FEMA 132 / June 1987
(Supersedes CPG 2-1A8 dated June 1973, which may not be used.)

ATTACK ENVIRONMENT MANUAL

Chapter 8

What the planner needs to know about the Postshelter Environment

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), complied 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

PREFACE TO CHAPTER 8

This description of the postshelter environment focuses on the barriers to survival and well-being that must be coped with if nuclear emergency operations are to be fully effective. It presumes that the reader is familiar with the materials in earlier chapters. The information presented, along with that in other chapters, is applied in chapter 9 to the problem of contingency planning for nuclear emergencies. A secondary purpose of chapter 8 is to introduce the planner to some of the technical basis for confidence that postattack recovery can be planned for.

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 8 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 chapter begins with a general view of the many problems to be faced upon shelter emergence. It then turns to the immediate demands: exerting leadership, damage assessment, dealing with possible effects on climate. Following this, early tasks of restoring supplies of power, water, and food, providing housing, and treating the sick and injured are discussed. The problems of recovering agricultural and industrial production are then treated, followed by a closing section on specific postshelter measures. There is a list of suggested additional reading for those interested.

CONTENTS OF CHAPTER 8

WHAT THE PLANNER NEEDS TO KNOW ABOUT
THE POSTSHELTER ENVIRONMENT

WILL THE SURVIVORS ENVY THE DEAD?

The rhetorical question headed one of the chapters in the late Herman Kahn's book, On Thermonuclear War, a book that was an out growth of a Rand Corporation civil defense study. Kahn's answer, based on the Rand study, was that though the amount of human tragedy would be increased in the postwar world, the increase would not preclude normal, productive lives for the majority of survivors and their descendants. Said Mr. Kahn, "My colleagues and I came to this conclusion reluctantly; not because we did not want to believe it, but because it is so hard to believe. Thermonuclear bombs are so destructive, and destructive in so many ways, that is difficult to imagine that there would be anything left after their large-scale use."

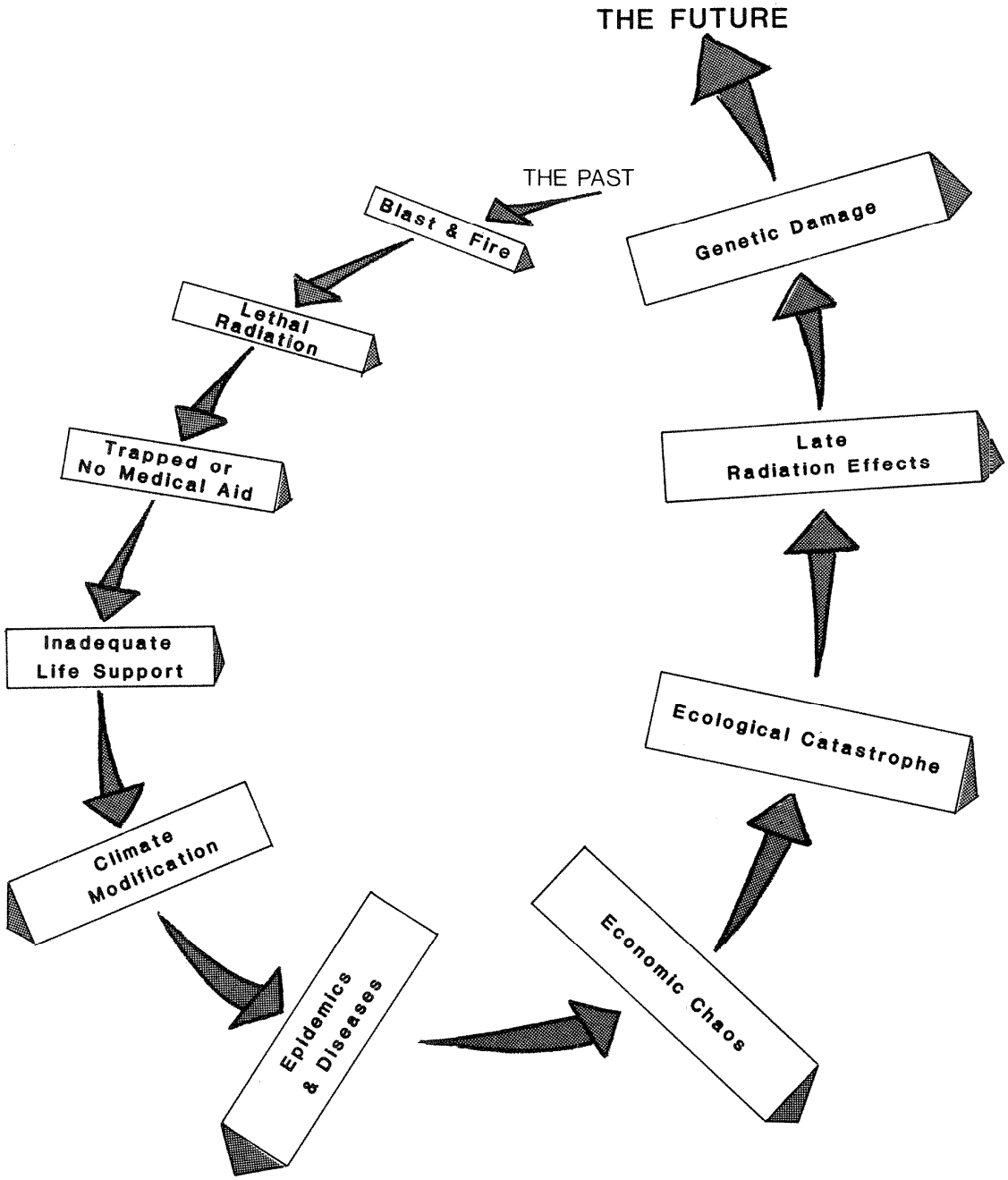
In chapter 1 of this manual, we saw that most of the U.S. population could survive the immediate effects of an attack such as the Soviet Union can deliver, especially if the defensive knowledge we have is fully applied in civil preparedness planning. But this is only part of the problem. Would the postshelter environment be so hostile that we or our descendents might prefer not being alive? To what measure could we restore the prewar conditions of life? Would more people die of disease, starvation, or a hostile environment than would be lost in the attack itself?

As suggested by this panel, the Nation's people, individually and as a society, would have series of hurdles or barriers that must be surmounted if they and their descendents were indeed to enjoy "normal" lives. Most nuclear defense planning was focused on the first three of these barriers: all-effects shelter or evacuation to cope with the direct effect barrier, fallout shelter and radiation detection instruments to cope with potentially lethal fallout radiation, and rescue and medical care preparations to succor the trapped and injured. This is as it should be. Failure to surmount the initial barriers would make the remaining problems academic. But, in a very real sense, all ten of these barriers must be surmounted. If there were catastrophic failure at any hurdle, there would have been little value in success at the other. When some people conclude that nuclear attack means total annihilation or that postshelter life won't be worth living, they usually have singled out one or more of the barriers as insurmountable.

In this chapter, we will discuss what is known about these barriers to well-being, particularly the last seven, and what the planner can reasonably plan to do about them.

PANEL 1

TEN BARRIERS TO WELL-BEING*



*Source: Adapted from Reference 13

PANEL 1

POSTATTACK RECOVERY

Another useful viewpoint for coping with the postshelter environment is shown here. It is the view that might occupy the attention of the Nation's leaders or that might be described in a history of the aftermath of a nuclear war.

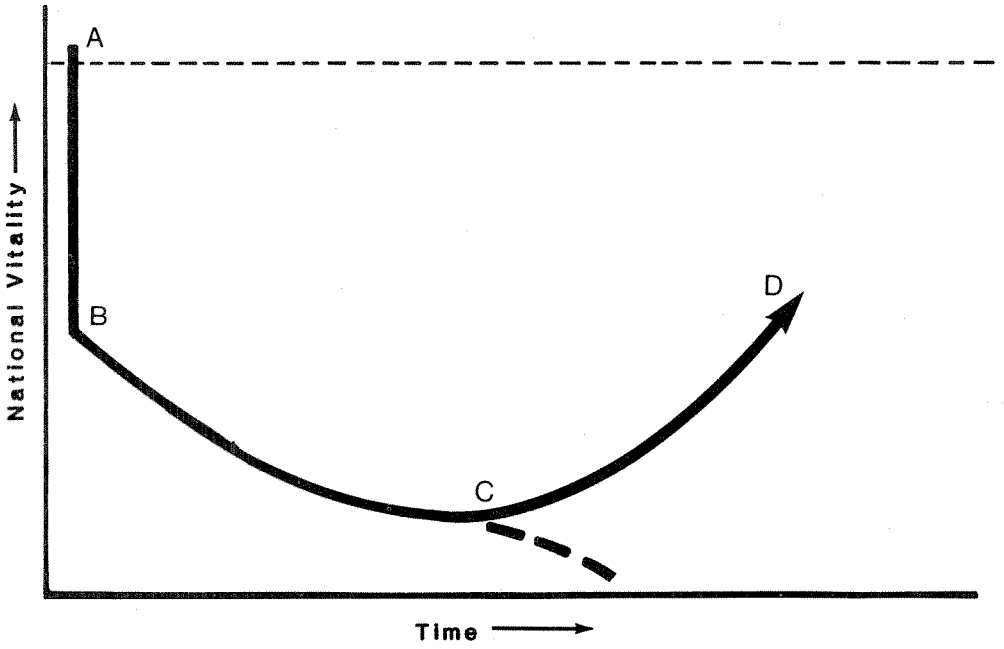
National vitality may be considered as a composite of population, material resources, and political, social, and economic institutions--the basic elements that make a viable country. Prior to the attack, the national vitaility is high, as shown at Point A. The immediate consequence of the attack is a sharp drop in vitality (Point B), with millions of dead and injured, great destruction of resources, and disorganization of institutions, such as government, banking, private ownership, and the like.

It is reasonable to expect that the initial sharp drop would be followed by a further decline in vitality because of continuing fallout radiation exposure, deterioration of abandoned factory machinery, wastage of scarce resources, inadequate mutual aid, lack of communications, and general disruption of normal patterns of living. Initial coping efforts would attempt to "stabilize" the situation and satisfy the most pressing wants so that sooner or later a minimum or "bottoming out" should occur (Point C), after which the Nation would begin its upward path to recovery (Point D).

There is a possible alternative history that the national leadership would strive to avoid. It is indicated by the downward dashed line at Point C, which implies that deterioration is so severe or management so inept or misdirected that national recovery does not occur at all, and the country degenerates into chaos and anarchy.

This viewpoint focuses on the need for national goals, goals widely shared at all levels of government and among the public at large. No local government or wider region can recover by itself. The emergency planner must recognize in planning that, while localities can (and may need to) deal with the first three barriers without outside help, adequate life support (food, water, and protection from the elements) may require assistance from outside the jurisdiction. Surviving organizations must consciously "coalesce" into wider and wider communities of common action if disease and epidemics are to be controlled and economic chaos avoided.

A POSSIBLE CHAPTER IN AMERICAN HISTORY



Source: Adapted from Reference 13

PANEL 2

SOCIAL AND PSYCHOLOGICAL NEEDS

As will be seen in this chapter, there is reason to believe that the surviving physical and human resources following an attack would be sufficient to permit a meaningful recovery. A good deal, however, will depend on the will and cooperation of the survivors.

People, the most valued part of the national entity, are at the same time the source of one of the critical postshelter resources: workforce. Therefore, the social and psychological effects of undergoing a massive attack by nuclear weapons could play a decisive role in determining whether the survivors would have the will and capacity to accomplish what appears to be possible. In 1970, a panel of behavioral scientists, government officials, and military staff officers, who had experience in studying or planning for nuclear attack contingency, developed a consensus on the social and psychological factors they felt would significantly influence the behavior of people after heavy attack on this country. It is significant that the panel, virtually unanimously, put at the top of the list the early satisfaction of the psychological needs shown here. The near unanimity of the panel on these priorities focuses the attention on the need for communications between the government and its people.

As noted in chapter 7, the process of providing leadership, information, reassurance, and instruction should be initiated in the shelter environment. This would be aided greatly by trained shelter managers and communications with the local EOC. Reliable one-way communication from various levels of government to the people is essential. There are about 11,000 privately owned AM, FM, and TV broadcast stations in the United States. About 9,500 of these participate in the Emergency Broadcast System (EBS), designed to provide the President, the Federal Government, and State and local authorities a means of communicating with the general public during the preattack, transattack, and postattack periods. However, only about 600 broadcast stations have been provided with emergency electric power and a fallout-protected broadcast studio. Many have facilities for remote programming from the local or State EOC. Approximately a fourth of these stations are protected against EMP. In view of the potentially damaging effects of the electromagnetic pulse on operating transmitters (see chapter 4), it would be good planning to arrange with nonparticipating broadcast stations to take EMP protective measures when they go off the air in an emergency. These stations could provide an important resource for communicating information, reassurance, and instructions in the postshelter environment.

