, the ignitions develop slowly into sustained fires, partly because the blast wave may extinguish some and reduce many to a smoldering condition. Prompt action to control ignitions in their early stages can be quite effective. For a period ranging up to an hour or more, many ignitions are potentially controllable. During the "controllable fire" situation, all efforts must be directed toward fire suppression, and other emergency actions would be taken for only the purpose of contributing to the fire control effort.

If emergency fire fighting is successful, the incipient fires will be suppressed or contained, with perhaps the loss of only a few buildings. On the other hand, the fire suppression effort may be insufficient and developing fires may get out of hand. Where most survivors are injured or damage and debris prevent prompt action, it may become clear almost at the outset that the developing fires cannot be controlled. In the "uncontrollable fire" situation, the focus of actions must shift from fire suppression to search, rescue, and movement of the survivors out of the fire area or to refuges where they can survive the ensuing burnover.

These two fire situations--controllable and uncontrollable--are really two different contingencies to be planned for. In other words, two separate sets of coordinated actions will be needed for the impact contingency.


Control or suppress fires; treat injured; maintain population in shelter.
CONTROLLABLE FIRE SITUATION
TWO DIFFERENT FIRE CONTINGENCIES
UNCONTROLLABLE FIRE SITUATION
People in public shelters rated as having high fire risk will be moved to alternate shelters.