PEOPLE NEEDS

Leadership

Information

Reassurance

Instructions

WHAT THE WAR WAS LIKE

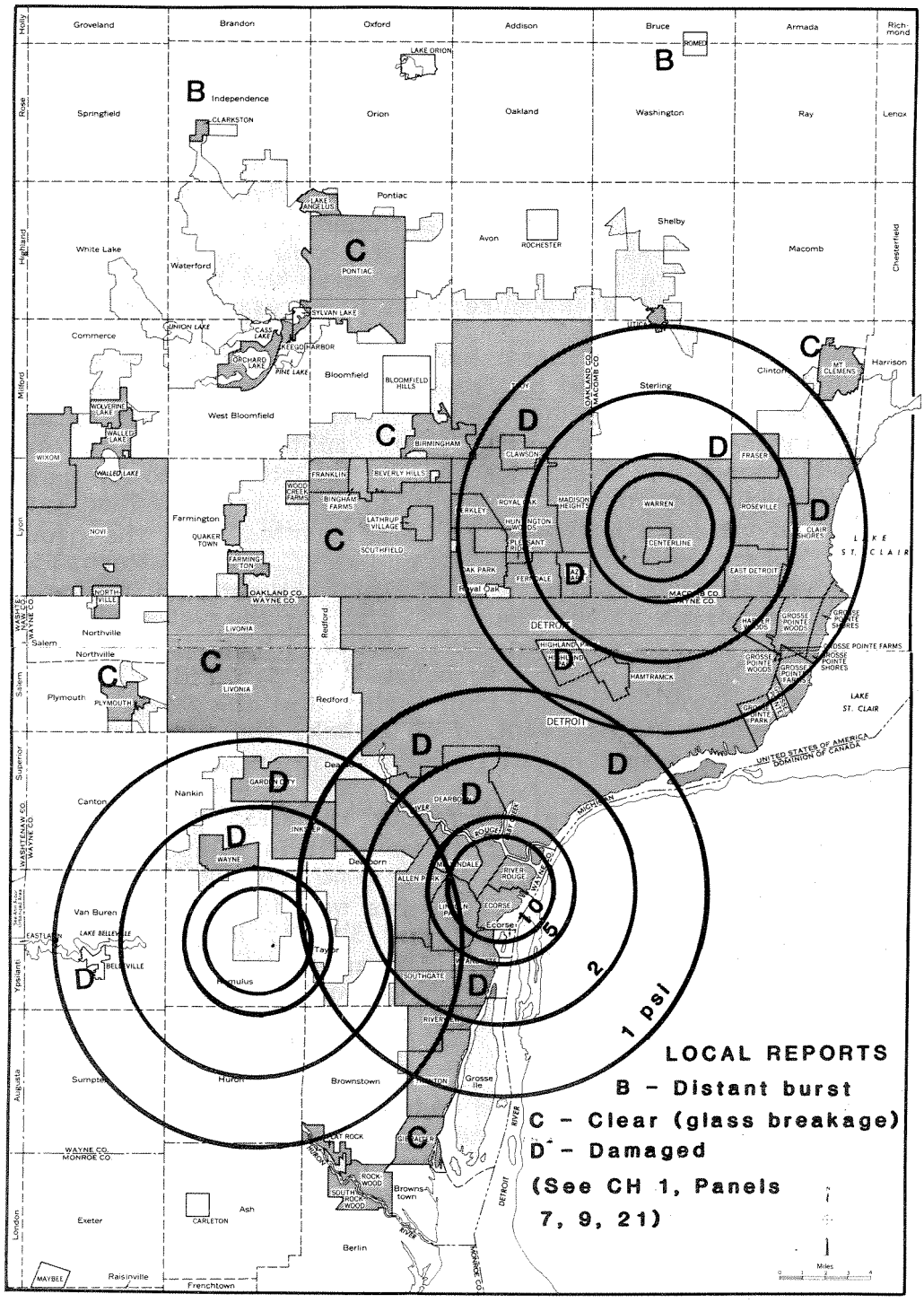
One of the problems of planning for a potential nuclear conflict is that the attack could take on a variety of forms. We do not know in advance whether cities would be struck, which military bases would be attacked, or whether detonations would be fallout-producing surface bursts. We do not know whether EMP damage would be widespread, whether fires would get out of hand, or how well radiation injuries would be avoided. It is because of these basic uncertainties that nuclear emergency planning must be contingency planning that takes into account all reasonable possibilities in a realistic manner.

The postshelter environment would have a significant feature: we would know what the war was like--since what occurred would be knowable. We could learn which cities had been spared and which were in ruins where the fallout was and where it was not, and how many had survived and their condition. Fallout radiation could be measured and the effects of radiation on people could be observed, thereby replacing the peacetime research data given in chapters 5 and 6. Damage to buildings, utilities, supplies, and industrial machines would be observable and might or might not conform to the estimates of chapters 2 and 3. In other words, damage assessment, the necessary first step, would provide the essential information upon which local, State, and national postshelter operations could be based.

The earliest and simplest attack effects information could be reported during the in-shelter period in the form of basic operating situation information (see panel 21 of chapter 1) or equivalent reports of "glass breakage," "structural damage," and fallout situation reports. Using these reports, damage assessors at State and Federal regional EOC's can "fit" direct effects templates to include localities that report damage and exclude those that report only glass breakage, as shown here. Once an approximation of the locations and sizes of damage areas is available, these can be laid over "lattices" of population, housing, and similar preattack data to get a first estimate of "what probably happened." At the national level, damage estimation would be done by computer because of the size of the task.

The urgent need to know "what happened," so that aid and recovery efforts can be planned, focuses the attention on the need for communications between various levels of government and between mobile units (and the people) and the local authorities in the EOC. Since communications systems are almost certain to be disrupted by the attack, early restoration of communications is a priority task to be planned for in the postshelter environment.

DETROIT URBANIZED AREA



EFFECTS OF 3 - 500 KT AIR BURSTS

PANEL 4

THE FALLOUT CONSTRAINT

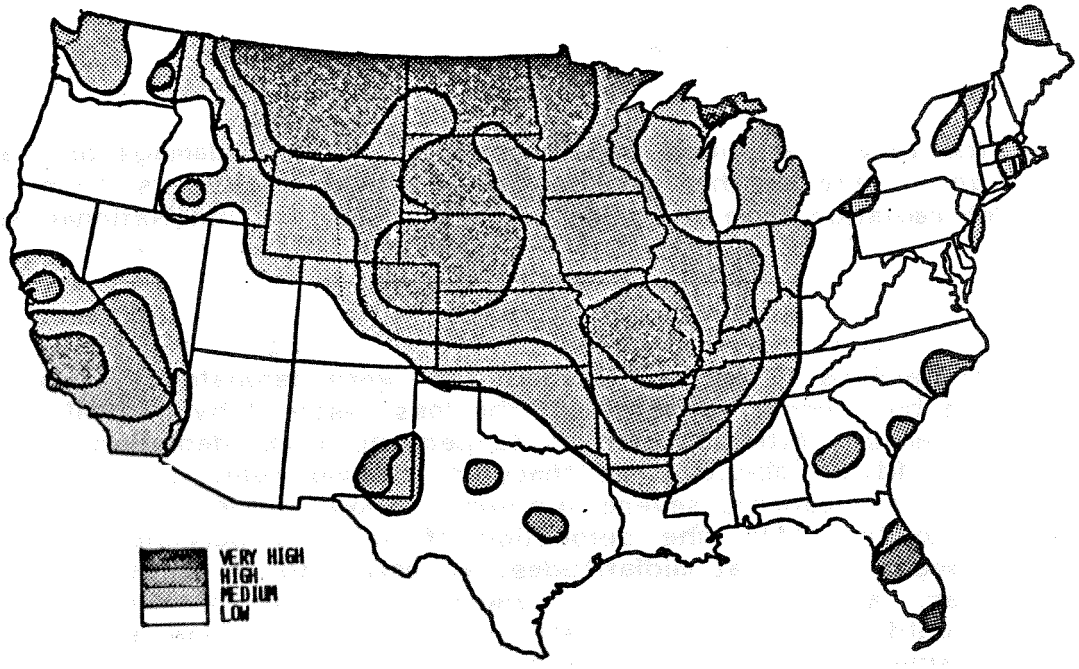
Gamma radiation from fallout is the attack effect that may persist in the postshelter environment in amounts sufficient to cause injury or death. Studies of possible attacks in which fallout-producing surface bursts are assumed to occur indicate that, by 1 week after that last detonation, very little of the U.S. would have exposure rates in excess of 50 R/hr.

The example fallout map shown here indicates the areas of the United States most likely to be covered by "serious" fallout radiation resulting from a potential attack of the 1990's. The attack concentrated on strategic nuclear and high military targets and military supporting industry; and included command and communication, transportation, power generation, and critical chemical industry targets. It did not target civilian population per se. The fallout situation depicted here resulted from the ground and very low air burst weapons. The "most likely" wind patterns for each month on the year were assumed, with the highest potential 1 week unprotected radiation exposure at any point constituting the value plotted on the map. Values for the areas shown are: VERY HIGH--15,000 R or more; HIGH--6,000 R to 14,999 R; MEDIUM--3,000 R to 5,999 R; LOW--less than 3,000 R. Alaska, Hawaii, Puerto Rico, Guam, and the Marshall Islands all fall in the LOW band. In the event of an attack, the wind patterns of the day would produce the actual fallout pattern to be encountered.

Time would further reduce the fallout radiation hazard. Using the radiation decay rules discussed in chapter 6, it is instructive to estimate the 1 week unprotected exposures in these same areas at 7 weeks after the attack. In the VERY HIGH areas, exposures would still likely be above 300 R; in the HIGH areas, between 100 R and 300 R; in the MEDIUM areas, between 30 R and 100 R; and in the LOW areas, the exposures would be less than 30 R. The effects of weathering would leave few, if any areas outside the bomb craters where a 1 week unprotected exposure would be as much as 30 R.

If the people are instructed and guided to limit postshelter exposures so as to avoid radiation sickness, the principal effect of fallout radiation during the early months would be to delay the accomplishment of recovery activities. Delay would occur for several reasons. Recovery workers would need to restrict their exposure outside shelter to a shorter work-week in most cases. Survivors most able to participate in the recovery work force would be those in the best fallout shelters or those coming from areas experiencing little fallout, thereby limiting the size of the work force. Survivors manifesting symptoms of radiation sickness would have to remain in shelter.

1990'S POTENTIAL FALLOUT THREAT



PANEL 5

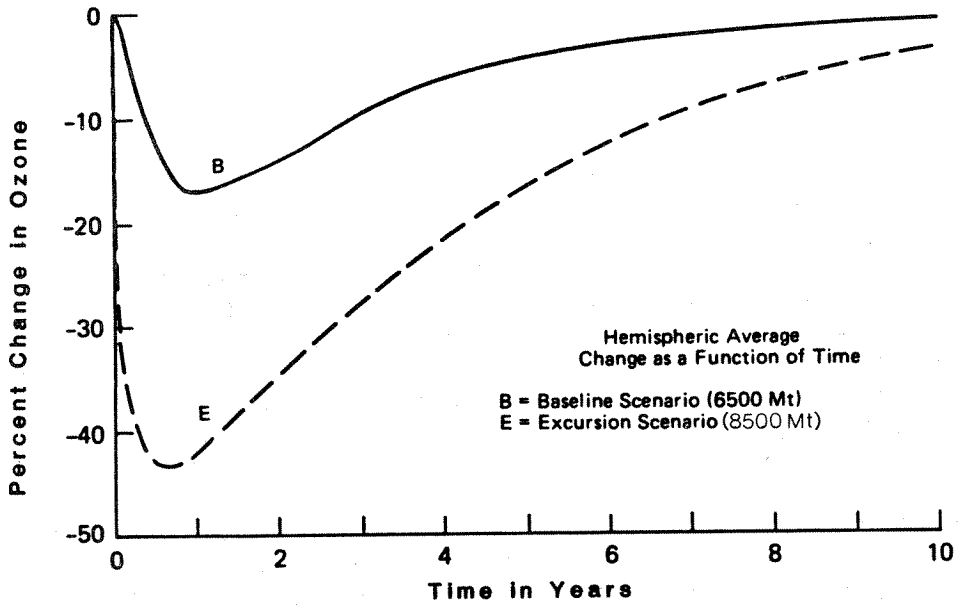
WILL THE SUN SHINE AGAIN?

Since the dawn of the nuclear age, scientists and fiction writers have speculated about dramatic and potentially disastrous alterations of the natural environment that might follow a nuclear war. The scientists who developed the first nuclear weapons during World War II made serious calculations of the probability that the first nuclear detonation would ignite the whole atmosphere. (It didn't.) Later, novelist Neville Shute fancied a kind of radioactive cloud in On the Beach that never decayed and was not depleted even though it contaminated all that it encountered. The supposed long term effects of fallout have been singled out periodically as an apocalyptic result of nuclear war, as in Jonathan Schell's Fate of the Earth.

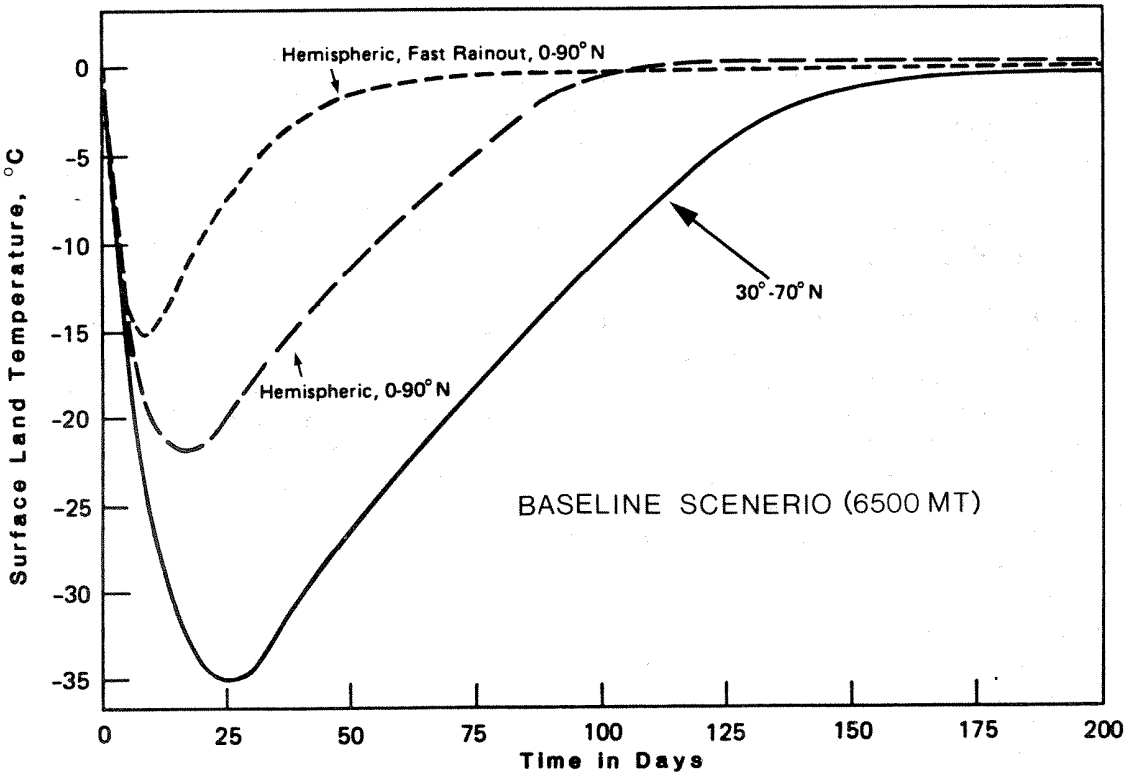
In the 1970's, attention was focused on potential damage to the ozone layer high in the earth's stratosphere, which shields us from harmful ultraviolet radiation from the sun. A 1975 study by the National Academy of Sciences (NAS) concluded that the ozone threat would not be catastrophic. A 1984 estimate is illustrated in the upper chart, which shows that, in the Northern Hemisphere, the maximum depletion would be about 45 percent if about 70 percent of the world's strategic nuclear stockpile were detonated; perhaps 17 percent if about half were detonated. There reductions would be temporary, with half the loss restored by natural processes in 2 to 3 years. With as much as 50-percent ozone depletion, ultraviolet radiation would be about three times its normal rate, causing increased incidence of skin cancer, severe sunburns, snow blindness, and cataracts. According to the NAS, the detonation of some 80 percent of the world stockpile would cause, at midlatitudes, an estimated 10-percent increase in skin cancer, a highly treatable cancer. By way of comparison, this increase would be only about one-tenth the increase now experienced by living in Dallas, TX, rather than Minneapolis, MN.

In 1982, two scientists, Crutzen and Birks, claimed that a large-scale nuclear war could create enough smoke from fires to block out as much as 99 percent of the sun's light for several months, resulting in a prolonged period of darkness and cold, now referred to as "nuclear winter." The curves in the lower chart show the predicted land temperature drop in the Northern Hemisphere for three assumptions on the spread and persistence of smoke from a 1985 study by the NAS National Research Council. These results are based on a simple one-dimensional model of the atmosphere. More complex global circulation models give average temperature drops that are one-half to one-third those shown. A temperature drop of 20 degrees or more over several months would have a serious impact on people, animals, and plants. How plausible or likely are these predictions? Frank Press, president of the NAS, states: "The unfortunate but unavoidable fact is that, even though we are 40 years into the nuclear age, much of the basic information needed to assess the likelihood and extent of global atmospheric consequences of a nuclear exchange simply does not exist."

PANEL 6



OZONE LAYER DEPLETION AFTER A NUCLEAR ATTACK



TEMPERATURE DROP AFTER A NUCLEAR WAR

PANEL 6

ECOLOGICAL DEFENSE

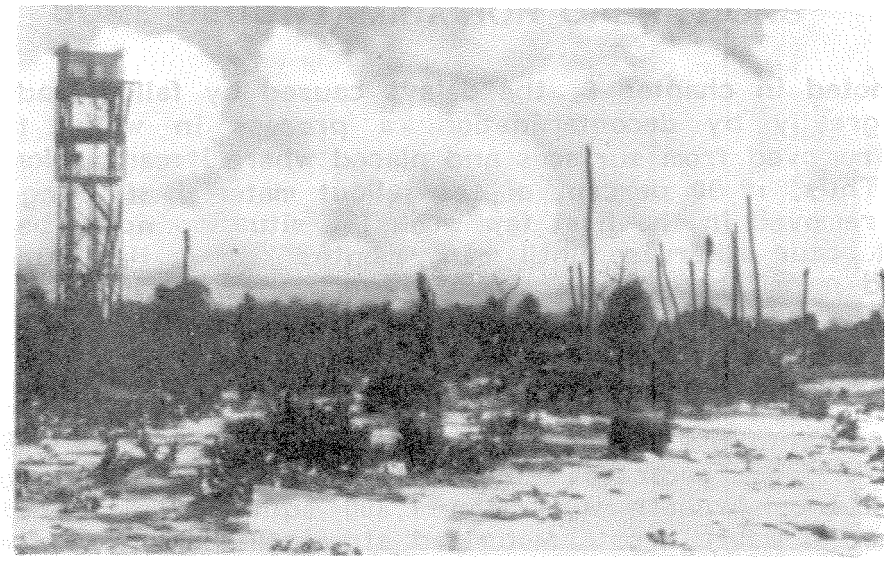
In chapter 6, some other possibilities of ecological catastrophe were discussed. Speculation that the attack environment might cause drastic upsets in the "balance of nature" have assumed that changes that exist for a relatively short time can induce permanent ecological damage. This is not borne out by experience. For example, some of the atolls in the South Pacific have experienced repeated direct effects and fallout from weapons tests comparable to the worst that could occur in a nuclear war. As these illustrations show, the tropical ecosystem has survived and recovered. Long-term consequences require continuous pressure over centuries of time, of which the impact of human habitation is the outstanding example.

Whether because of radiation injury, a spell of "nuclear winter" or abnormal ultraviolet radiation in sunlight, it would be prudent to plan on 1 cropless year following nuclear attack. One also should anticipate temporarily modified rainfall patterns and an increase in violent tropical and winter storms.

Trees, especially pines, are vulnerable to fallout radiation. The loss of a forest can be regained only after many decades. Dead trees are a valuable resource for wood products if they are harvested. If not harvested, they become a refuge for insect pests and plant diseases. They become a fire hazard. Forest fires destroy both trees and ground litter, resulting in increased surface runoff and erosion, excessive silting of streams, reservoirs, and irrigation works, loss of water for crops, and loss of crop yield. Prompt harvesting and reforestation are postattack actions needed to control these consequences.

Fallout radiation effects on insects and wild animals could affect agricultural production. For example, bees are essential to the pollination of certain agricultural crops, particularly fruits. A large reduction in the natural population of birds and preying insects could produce severe crop infestation by parasitic insects. But human beings are not helpless. They could move bee colonies where they are needed. They could import or otherwise assist the repopulation of fallout areas with beneficial species. All of these actions could well be called, "ecological defense."

A BATTERED ISLAND



Bikini Islan, November 1955

View of same areas as above in 1967. Some coconut trees had reached 20 feet and were bearing fruit.

DECONTAMINATION

As noted in chapter 6, the delays caused by fallout radiation can be reduced greatly by decontamination, a process in which the deposited fallout is removed from surfaces and placed where it can no longer irradiate people. Thus, if 90 percent of the fallout material affecting a workplace could be removed in the first few weeks, a situation would be created that would not occur otherwise until many months later. Halving the exposure rate would permit recovery workers to work twice as long as would otherwise be the case.

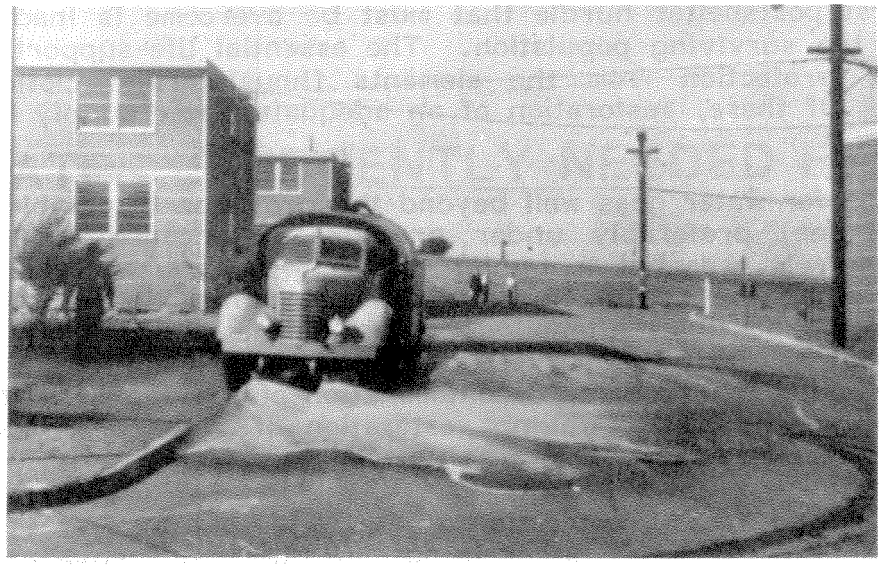
Outside damaged areas, decontamination can be accomplished using a variety of common methods. Flushing fallout particles from roofs and paved surfaces and into the storm drains by means of a firehose has been found to remove over 90 percent of the fallout materials. An hour's work by three workers with a firehose will clean 1,800 square feet of roof or 15,000 square feet of paved area. Motorized street flushers and street sweepers are more effective on paved areas and three to five times faster. Open ground areas can be scraped by earth-moving equipment: scrapers, graders, or bulldozers. These methods typically remove a slice of native soil amounting to several hundred times as much as the thin coating of fallout removed with it. The scrapings must be dumped at a remote corner of the cleared area. With room to maneuver, these methods are as effective as the paved area methods and almost as fast.

In damaged areas, widespread debris would complicate the decontamination process. If water pressure has been restored, the preferred decontamination procedure is to firehose an area 30 to 50 feet in radius around the debris-clearing equipment, flushing the exposed fallout down into or under the debris piles. Then, the street or area can be cleared of debris, and the remaining fallout in the cleared area can be flushed into the drains. Without water, debris removal must occur first, followed by motorized sweeping or vacuuming of the fallout.

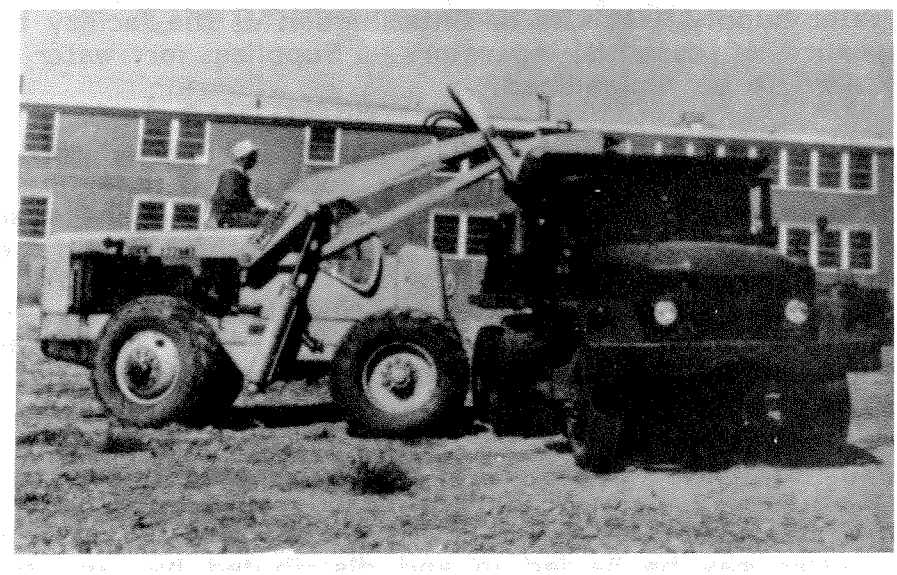
Because of the specialized equipment and operator skills required by most decontamination techniques, widespread decontamination of whole cities does not appear practical. Decontamination would be useful to permit key utility plants, staging areas, and supply warehouses to be operated in the first weeks after attack. Later, a large part of the population can be usefully employed in mass cleanup efforts, using household brooms, garden hoses, and shovels. Calculations have shown that such efforts can result in significant reductions in population exposure to radiation over the long term. Collection of fallout into piles, in streetsweepers, or in dump trucks, could lead to hazardous sources of gamma radiation. All persons involved in decontamination efforts, particularly the earliest efforts, must wear dosimeters and must follow radiation exposure guidelines carefully.

PANEL 8

SOME DECONTAMINATION OPERATIONS



Decontaminating with a street flusher



Removing fallout from an unpaved area

RESTORING THE WATER SUPPLY

The first postshelter hurdle that must be overcome is inadequate life support for the surviving population. The essential life-support needs are water, food, protection from the elements (housing and clothing), and health care. Of these, restoration of an adequate water supply is the most urgent.

The need for water goes well beyond the provision of potable water for drinking. Water, preferably under pressure, is needed for sanitation, which, in turn, is essential to public health. An early recovery milestone would occur when the use of flush toilets is regained, baths and personal hygiene become possible, utensils can be cleaned, and clothes can be washed. Another early water need is for fighting of fires. In fallout areas, water will be needed for decontamination of key facilities and staging areas. These needs justify making restoration of waterworks operations a first priority recovery goal.

In undamaged areas, restoration of the water supply may depend only on the availability of electric power to operate pumps and chlorinators. See chapter 4 for the reasons why EMP may result in widespread loss of electric power. Plans should define the power needs of each water facility and where auxiliary sources of generators and fuel are to be obtained. If portable generators are unavailable, induction motors can be converted into generators as described in panel 10. Other actions may be needed to restore the water supply, such as decontamination of the facility to minimize radiation exposure of essential operators. Supplies for water treatment facilities may need to be replenished.

Water quality control in the immediate postshelter period may not be of crucial importance in undamaged areas since boiling and other measure can be instituted to improve potability. Much of the population is served by water systems that use ground water from wells that should be free of fallout contamination. Even where this is not the case, there are usually a number of commercial concerns, such as breweries, that have their own water supplies independent of municipal supply. Also, older maps of an area may show locations of wells and springs no longer used that might be potential sources of supply.