PANEL 19

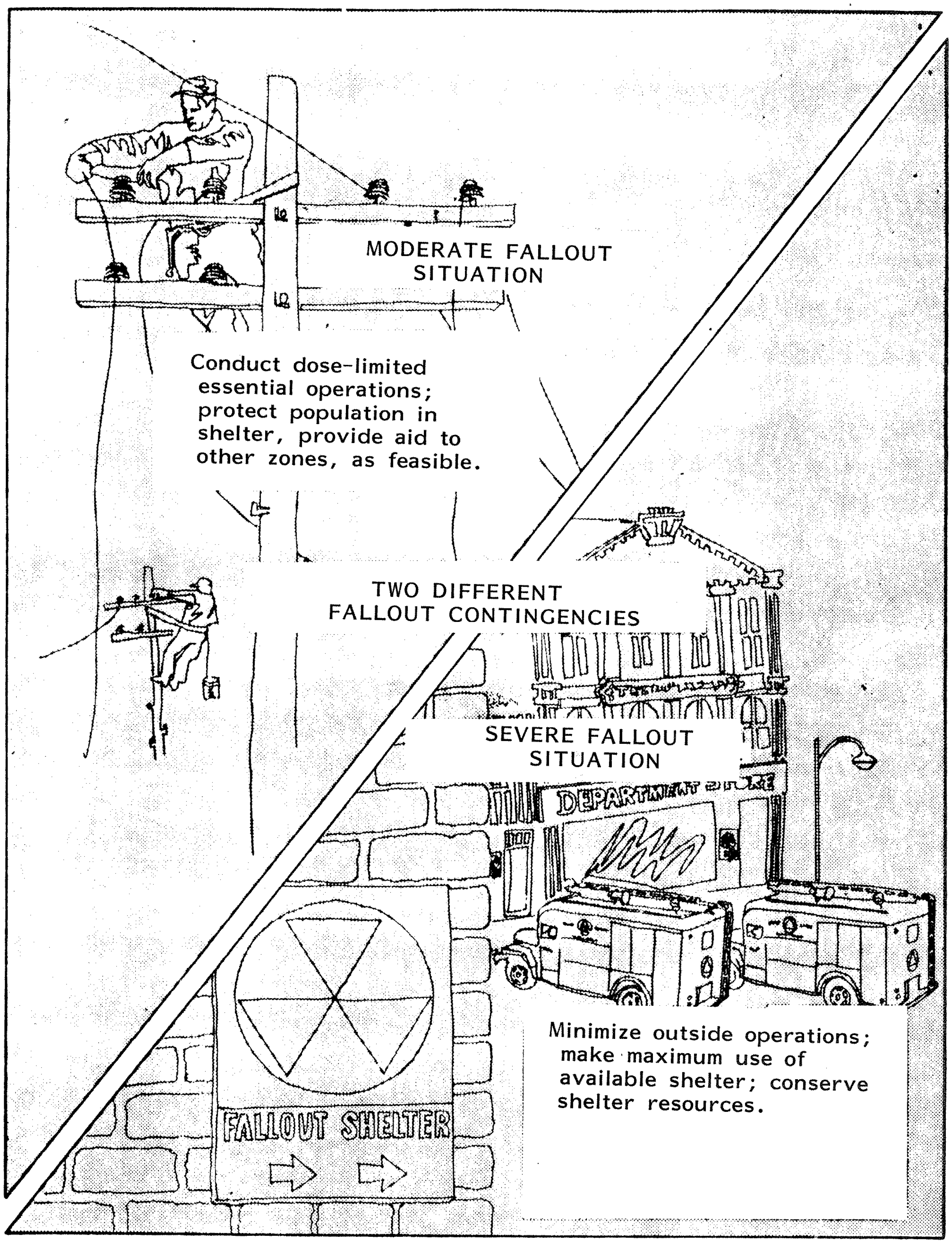
# BASIC FALLOUT SITUATIONS

For operational purposes, it is also important to subdivide the radioactive condition into two basic, operating situations. Dose rate of a few Roentgens per hour would place only minor restrictions on outside operations. At higher dose rates, less and less time could be devoted to emergency operations without subjecting personnel to exposures that could prove disabling. At 50 R/hr, four to five hours of exposure would result in some radiation sickness.

With high radiation dose rates (above 50 R/hr), few outside operations are feasible without risking incapacitating exposure. Only desperate needs, such as protecting the population against fire, would justify emergency operations. Unless a critical need existed, the most appropriate response would be to "pin down" in the best available fallout shelter until radioactive decay results in a less hazardous fallout environment.

At lower dose rates (below 50 R/hr), outside operations are generally feasible. Operations should be confined to essential tasks, such as search and rescue, resupply of shelters, and reconstitution of urgent utility services. Exposure of persons conducting such operations can be controlled by rotation of work crews and similar measures. Therefore, as the dose rate decreases, the range of appropriate emergency actions is much greater than in high radiation situations and should be planned for as a separate contingency.

For planning purposes, exposures should be kept as low as possible, and the Radiation Penalty Table (panel 12) should be used as guidance. Remember that the dose rates decrease rapidly during the first few days after fallout cessation.


MODERATE FALLOUT SITUATION
Conduct dose-limited essential operations; protect population in shelter, provide aid to other zones, as feasible.
TWO DIFFERENT FALLOUT CONTINGENCIES
SEVERE FALLOUT SITUATION
DEPARTMENT STORE
FALLOUT SHELTER
Minimize outside operations; make maximum use of available shelter; conserve shelter resources.

PANEL 20

# BASIC OPERATING SITUATIONS

Based on consideration of the fire and fallout problems just discussed, it appears that the four damage conditions of panel 14 should be expanded to apply to the truly different operating situations that may be encountered. Nine such operating situations can be identified when the "radioactive area" is subdivided into "moderate" and "severe" fallout situations and the "impact area" is subdivided into "controllable" and "uncontrollable" fire situations. These nine operating situations are shown in this chart.

Each box in the chart summarizes the priority actions appropriate to each contingency. These guidelines and a knowledge of the attack environment can form the basis for attack-specific appendices to the umbrella emergency plan for any jurisdiction. Note that the guidance for the "uncontrollable fire" situation applies no matter what the fallout situation is found to be. Hence, there are only seven contingency plans needed.

## PRIORITY ACTIONS IN CONTINGENCIES

| Fallout Situation | Fire Situation | | |
|---|---|---|---|
| | Negligible[1] | Controllable[2] | Uncontrollable[2] |
| Negligible (under 0.5 R/hr) | *Negligible Fallout--*<br>*Negligible Fire*<br>Maintain initial shelter posture; provide aid to other jurisdictions or zones as feasible; prepare for reception of survivors. | *Negligible Fallout--*<br>*Controllable Fire*<br>Control or suppress fires; treat injured; maintain population in shelter. | *Negligible Fallout--*<br>*Uncontrollable Fire*<br>*Moderate Fallout--*<br>*Uncontrollable Fire*<br>*Severe Fallout--*<br>*Uncontrollable Fire*<br>People in public shelters rated as having high fire-risk will be moved to alternate shelters as soon as an uncontrollable fire situation is anticipated or develops. Movement will commence upon order from authorities at the local EOC; or, if communications do not exist with the EOC, upon the initiative of shelter complex directors, shelter managers, or city employees in the high fire-risk shelters. |
| Moderate (0.5 to 50 R/hr) | *Moderate Fallout--*<br>*Negligible Fire*<br>Protect population in shelter; conduct dose-limited essential operations; provide aid to other jurisdictions or zones as feasible. | *Moderate Fallout--*<br>*Controllable Fire*<br>Control or suppress fires, on a dose-limited basis, treat injured; maintain population in shelter. | |
| Severe (over 50 R/hr) | *Severe Fallout--*<br>*Negligible Fire*<br>Make maximum use of available shelter; conserve shelter resources; minimize outside operations. | *Severe Fallout--*<br>*Controllable Fire*<br>Suppression or control of fires must be undertaken by shelter population and fire personnel; treat injured; stay in shelter. | |

[1] The emergency plan each jurisdiction should cover the three contingencies of this category.
[2] The emergency plan of each high risk area should cover the additional contingencies of these two categories. (Controllable Fire and Uncontrollable Fire.)