The emergency planner needs to know where these sources are so that safe drinking water can be provided, especially for the children, during the first month (see chapter 6). In damaged areas or where water sources are polluted, water may be hauled in and distributed by tank truck until undamaged portions of the utility distribution system can be put back in use through rerouting, isolation of damaged piping, and repair of the works itself.

WATER IS URGENTLY NEEDED FOR:

- Drinking
- Sanitation & Sewerage
- Firefighting
- Bathing & Washing
- Cleaning & Scrubbing
- Laundering
- Decontaminating
- Industrial Processes

EXPEDIENT ELECTRIC POWER

Standby power plants installed in communication centers, hospitals, and some other key locations serve important but limited purposes. Portable engine-generator sets are rather widely available but the total capacity they represent is small compared to the potential demands for electric power in the immediate postshelter period. What most emergency planners do not know is that most electric motors (the induction motors) can be converted into electric generators to provide power to drive other motors--the pumps in waterworks and sanitary lift stations, for example. The number of unessential motors suitable for conversion is enormous and could, theoretically, provide virtually all the emergency power needs of the nation.

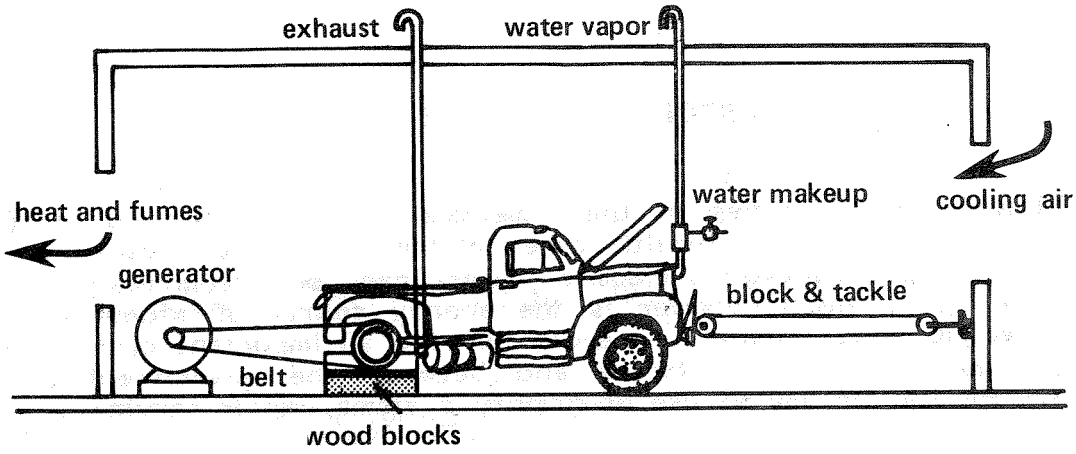
An induction generator is an induction motor that is driven by an engine (the prime mover) so that, instead of working as a motor, it becomes a generator of electric power, as shown in the upper sketch. Some electrical components are also needed, but they are usually to be found in factories or office buildings. The information presented in the lower sketch is intended only to convey a general idea of what an expedient induction generator setup might be like. How-to-do-it information that can be understood by electricians or power engineers can be found in reference 6, AD 739 945 cited in the final panel, which should be consulted, especially for safety advice.

The major components of an induction generator are:

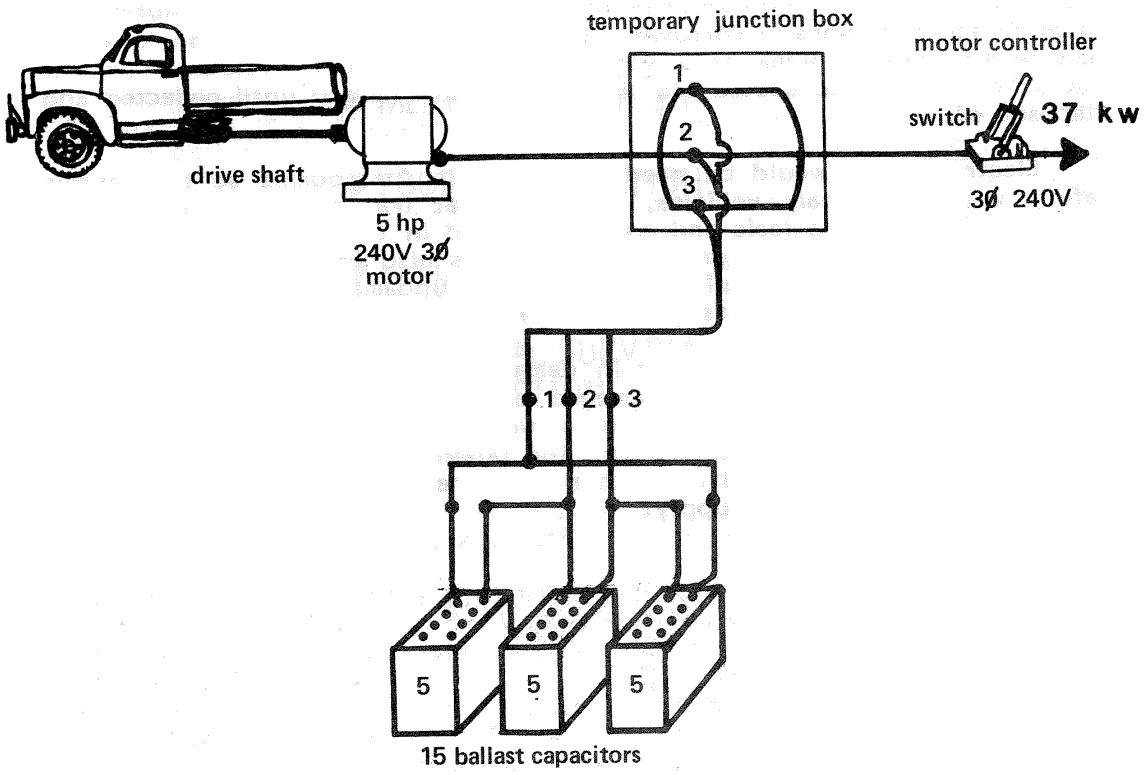
(1) An induction motor to be used as the generator. It should be about four times as large as the largest motor to be started. That is, a 5-hp pump motor needs a 20-hp induction generator to start it.

(2) The prime mover must be an internal-combustion engine about three times the generator's size. In other words, a 20-hp induction generator need a 50 to 60 horsepower truck or tractor engine to drive it. An adjustable speed governor on the engine is most desirable. The engine can be coupled to the induction motor by belt drive from a rear wheel (upper sketch), directly from the drive shaft (lower sketch) or through the "power takeoff unit" with which many trucks and tractors are equipped.

(3) A source or excitation, usually a capacitor of about the same rating as the induction motor. Heavy-duty power capacitors are often used to improve "power factor" and thus can be found near large motors or near the distribution panel in many facilities. Another source of capacitor is the ballasts in fluorescent lighting units. The lower sketch shows a 5-hp induction generator excited by 15 capacities from such ballasts. This generator will produce over 3.5 kilowatts of electric power.



EXPEDIENT INDUCTION GENERATORS



PANEL 10

RESTORING ENERGY SUPPLIES

Virtually all activities in the immediate postshelter period needed to provide life support and health care to the surviving population would require sources of energy: electric power, gas, petroleum fuels, and the like. Of these, electric power is the energy source of widest immediate use. Electric power would be needed for the all-important communications among organized recovery forces and between the government and the people. Except for limited use of gravity systems, water service cannot be restored nor can sewage disposal become effective without an electric power supply.

Recovery activities would largely be limited to daylight hours unless building and street lighting is available. Treatment of injured survivors also would be difficult unless electric power is available. One special problem of immediate significance in the postattck period is the fate of food, mainly meat, in cold storage and freezers at wholesale, retail, and household levels. These supplies of protein would be of great nutritional value to the survivors. Moreover, unless power for refrigeration is available within about a week of power loss, these potentially valuable supplies would become organic wastes constituting a health hazard until collected and disposed of.

Electric power would be needed to operate fuel pumps so that public safety vehicles, repair vehicles, and essential transport can continue to operate. Many of the tools and equipment used in the repair of communications, water, sewage, and other key facilities also require electric power. Finally, electric power would be needed in undamaged industrial plants where essential survival items such as pharmaceuticals must be produced.

Restoration of electrical power in damaged areas is likely to be a slow process. Power outages in undamaged or lightly-damaged areas may not take many days to correct since many power generating stations are located where they are likely to survive and the power systems are will interconnected. Inventories of coal and other fuels needed for power generation, however, may be in short supply.

ELECTRIC POWER IS NEEDED URGENTLY FOR:

- COMMUNICATIONS
- WATER SUPPLY
- WASTE DISPOSAL
- LIGHT
- MEDICAL TREATMENT
- FOOD PRESERVATION
- FUEL PUMPS AND REPAIR TOOLS
- ESSENTIAL SURVIVAL ITEM PRODUCTION

ESTABLISHING THE FOOD SUPPLY

Since fallout radiation or climatic disturbances may injure or kill many growing crops and food animals and may prevent farm workers from caring for them for a period of time, one can anticipate loss of one growing season and depletion of animal herds. Fortunately, food reserves in the United States are immense and increasing as the result of bountiful harvests and diminishing exports. The Agriculture Department's Commodity Credit Corporation (CCC) owns enough wheat--464 million bushels in 1985--to bake 124 1-pound loaves of bread for every man, woman, and child in the country. And, the CCC stocks account for only part of the reserves available at any one time.

Of course, only the processed foodstuffs at the wholesale, retail, and household levels would be immediately available. About 70 days of this kind of food are in the pipeline, which should survive about in proportion to the surviving population. The huge supply of grain stocks is not located near the major population centers and requires some processing before reaching the consumer. Emergency transportation of food would be a critical postattack problem. Estimates indicate that surviving rail and truck transport would be adequate for priority food shipments, the fallout situation permitting. Food processing plants may be located where damage is likely. Other grinding facilities may need to be adapted to the milling of grain. Grain normally grown for animal feed may have to be diverted to human use. The U.S. Department of Agriculture is responsible for postattack management of "primary" food resources and for the complex processing and distribution of them. State and local governments must control the use of "secondary resources" of food in the hands of local wholesalers and retailers, and in households. As discussed more fully in panel 19, current plans involve consumer rationing of essential items, including food, even in undamaged localities where supplies would appear to be ample.

In effect, the local government takes charge, using private food organizations and personnel as feasible. So long as much of the population is confined in public shelters (whether the attack environment demands this or not), delivery of food based on shelter head count is an automatic form of rationing. Individual families surviving in residential basements will be dependent on household stocks during this period. As shelter emergence become possible, food distribution may continue as a mass feeding program based on the shelters, work places, elementary schools, and staging areas. Only when housing is reestablished and necessary utilities and fuels are judged to be in adequate supply is over-the-counter rationing and home preparation of meals likely to be feasible.

U.S. GRAIN PRODUCTION AND AVERAGE STOCKS
(Days of food for the U.S. population,
assuming 3,000 calories per person per day)

	(Days)			
	1982	1983	1984	1985
U.S. Grain Production	2837	1822	2626	--
U.S. Grain Stocks				
U.S. Grain Stocks (Avg.)	1065	1286	1253	1350
On Farm	644	756	681	825
Off Farm	421	530	572	525
CCC Grain Stocks (Avg.)	62	100	67	87
CCC Stocks/U.S. Stocks (%)	5.8%	7.8%	5.0%	6.4%

Source: USDA

EMERGENCY HOUSING

To the extent that people have survived the attack environment, both direct effects and fallout, the areas where they were sheltered may continue to offer adequate protection against the elements. We saw in chapter 2 that people can survive blast and fire effects better than houses. Thus, millions of homeless survivors can be expected after a nuclear attack. Some portion of these would have been driven from untenable shelters during the emergency period and would have had to seek shelter elsewhere. Nonetheless, providing emergency housing is unlikely to be as urgent as assuring that the survivors have water for drinking and that no family or small group need forage on their own for the next meal.

Postshelter emergency housing will be important to plan for not only for health reasons but also for morale purposes. Just as the opportunity to take a bath is likely to mark an early postattack milestone, so will the opportunity to sleep once more in a bed in the privacy of one or more rooms used by a family. As shown in this chart, such relative comfort is likely through use of surviving housing units because Americans presently enjoy housing accommodations that are quite roomy compared to those in many other countries of the world.

A measure of adequacy in emergency housing would likely be the criterion of 40 square feet per person used following peacetime disasters. This is four times the shelter space allotment but far short of the space normally available in U.S. housing units, the majority of which have five or more rooms. In areas near nuclear detonations, a major repair task would be to cover in various ways the window openings that have been blown out by the blast wave. In fallout areas, occupancy of emergency housing during the first month may require conversion of multistory office buildings into dormitories by bringing beds from the less protective residences or decontamination and intensive use of selected multiunit dwellings until the rest of the housing can be safely used. In any event, occupancy of emergency housing would entail the restoration of electric power, water, and the availability of fuel for heating and cooking.

Ultimately, the housing destroyed in the attack would have to be replaced to the extent the survivors require it. A standard of housing approaching the preattack situation is consistent with recovery goals; so is the need to assure the public of the return of private property to its rightful owners at the earliest possible time and the replacement of losses through some system of loss sharing. This is longer-term matter that would be planned for at the Federal level in conjunction with recovery of industrial production.

HOUSING SPACE IN VARIOUS COUNTRIES*

Place	Persons per Room	Relative to U.S.
United States, Canada	0.6	1.0
West Germany	0.7	1.2
Finland, Austria	0.9	1.5
Puerto Rico, Italy	1.1	1.8
Czechoslovakia, Poland	1.3	2.2
Greece, Israel	1.5	2.5
Korea, Uruguay	2.0	3.3
Pakistan, Yemen	2.8	4.7

*from United Nations Statistical Yearbook, 1980

PUBLIC HEALTH

Survivors of nuclear attack may be exposed to endemic diseases capable of rapid development in an uncontrolled postshelter environment. There are more than a dozen diseases that may increase sharply unless early priority is given to adequate sanitation and public health measures. The need for disposal of human wastes and personal cleanliness was referred to in panel 9 as an important reason for early restoration of water service. This implies that provision of electric power for sewage treatment plants and sanitary lift stations must be given equal priority. Where damage has occurred, repairs to the sanitary waste-disposal system must be scheduled concurrently with repairs to the water system, if people are to be housed or sheltered in the area.

In addition to human waste disposal, major public health problems would be created, especially in damaged areas, by the creation of breeding areas for flies, rodents, mosquitoes, and other disease-carrying species. In all but the winter season, intestinal (enteric) diseases, such as shigellosis, salmonellosis, and infectious hepatitis, could erupt to epidemic proportions because of greatly increased numbers of flies. A large increase in the fly population can be expected if organic wastes are left uncollected for more than a week.

Garbage and rubbish produced incidental to feeding the population may constitute a relatively small part of the putrefying organic matter. In blast areas, the bodies of the deceased must be collected and buried or burned. Animal corpses also must be disposed of. Solid organic wastes are likely in damaged industrial plants, warehouses, food and produce markets, and in households. If electric power were out for more than a week or so, frozen and refrigerated products would have begun to deteriorate. Food that is beyond reclaiming must be treated as organic waste.

A supply of insecticides and poisons can be expected to remain available for vector control following attack. The most important single operation is that of collecting and disposing of solid organic wastes. Next in priority is the control of houseflies, along with mosquito control. The table suggests a postshelter schedule of activities to be undertaken.

POSTSHELTER SANITATION NEEDS

Desired Schedule	Organic Waste Collection	Fly Control	Rodent Control	Mosquito Control
First Week	Undertake at High Priority	Begin Adulticide	Wait	Wait
Second thru Fourth Week	Continue as Necessary	Continue as Necessary	Place Poisons & Traps	Begin Larvacide
Second thru Twelfth Month	Return to Normal	Return to Normal	Return to Normal	Return to Normal

TREATMENT OF INJURED SURVIVORS

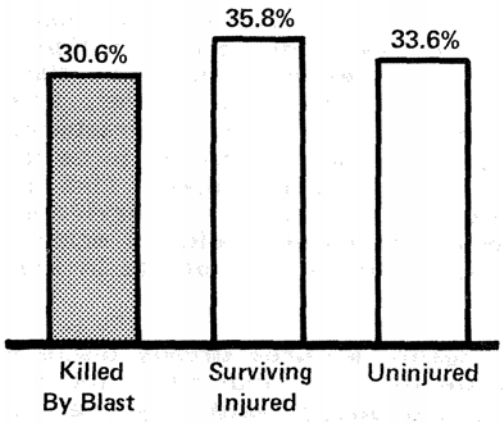
It is sometimes useful to consider postshelter medical care needs in two time periods: (1) an "immediate postattack period," lasting the first month, in which the treatment of injured survivors is the most important medical problem; and (2) a "late postattack period," covering the remainder of the first year, in which treatment of victims of communicable diseases is the central health care need.

In the immediate postattack period, treatment of trauma (wounds and broken bones) and burns creates the greatest demand for professional care by physicians and surgeons. There is no specific treatment for radiation sickness beyond bed care, cleanliness, and replacement of fluids. This can be provided by relatively untrained personnel. Proper treatment of injuries and burns, however, places a heavy demand on those who possess specialized medical skills. A characteristic of nuclear attack is that the numbers of surviving injured are expected to equal or exceed those killed by blast. This could mean tens of millions of injured survivors throughout the nation. Since today there are only about two physicians and 10 auxiliary medical personnel (dentists, veterinarians, nurses, etc.) per 1,000 population, case loads would be many times normal even if emergency plans placed medical personnel in the most survivable shelter locations.

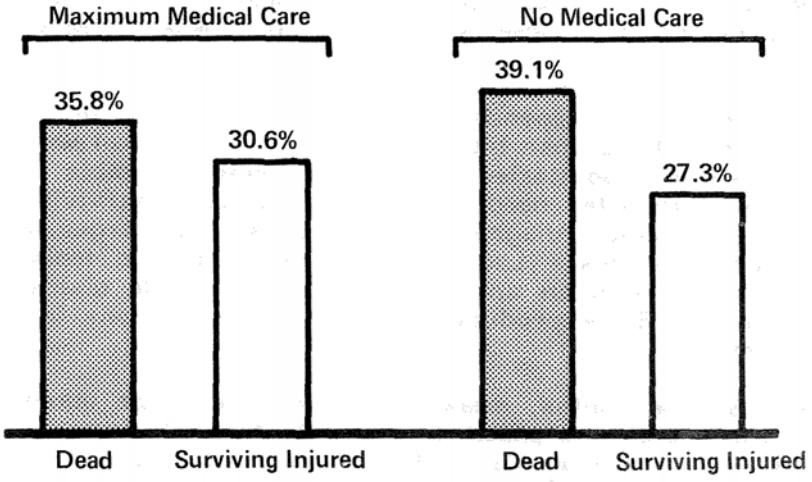
Studies, such as the one illustrated here, have indicated that medical care would have only a limited effect on the number of fatalities because most of the injured either would be beyond help when they could be treated or would survive in any event. The example shown is a detailed case study of casualties following an assumed attack on the Detroit target complex of chapter 1. The upper bar chart shows an estimate of the situation 24 hours after the attack. The lower bar chart shows the estimate for 30 days after the attack, assuming on the one hand peacetime levels of medical treatment and no treatment on the other. The estimates were formed by defining injury types in detail and then consulting hospital and medical records to predict outcomes. The complicating effect of fallout radiation injury was taken into account.

The results show about three-quarters of the injured would have survived without medical care. About 15 percent of the surviving injured would succumb during the 30-day period despite maximum medical care. Approximately 10 percent of the surviving injured could be saved by such medical treatment. In the study cited here, the medical care judged to have been available after the assumed attack did not save any significant number of the surviving injured. Later analyses have indicated that postshelter medical treatment might have an important effect on the "quality of survival" and how rapidly the injured can be returned to a useful place in society.

EFFECT OF MEDICAL TREATMENT



ESTIMATE AT ONE DAY



ESTIMATE AT THIRTY DAYS

TREATMENT OF DISEASE

Degradation of the public health measures discussed in panel 14, difficulties in maintaining personal cleanliness, poor nutrition, and radiation injury could lead to postshelter increases in communicable diseases, possibly of epidemic proportions. In contrast to attack injuries, where the availability of doctors is the limiting factor in effective treatment, the critical element in treatment of communicable diseases appears to be the adequacy of medical supplies, particularly drugs and medicines. Like attack injuries, communicable diseases can affect a large fraction of survivors. But, unlike attack injuries, effective medical treatment could be achieved and would have a great impact on preventing further loss of life in the first postwar year.

In addition to the public health measures already discussed (water and sewage treatment, organic waste disposal, and insect and rodent control), one set of postshelter medical and public health priorities is shown here. Isolation of infectives when diagnosed is of greatest importance. In addition, maintenance of the "external quarantine" to prevent entry of diseases, such as yellow fever and typhus, into the country is needed, since the population is defenseless against many diseases that no longer are endemic in this country. Some diseases, such as plague and tularemia, are transmitted from wild rodent reservoirs. The general rural relocation of survivors that may occur either preattack or postattack could increase contact with the animal reservoir. Close surveillance of these threats may be necessary.

Physicians are normally dependent on laboratory tests to aid in diagnosis of disease so that the proper treatment can be instituted. Many, if not most, of these medical laboratories may be rendered unusable by attack effects. An early postshelter need would be to establish surviving laboratories to service the medical diagnostic needs of a much larger area than was common prior to attack. Lacking adequate diagnostic tools, broad spectrum antibiotics to treat an uncertain range of possible diseases would be in great demand. Early production of these preparations in quantity would be necessary.

After the first few months, measures would need to be taken to provide as well-balanced a diet as possible, with attention to sources of protein and vitamins, without which people would become more susceptible to infection and suffer more severely from illness.

PRIORITIES FOR COMMUNICABLE DISEASE CONTROL

1. Isolation and Quarantine.

2. Disease Surveillance.

3. Establishing Regional Diagnostic Laboratories.

4. Drug Protection, especially Antibiotics and Disinfectants.

5. Production of Immunologicals.

6. Food Quality Control.

EXPANDING PUBLIC SAFETY FORCES

Most regular public safety functions of local government must be resumed before the release of the general population from shelters after an attack. Outside of damaged areas, existing public safety forces should be sufficient to perform these functions in their normal manner whenever fallout conditions permit the release of the sheltered population. However, if the normal population were greatly increased by an influx of survivors from areas more severely affected, most of the regular public safety tasks would require longer work shifts, increased manpower, or both.

In addition, there will be many special public safety needs to be met. Most of these would impact on the police force, since they are normally associated with the peacetime law enforcement function. A large expansion in numbers of auxiliary police, guards, and watchmen would be necessary. These people would not need much training in most cases, but they would need to be selected and recruited and would need professional supervision. In many cases, professional peace officers would need to devote most of their time to supervision and training of a greatly expanded public safety force.

Control of access into damaged or contaminated areas should be planned. Control points would be needed on major access routes. Minor streets and roads should be blocked completely and posted with warning signs. Locations of special hazards because of concentrations of fallout or because of damage to buildings and structures would need barriers and warning signs. A program of demolition and correction of hazardous conditions should be planned. Finally, areas vacated during or before the attack should be patrolled if and when feasible.

Another class of special needs arises from the requirement to control rigorously the use of critical resources. The most critical are food, fuel, and pharmaceuticals. Construction supplies, household supplies, and transport are also essential survival items. Guards and watchmen would be needed to prevent pilferage and unauthorized use. One means of minimizing opportunities for circumventing control of scarce resources is to limit unauthorized travel, especially vehicular travel. Requiring special identification for such movement also would conserve the limited fuel supply.

A specialized problem would also arise in directing the movement of incoming refugees, mutual aid teams, and supply transports to staging areas and warehouses with which they would be unfamiliar.

POSTSHELTER PUBLIC SAFETY NEEDS

REGULAR

1. Fighting Fires
2. Controlling Traffic
3. Investigating Crimes and Complaints
4. Responding to Accidents and Other Emergencies

SPECIAL

1. Controlling Access to Damaged Areas
2. Controlling Access to Fallout Areas
3. Marking Hazardous Areas
4. Correcting Hazardous Conditions
5. Patrolling Vacated Areas
6. Guarding Essential Resources
7. Preventing Unauthorized Travel
8. Directing Refugees and Aid Teams

REDEPLOYMENT

In preparedness planning, we must aim at readiness for all likely contingencies in every locality. For example, every locality should be prepared for fallout, with shelters, radiation detection instruments, and people trained to use them. But we know, in reality, that some cities and counties are better prepared than others and are likely to remain so. In the postshelter environment, we would know where the damage occurred and where the fallout was (see panel 4). We saw in panel 5 that some areas of the country would have negligible fallout while other areas, not too far distant, would have a persistent radiation threat. In areas of negligible fallout, trained monitors and instruments would not be needed. Their know-how would be invaluable in the fallout area. What would be needed would be a redeployment of specialized personnel and equipment to areas of need.

This partial listing of valuable specialties emphasizes the point that "know-how" is the most important aspect of redeployment. The stricken areas would not be without resources but experience and knowledge may be in short supply. An extra shift of trained operators could permit the existing equipment to be worked around the clock. In most cases, the specialized equipment needed could be carried with the personnel.

Trucks and heavy construction equipment would be necessarily move by road or rail. Most everything else could be brought in by air. Regular commercial aircraft generally have been earmarked for military support missions, but the Civil Air Patrol (CAP) and most private and corporate aircraft would be available for urgent recovery needs. Most States have SARDA plans for this purpose. (SARDA means State And Regional Defense Airlift.)

Local emergency plans should provide for assessment of the need for specialized help in the immediate postshelter period. No locality should attempt to "go it alone" with inadequately trained advisors when making deficiencies known to the State would often bring help. Alternatively, for the lesser contingencies, plans should call for notifying the State of available skills and equipment that might be used in more severely affected jurisdictions. Only in this way can the State and Region "put it all together."

SKILLS AND EQUIPMENT NEEDED IN SOME
AREAS MORE THAN IN OTHERS

1. Radiological Officers, monitors, and radiation detection equipment.

2. Doctors, nurses, and medical people.

3. Utility repair crews and trucks.

4. Public health experts, exterminators, and supplies.

5. Leaders and planners, including experienced construction managers.

6. Bulldozers, cranes, loaders, and their operators.

7. Skilled construction crews and tools.

EARLY PRODUCTION PROBLEMS

Economic models, such as that described in the next two panels, estimate what is physically capable of being done with the available productive resources if these resources are used efficiently to achieve some stated goal. In peacetime, those who have immediate control over productive resources tend to use them in ways each thinks will maximize private gain. In a "free enterprise" economy, this also is considered to be in the national interest. In almost all postattack recovery analyses, it has been assumed that what people do with the resources over which they have immediate control would be determined for them by general rules and specific orders that fit a national recovery plan.

It seems most likely that, for at least the first few months after a nuclear attack, national authorities would lack the information, staff, and experience to be able to do much central management of the economy. Therefore, official planning provides for a set of prepositioned regulations that become effective upon attack and that (1) delegate Federal authority to heads of regional offices of the Federal Government and to State and local authorities, and (2) freeze prices, wages, and rents, institute consumer rationing, and establish a priority system. Federal authorities have made up a list of survival items (mostly medical, food, shelter, and fuel) that would be attached to the proclamation of the priority system by the State Governor or his legal successor. These excerpts are from the proclamation that appears in virtually all State plans. Each producer of an item on the priority list need merely certify on his orders that the supplies are needed for production of the priority goods. Local heads of government would be directed to initiate the controls. It is expected that producers and suppliers, impressed with the gravity of the emergency, would comply with the published rules without need for extensive surveillance.