# PLANNING ASSUMPTIONS

The challenge of realistic emergency operations planning is to translate these precepts into specific arrangements that will organize all local capabilities and resources to carry out the nuclear defense mission within the particular community and the surrounding region. The general actions needed are enumerated in planning guidance and further discussed in the following chapters.

Until the planner explores each necessary action to the point where specific assignments can be made, the foundation for operational readiness will not be laid. Realistic plans will define exactly who will carry out what tasks and with what resources in response to events precipitated by the attack. This will require a firm understanding of the operating conditions under which each action must be carried out. The basic planning assumptions and considerations listed in the opposite panel serve as the basis and foundation for initiating action to prepare or update the attack preparedness portions of the emergency operations plan.

PLANNING ASSUMPTIONS

1. A period of crisis will most likely precede a nuclear conflict.

2. Local agencies of government form the backbone cadre for emergency operations; all services require expanded operating capabilities.

3. Survival is dependent on evacuation and dispersal of resources from high hazard areas and on prompt and continued use of best available shelter against direct effects and fallout by the population. Preservation of the sheltered population is the fundamental goal of nuclear defense operations.

4. Emergency operations will be directed toward the control of the main continuing threats of life and property: <u>fire</u> and <u>fallout</u>.

5. Time is of the essence in emergency operations. Measures tardily undertaken will probably be ineffective. Rapid assessment of the basic operating situation and response by planned actions is essential.

6. Nine basic operating situations form the framework for contingent operations. Jurisdictions suffering damage will attempt to control the fire situation with surviving resources. When resources are insufficient, the area must be abandoned or help must come from less affected areas. Fallout, if present, may limit or cut short emergency operations.

## NUCLEAR DEFENSE PLANNING

Emergency planning would be much simpler if we knew in advance just what a nuclear attack might be like in each locality of the country. But this is no more knowable than is the locale, nature, and size of the next major peacetime disaster. The most effective plan is one that provides procedures for foreseeable situations and establishes ground rules for handling unexpected conditions. The plan should assign responsibility for performance of required functions and specify the proper response (both means and content) to any given contingency. A plan that only assigns responsibility and states that "people will do their best" is an inadequate plan.

Many years ago, President Eisenhower told a group of nuclear defense planners, "plans are worthless, but planning everything … keep yourself steeped in the character of the problem you may one day be called upon to solve--or to help to solve." This manual is intended to aid you in understanding the character of nuclear attack. It is based on a rich literature of detailed studies and investigations. Some of the more useful of these are listed here for you to explore.

## SUGGESTED ADDITIONAL READING

The following sources provide additional background on the material in this chapter:


1. CPG 1-6, Disaster Operations, Federal Emergency Management Agency, July 1981.

2. CPG 1-7, Guide for Increasing Local Government Civil Defense Readiness During Periods of International Crisis, Federal Emergency Management Agency, May 1981.

3. CPG 1-8, Guide for Development of State and Local Emergency Operations Plans, Federal Emergency Management Agency, October 1985.

4. CPG 1-8A, Guide for the Review of State and Local Emergency Operations Plans, Federal Emergency Management Agency, October 1985.

5. Effects of Nuclear Weapons, 1977 Edition, Glasstone, S., and Dolan, P. J. (editors), Superintendent of Documents, USGPO.

6. Devaney, J. F., The Use of Systems Techniques in Civil Defense, URS Research Co., May 1970.

7. Soviet Military Power, Fifth Edition, 1986, Superintendent of Documents, USGPO.

8. Rainey, C. T., Natural Disaster Operations Planning, Stanford Research Institute, March 1972.

9. Schmidt, L.A., A Sensitivity Analysis of Urban Blast Fatality Calculations, Institute for Defense Analysis, January 1971.

10. National Council on Radiation Protection and Measurements, Radiological Factors Affecting Decision Making in A Nuclear Attack, Report No. 42, Bethesda, MD 20814, November 1974.