Associated with any price and wage-rate freezes would be a freeze on interest rates. At these rates, there would be a supply of credit from banks, backed by the Federal Reserve System, for priority activities. Plans also exist under which banks could limit withdrawals in order to ensure equitable amounts of cash for all depositors.

It is reasonable to expect that sometimes there would be insufficient supplies to satisfy all priority orders and other important needs. Federal regional offices, State Resource Priority Boards, and State departments would assist in adjudicating these problems. But the emergency planner should recognize that the local government is expected to play a key role during the immediate postshelter period in assuring that resources are carefully conserved and channeled into the most urgent uses and activities.

EXAMPLE STATE PLAN FOR EMERGENCY MANAGEMENT
OF RESOURCES

EXCERPTS FROM GOVERNOR'S PROCLAMATION

To: Executive Heads of All Political Subdivisions in this State

I hereby proclaim these policies and guidance in effect throughout this State...

Facilities in your jurisdiction which produce or distribute items or provide services essential for local, State and National survival...

You are requested to authorize essential local users...to use the following certification on their purchase orders...

If supplies of essential survival items available...are inadequate, you are to restrict further their use to those needs which, in your judgment, are most urgent...and request...resupply to make up local deficiencies.

You are to inform persons engaged in essential local activities or operating essential facilities how to obtain emergency...

As soon as possible, you are requested to arrange for rationing of designated essential consumer items.

Governor

RESTORING INDUSTRIAL PRODUCTION

Nuclear defense measures that would increase the shortrun survival of the population in a nuclear war would be of little value if the war would so cripple the nation's economic system that the survivors could not be supported in the long run. In a sense, there would be a race between resuming production of essential survival items and the depletion of inventories from which essential needs were being met in the meantime. Whether the race could be won would depend on how long the inventories could last, how many factories survived, what kinds of things they could produce, whether damaged factories could be repaired or "cannibalized" to create new factories, and how long it would take to build new sources of supply.

Understanding the economic recovery problem is immensely complicated because of the interdependence of modern industry. An example is shown here. Suppose all of the economic activities that go to make up a modern industrialized society were lumped into 15 classes or "sectors" of economic activity. Then it would be found that each sector depended on goods and services obtained from all the other sectors in order to produce whatever that sector was intended to accomplish. For example, the Motor Vehicles sector, according to one study, buys $1.39 worth of goods from the Food and Textiles sector for every $100 of motor vehicles sold. (Presumably this is for upholstery and the like.) A big supplier is Primary Metals--steel and aluminum. Another is Fabricated Metals. The biggest dependence is on parts suppliers within the Motor Vehicles sector itself. Altogether, the Motor Vehicles sector pays out about 70 percent of its gross sales to suppliers of goods and services. With what is left the Motor Vehicles "industry" has to pay its own employees, pay taxes, and make a profit.

What this means is that even if Detroit were spared in an attack, whether or not it could produce motor vehicles would depend on how much damage and destruction occurred in other sectors. The other sectors, in turn, are dependent upon their suppliers, who are again dependent on the surviving source of their supply. Thus, merely summing up how much industry survived will not tell how much can be produced by a postshelter industrial base that has been damaged to various degrees in its many interlocking parts.

PURCHASES BY THE MOTOR VEHICLES SECTOR

	Sectors	Purchases Per $100 of Sales
1.	Food and Textiles	$ 1.39
2.	Wood and Paper	0.15
3.	Chemicals	0.62
4.	Petroleum Refining	0.17
5.	Rubber and Leather	2.23
6.	Stone, Clay, and Glass	1.12
7.	Primary Metals	10.00
8.	Fabricated Metals	6.33
9.	Machinery, except Electrical	4.34
10.	Electrical	2.15
11.	Motor Vehicles	32.96
12.	Aircraft and Transportation	0.09
13.	Instruments and Optics	0.64
14.	Trade and Services	5.13
15.	Diffuse*	3.08
	Total Intermediate Purchases	$ 70.40

*Includes Agriculture, Mining, Construction, Transportation, Utilities, and Imports.

ECONOMIC RECOVERY

A measure of all goods and services produced by the peacetime economy to satisfy the final purchasers is the Gross National Product (GNP). One way to judge the potential viability of the war-damaged economy is to compare its capability in terms of Gross National Product with the undamaged preattack GNP. To do this, the interindustry transactions for each "sector" are established from census data (such as shown in the previous panel), damage to each sector is estimated for a given presumed attack, and the possible end-product production is calculated on a computer. This is known as an "input-output" analysis; the results of one such analysis are shown here.

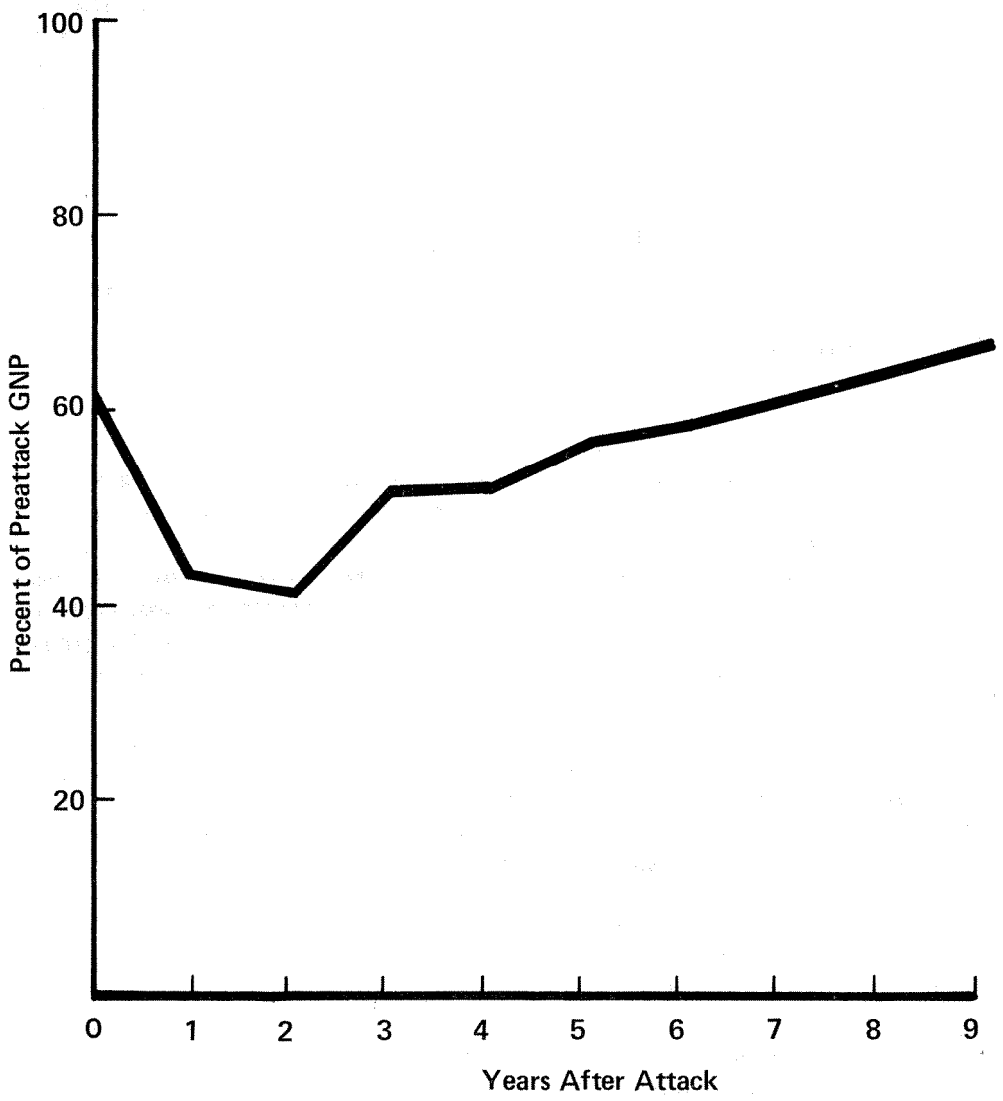
The computer model used in this analysis is based on the 15-sector economy shown in the previous panel. Final demand on the surviving industry is composed of consumption requirements of the population and investment in building new facilities to replace those lost in the attack. The model attempts to use the surviving capacity (limited by interindustry requirements for intermediate products) as much as possible to meet consumption requirements and to allocate investment in critical sectors in such a way that the stream of GNP into the indefinite future is as great as possible. Investment of $2 in new construction was assumed to produce $1 of increased capacity 2 years later.

The results shown here are based upon an assumed attack in which, in addition to military and other targets, about one-third of the Soviet weapons are targeted to maximize damage to all economic sectors. The surviving capacity is estimated to be about 60 percent of the preattack GNP but limits on available resources further reduce production to about 40 percent of the preattack level at the end of the second year. Then, the investments made in the interim begin to pay off and the economy begins to grow. By the ninth year, the economy is estimated to be about two-thirds of the preattack level and growing at about 4 percent each year. (Note the similarity between this projection and that of panel 2.)

Larger attacks would further limit the surviving industrial capacity. Also, an attack of the same magnitude that aimed at destroying a critical sector, such as petroleum refining, would leave much of the surviving capacity in other sectors unusable until substitute refining capacity could be developed. Thereafter, there would be a very rapid increase in overall production. Finally, the lumping of production facilities into a relatively few economic sectors assumes that the products are readily substituted for each other or that the facilities can be readily converted. This is not always the case. So most analyses use 80 or more sectors. These analyses predict economic viability over a wide range of sizes and kinds of nuclear attack.

PANEL 21

ONE PROJECTION OF ECONOMIC RECOVERY



PANEL 21

CRISIS ACTION FOR ECONOMIC RECOVERY

A period of extreme crisis could provide both the time and the sense of urgency that would be necessary for taking action to improve the prospects for postattack economic recovery. Local government, working cooperatively with local industry, could make the essential peacetime plans without which the task of implementing crisis actions would be much more difficult. Mobilization during times of international tension is compatible with current estimates of a low probability of sudden attack (see chapter 1).

Many major corporations have made peacetime arrangements for protected alternate corporate headquarters. In a crisis, most other businesses could relocate essential records and management personnel outside the large cities. Management will recognize such plans as insurance to help them "stay in business."

Hundreds of billions of dollars of economic assets are located in potential target areas in the form of finished inventories, parts, and specialized equipment. In a crisis, many of these resources could be loaded on trucks, railroad cars, and delivery vehicles and removed from the area where they could be placed in temporary open storage or parked in the loaded vehicles. Equipment and parts needed to sustain production, if this should be necessary, could be buried later on the premises to protect them against blast and heat damage. This could be done in a few hours' time in many instances. Delicate and irreplaceable control equipment should be wrapped in plastic before burial. Machine tools and bulky equipment that cannot be moved can be made less vulnerable to damage by sandbagging and other protective measures so that they could be recovered even if the building were demolished. A large proportion of business assets could be preserved with the use of these measures.

Facilities outside the cities for bulk storage of fuels, chemicals, grains, and other essential commodities could be filled to capacity despite seasonal demands. As noted in the next panel, fuel, fertilizers, and pesticides will be of particular importance in assuring early recovery of agricultural production. Needless to say, expedient shelter for key workers should be planned at industrial and supply facilities that are intended for continued operation or for early postatttack use.

Finally, government can contribute to early recovery by offering radiation detection equipment and crisis training and by preparing plans and materials for implementing rationing and other control measures.

CRISIS PREPARATIONS

- Remove records and management to safer locations.
- Relocate valuable equipment and inventories.
- Bury critical movable items.
- Protect machine tools and special equipment.
- Augment inventories of fuel, chemicals, and other stocks outside urban areas.
- Accelerate production and safe stockpiling of essential survival items.
- Provide shelter and alternate locations for work force and dependents.
- Expand radiological monitoring capabilities outside urban areas.
- Mobilize postattack control measures.

AGRICULTURAL PRODUCTION

In his major study, Economic Viability After Thermonuclear War: The Limits of Feasible Production, Rand economist Sidney G. Winter, Jr., came to this conclusion: "If measures could be devised and preparations made to assure that agriculture would not be drastically altered, then it appears that other economic problems could be managed." At the time of Dr. Winter's study, it was thought that contaminated farmland might have to be quarantined for many years. As discussed in chapter 6, this is no longer believed to represent a serious problem. Nonetheless, recovery of agriculture remains crucial to postattack viability.

In the United States, less than 5 percent of the population produces peacetime surpluses on a fraction of the arable land. This means that agriculture is dependent on other sectors of the economy to support its mechanized and intensive operations. The most critical needs are fuel and fertilizer. Without petroleum products, adequate crop production for sustaining the surviving population would be virtually impossible. All major food and feed crops are mechanically planted and harvested. Livestock, which accounts for nearly half the caloric value of the food produced, depends on the availability of feed, which is itself dependent on petroleum. The petroleum refining industry, which is highly concentrated, is potentially vulnerable. However, the use of farm machinery is seasonal and petroleum storage on or near farms is substantial. Postattack, a greater share of the surviving fuel could be directed to agriculture, and plans should be made to allocate petroleum to these areas where immediate use of machinery is essential and where high yields are to be expected.

It has been estimated that about one-half of U.S. food production can be attributed to applied fertilizers. Lack of fertilizers can be accommodated partially by emphasizing crops and farm regions not requiring fertilizer and by bringing more land under cultivation. The latter course, however, requires more fuel. Nitrogen is the principal nutrient required. Nitrogen production facilities are located throughout the country and considerable excess capacity exists today. Sufficient production is expected to survive a major nuclear attack.

Major field crops are grown without pesticides in may places. Lack of pesticide availability would be most strongly felt in the yields of potatoes, fruits, and vegetables. Irrigation is also important for these crops, as well as for rice and sugar beets. Availability of electricity is most critical to modern dairy and poultry production.

Studies have shown that capabilities for transportation, storage, and food processing of basic agricultural commodities should survive as well or better than food production, except for wholesale warehousing. Good management, based on adequate plans, appears to be the key to recovery of food production.

CRITICAL NEEDS FOR FOOD PRODUCTION

- Fuel and Lubricants
- Fertilizer
- Pesticides
- Seeds
- Irrigation and Drinking Water
- Equipment and Parts
- Feed
- Electricity
- Transportation, Storage, and Processing

RADIATION EXPOSURE CONTROL

The final barriers to recovery that the survivors must surmount are the possible late somatic and genetic effects of irradiation discussed in chapters 5 and 6. The key to mitigating these problems is good radiation exposure control. Exposure control in the postshelter environment will be greatly aided by the advice of trained Radiological Officers.

Exposure control begins, however, with effective warning and sheltering of the population at the time of attack. Effective sheltering involves the use of the best available fallout shelter, not just those that meet some minimum criterion, such as PF 40. That is, the planner must be concerned not only with preventing lethal exposure but also with keeping the radiation burden of the survivors as low as possible. To this end, a protection factor of 400 is vastly better than a protection factor of 40. Plans to build expedient shelters (chapter 7) and to improve the protection in existing shelter areas can contribute to exposure control.

People should be encouraged and instructed to remain in shelter as long as possible in fallout areas. Naturally, this advice must be balanced against the need to get on with the urgent tasks of recovery. But many, especially children, are not needed for these early tasks outside. Children and young adults should be given maximum protection to minimize genetic damage in subsequent generations. Late radiation injury is of lesser concern to those over 40 years of age. Even so, the shelter areas should be used as off-duty quarters for the workers.

An important control measure during the first month after attack would be to limit the intake of radioactive iodine by children (see chapter 6, panel 25). They should be provided with stocked water, water from wells, or water from areas of low contamination and kept from drinking contaminated milk.

Even in areas of moderate fallout, decontamination would be important to limit the continued exposure to radiation over the months and years ahead. In the process, the necessary radiation exposure should be spread among the able-bodied survivors by rotation and work shifts so that the radiation burdens of individuals are kept as low as possible.

ELEMENTS OF EXPOSURE CONTROL

- Make sure there is a person on the staff who is well-trained and qualified in radiological protection.
- Make use of best available fallout shelter.
- Keep the population in shelter as long as possible.
- Preferentially protect children and young adults.
- Use shelters for lodging after "shelter emergence."
- Provide children with uncontaminated drinking water for the first month.
- Decontaminate living and working areas.
- Spread the necessary radiation exposure among the work force.
- Keep on decontaminating.

MOTIVATING THE SURVIVORS

In chapter 7, panel 23, some points are made about human behavior in disaster. We can expect the survivors' motivations to be dominated by concern for the safety of self and family from the time they believe an attack is imminent until they understand the attack to be over. After the attack is over, survivors would try to learn of the fate of separated family members and would seek information about the national and local situations. One can expect most behavior to focus on the problem of supplying the basic needs for food, water, and shelter for the family.

Individual and small group foraging and hoarding of found supplies consume available resources and do nothing to bring about future resupply. A significant implication for planning is that means must be found for satisfying the survivors' basic needs while, at the same time, motivating and directing the efforts of survivors in other critical recovery activities. Most students of this problem believe that local authorities should take charge of all critical supplies in order to satisfy equitably the subsistence needs of the survivors, to eliminate competing ways of meeting these needs, and to provide meaningful rewards for productive work in critical recovery activities. The survivors are apt to welcome positive action of this kind and are likely to place a high social value on opportunities to participate in activities clearly associated with improving personal and national well-being. The recovery management precepts recommended by one of the knowledgeable research groups on this subject are presented in this listing.

One observation from disaster research is that communities of survivors tend to develop strong bonds of solidarity and to look for guidance and support from leaders who have brought them through difficulties. After nuclear attack, the most immediate and acceptable authority structure is that which developed during the shelter stay. This suggests that a good plan is to continue the shelter organization into the postshelter environment, rather than allowing it to dissolve while attempting to build a wholly new organization to provide for the subsistence needs of the survivors. Emergent shelter leaders should be welcomed into the "official" organization and encouraged to continue to care for and represent the groups in their charge.

RECOVERY MANAGEMENT PRECEPTS

1. Exercise strict control over existing supplies of food, housing, and other critical supplies and provide security for these supplies of goods.

2. Satisfy the subsistence needs of the survivors so as to release workers for participation in critical recovery activities.

3. Reward work in critical recovery activities (in a way that is linked to increased distribution of goods to the worker's family).

4. Perpetuate family and group solidarity and leadership developed in shelter into the postshelter period.

5. Communicate survival and recovery goals and foster expectations of improvement in well-being as goals are achieved.

6. Publicize plans for ensuring continued ownership of private property, for relieving, at least temporarily, individuals of preattack economic obligations, and for providing some degree of restitution for losses when national production affords a surplus.

7. Establish recovery management under the auspices of the highest constitutional authorities, oversee its performance by elected representatives at all levels, and plan for return to political and social institutions acceptable to the survivors as soon as feasible.

REESTABLISHING INSTITUTIONS

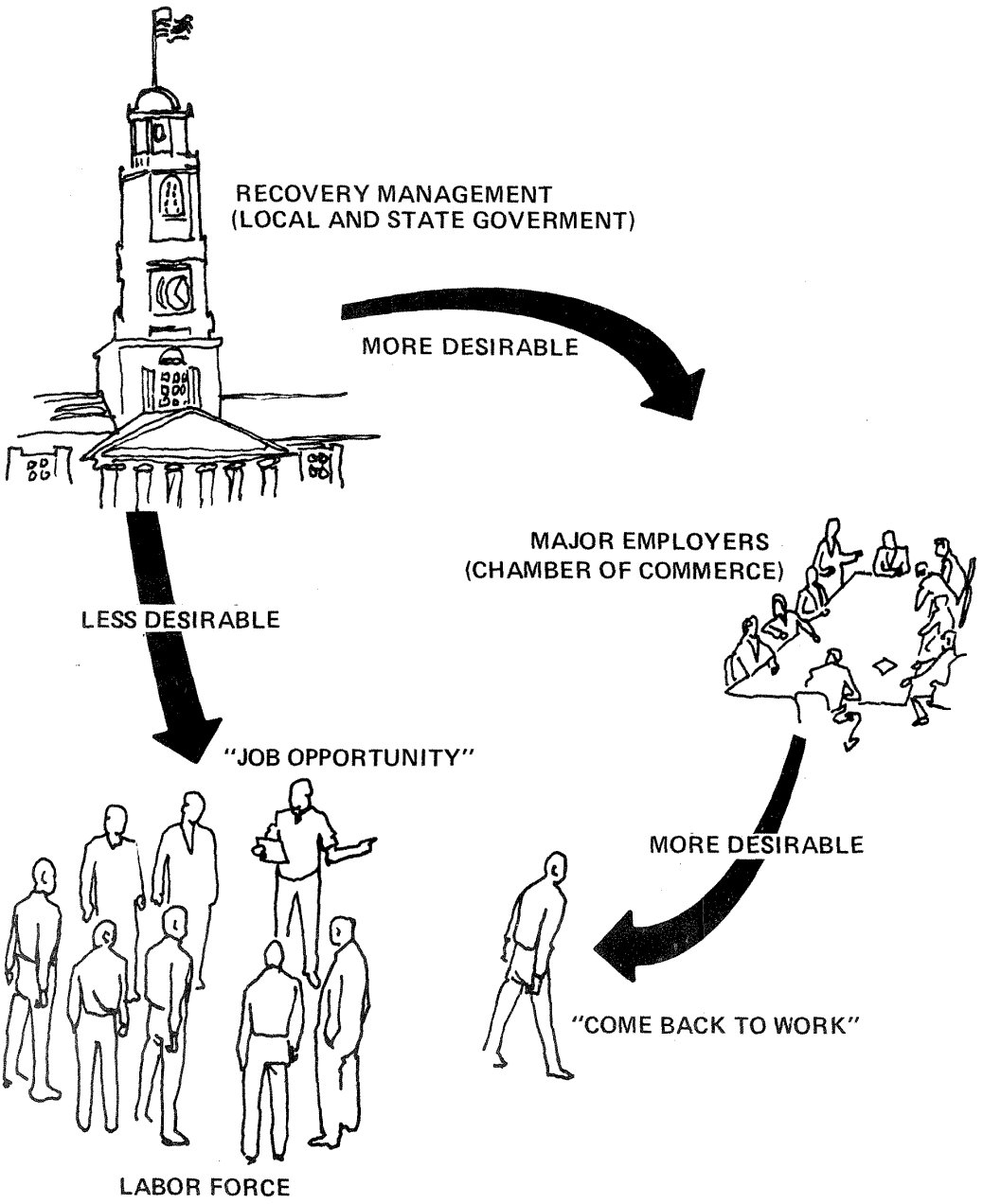
During the most peacetime disasters, certain organizational activities cease to be important--an industrial plant may be closed for the duration--while the workers often are expected to engage in "emergency" or unusual activities. They may help rescue victims or care for refugees. They and their families may use different lodgings, supermarkets, or stores. But these changes are usually temporary. When things "return to normal," most affected people are once more performing work and consumer activities that closely approximate their predisaster routines of living. In sum, the disaster is over when most organizations (and therefore their employees) again are operating as part of larger networks of organizations and institutions.

In contrast to peacetime disaster, a widespread nuclear attack would damage the entire system of interlocking organizations. Postshelter relationships often would not be the same as before the attack. In other words, there would be less of a "normal" pattern to return to.

The emergency planner should understand that most family heads and, hence, families, "anchor" their daily lives around their job affiliations. In many respects, anticipating a "return to normal" means resuming the predisaster work affiliation. And this job affiliation is also the principal link between the individual and the organized distribution of work activities throughout the economy. After all, an early goal in postattack recovery management must be to reconstitute a routine procedure by which goods and services are produced, distributed, and exchanged. One means of achieving this goal is to emphasize organizational continuity during crisis and emergency periods.

A working organization can remain reasonably "intact" for a while even if it is not functioning. If damage assessment and planning eventually indicate that the organization has no place in the postshelter world, then employees can be systematically placed in similar work elsewhere. One should plan in the interim to maintain the communications link with the individual worker through the preattack work organization. Preserving the integrity of economic organizations-all of them, not just critical industries--is probably the most efficient approach to organizing the postwar labor force. The alternative--allowing people to lose their work identity and hiring more or less anonymous "workers" through employment agencies--is likely to make more difficult the psychological process of "returning to normal."

LABOR : EMPLOYED OR UNEMPLOYED



POSTSHELTER PROBLEMS IN DAMAGED AREAS

The information in chapter 8 to this point is broadly applicable to all nuclear emergency planning. In addition, there are some recovery operations that are peculiar to damaged areas. The next four panels deal with these operations.

The immediate survival needs at the time of initial shelter emergence would be water, food, accommodations. As radiation declines to levels permitting outside operations, the first step would be to establish number of "staging areas" as bases from which to conduct early operations and to which can be brought aid from the nearby undamaged areas. (The idea of using a staging area was first discussed in chapter 2, panel 27.)

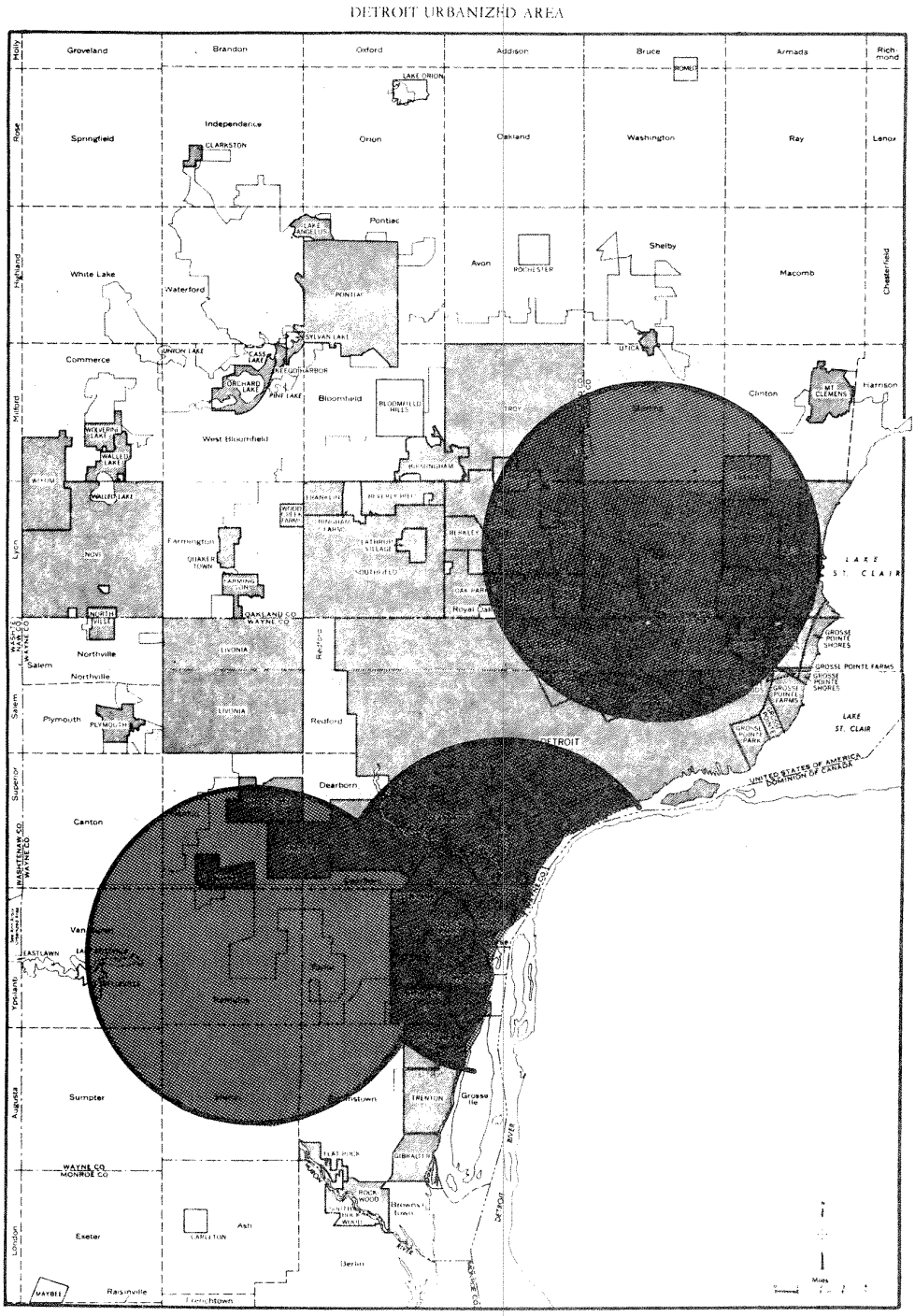
Routes would need to be cleared through the debris to permit vehicular access from the staging areas to the undamaged region; to the shelters where survivors were located; and to water, sewage, and power facilities.

Water, food, and medical aid may need to be provided to the sheltered population prior to the time that they could be relocated. At the appropriate time, survivors would be brought to the staging areas where buses would move the homeless to housing in the light-damage and undamaged areas.

Housing experiencing in excess of 3-psi blast overpressure generally would not be repairable for habitation. The areas in Detroit where housing would be lacking are shown here for the same attack presented in panel 4. Outside these areas, housing may need decontamination and some repairs. Utility services also may need restoration. In cold weather, broken windows would need to be covered throughout the metropolitan area.

Vital facilities would need repairs if such would permit early return to operation. Surviving equipment and materials in more heavily damaged facilities would need to be protected from further damage until they could be removed for use elsewhere.

Studies have been made that show that these initial postshelter recovery activities are feasible to complete in about 1 week, using surviving equipment and a fraction of the able-bodied survivors.



AREAS WITHOUT HOUSING - DETROIT
TARGET COMPLEX - THREE 500 KT AIR BURST WEAPONS
(SEE PANEL 4)

PANEL 27

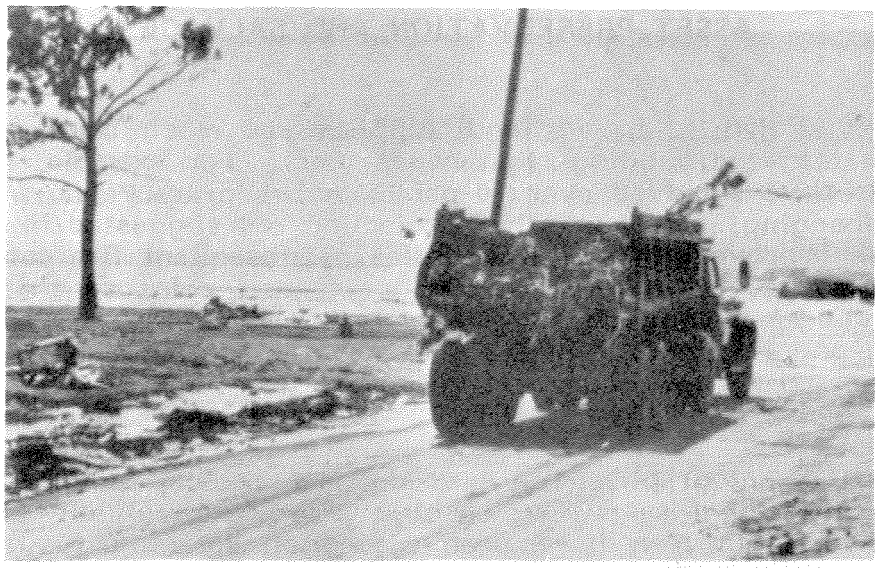
DEBRIS CLEARANCE

Clearing of debris is a common activity required after most natural disasters. In the aftermath of such disasters, contracts are let with private construction and construction firms who set to work cleaning up the mess, drawing equipment and equipment operators from as wide an area as necessary for the job. Some inefficiency can be tolerated because of the abundance of resources. The photograph, from Hurricane Camille, shows a truck loaded about one-quarter full, partly because the tailgate has been removed to ease the dumping process. Chunks of debris drop off the trucks in route to the dumping site; where, because of inadequate organization, they often wait in line to dispose of their loads.

Debris clearance after nuclear attack can draw on peacetime experience but research has indicated that efficient use of surviving construction equipment and manpower will be necessary if essential clearance is to be accomplished in a timely manner. Construction trade officials (Associated General Contractors of America) recognized this need and prepared "Plan Bulldozer" as an aid to local government. This plan was designed to mobilize construction contractors to furnish materials, operate equipment, and supply skilled personnel as long as necessary under the direction of civil or military authority in event of natural disaster or nuclear attack.

As noted in chapter 2, debris created by a nuclear detonation is expected to be distributed off-site where it would block access by wheeled vehicles. Clearance of streets would be a major postshelter task upon which most other activity would depend. Preattack estimates of probable debris conditions, supported by postattack reconnaissance, would be needed so that proper groups of equipment could be assembled to handle the task. The nature of the task, and, hence, the equipment required, depends on the size and content of the debris chunks, the general depth of debris, the extent to which automobiles, trees, and utility poles are included in the debris, the width of the road to be cleared, and similar factors. These factors have been analyzed into a limited number of basic tasks, for each of which appropriate "equipment groups" have been defined. A typical equipment group is summarized in the lower chart. This group is designed to clear the light structural debris, which may include chunks up to 30 inches in size. The group can clear 1,000 feet per 24-hour day of 50-foot roadway through debris 5 feet deep. The equipment codes shown are those set up in Plan Bulldozer.

DEBRIS REMOVAL



TYPICAL EQUIPMENT GROUP

1 Crawler-type Bulldozer, 250-300 H. P. (Code 286)

1 Front-End Loader (Side Dump) (Code 174)

2 Dump Trucks, 10 - 15 cu. yd. (Code 313)

1 Night Lighting Equipment (Code 602)

1 Tools and Supplies (Codes 620 and 621)

Supporting Resources Needed: Availability of fuel and lube truck (about 40 gal. of diesel fuel per hour), repair truck, equipment operators, and 2 unskilled laborers per shift.

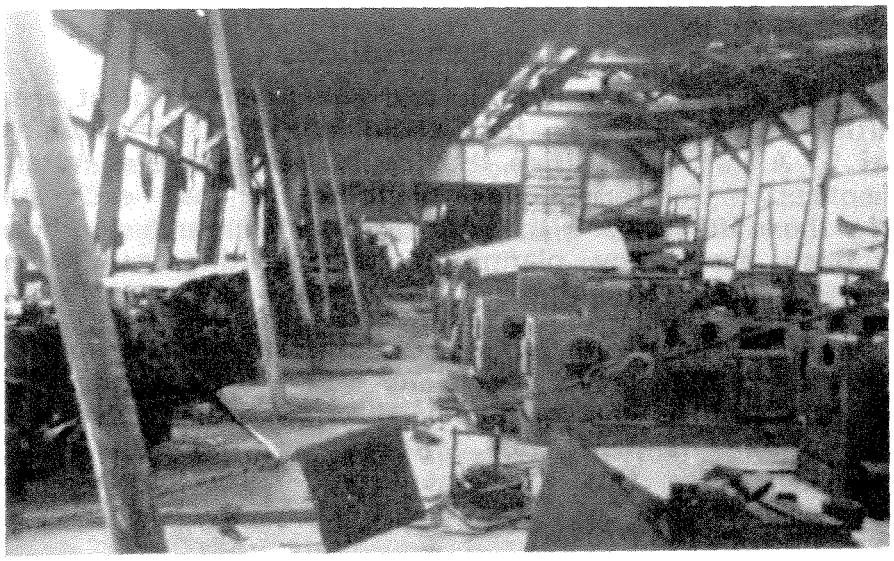
Source: Reference 25

ASSET PRESERVATION AND SALVAGE

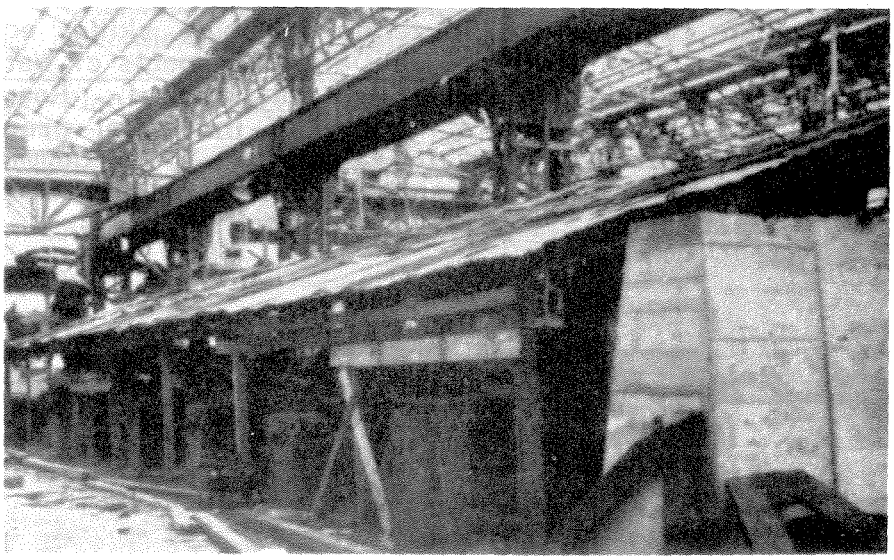
Most production equipment and supplies are much more resistant to blast damage than the buildings that house them. For example, heavy-duty machine tools have survived over 10-psi blast overpressure during weapons tests. Sandbagging, burial or other protection, as suggested in chapter 2, would greatly improve survival possibilities. Subsequent fire can warp and melt delicate parts, as well as remove grease and paint so that corrosion can occur. Corrosion and rusting of neglected assets caused much damage at Hiroshima and Nagasaki. On the other hand, much damage was avoided by protective actions taken during the first few weeks after the detonations.

The upper photograph shows a wood-frame machine shop with windows and roof damaged by blast. The machine tools are essentially undamaged. Sheets of corrugated iron have been placed on some of the machines to protect them from the weather. The lower photograph shows a more advanced form of weather protection in a Nagasaki industrial plant.

As soon as feasible after shelter emergence, work parties should be formed from employees of commercial and industrial concerns in the damaged area. These teams should conduct an assessment of damage at each work site to determine whether the facility is operable or can be repaired. Surviving equipment should be coated with grease (usually available on the site) and covered by tarpaulins or sheets of stripped roofing. Supplies may be removed for immediate use or preserved on site, depending upon their nature. Salvage of usable equipment and supplies will probably be appropriate in residential areas as well. There will be a need for surviving beds, mattresses and bedding, canned good, cooking utensils, water containers, and the like.



Undamaged machine tools at Hiroshima. Sheet metal is being used to protect against weathering.



Arrangement of temporary weather protection in Nagasaki industrial plant.

EMERGENCY REPAIRS

Assessment of damage to buildings and equipment in blast areas should be limited initially to structures that could be used for housing and to "vital facilities." A list of facilities that could be considered vital is shown here. An implication for emergency planning is that each jurisdiction should identify those facilities within its boundaries, such as those on this list, and establish emergency planning and operating relationships with managers of those facilities under private ownership.

Damage assessment should be accomplished by plant engineers and operators who know the facility. Decisions would usually have to be made as to whether the facility can be repaired or whether salvage of usable equipment and supplies is preferable. Repair requirements would need to be estimated. Generally, this assessment would be feasible in over 90 percent of the damaged area by the second week after attack.

Congress has included in the definition of "civil defense" all activities and measure designed or undertaken to effectuate emergency repairs to, or the emergency restoration of, vital utilities and facilities. To assist emergency planners in preparing to undertake these actions following an attack, research has been conducted to define the likely nature of damage to most of the vital facilities on the list, the best repair procedures and strategies, and estimates of repair requirements in terms of labor, skills, equipment, supplies, and time. On such study, Civil Defense Aspects of Water Works Operations, has been republished and widely distributed. Results from others have been incorporated into a variety of industrial preparedness manuals prepared in cooperation with the Departments of Commerce and Interior. Some of the most useful research reports are listed in panel 31, Suggested Additional Reading.

VITAL FACILITIES

- Water Works and Distribution Systems
- Sewage Collection and Treatment Plants
- Electric Power Distribution Facilities, including substations, transformers, and switching stations.
- Telephone System
- Public Safety Radio Transmitters
- Petroleum Refineries and Pipelines
- Natural Gas Production and Distribution
- Food Processing Plants, especially grain mills and canneries, Food Container Factories, and Warehouses
- Chemical Plants, especially producers of fertilizer, insecticides, and disinfectants
- Plants Producing Other Survival Items
- Defense Production Plants
- Air, Rail, Truck, and Water Transportation Facilities

SUGGESTED ADDITIONAL READINGS

As with initial survival itself, much of the planning and preparations for coping with the postshelter environment must be done in the local jurisdiction. In other words, if you, the emergency planner, do your job well, the survivors need not "envy the dead." The sources shown here provide additional background on the material in this chapter. Those with an "AD" number are available from the National Technical Information, Service, U.S. Department of Commerce, Springfield, VA 22161.

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7. Brown, S. L., et al, Agricultural Vulnerability to Nuclear War, Stanford Research Institute, February 1973. (AD 765 725)

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