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C. D. Little Harbor Report

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Contents

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In addition to publishing articles which reflect Canadian Government policy the Digest may also publish articles by private individuals on subjects of current interest to the emergency measures programme. The views of these contributors are not necessarily subscribed to by the Federal Government.

Editor: A. M. STIRTON

THE QUEEN'S PRINTER, OTTAWA, 1969

C.D. LITTLE HARBOUR REPORT

Part One of a Report to the U.S. Atomic Energy Commission by a Committee of the National Academy of Sciences

From time to time the average citizen is confronted with an awful realization that he lives in a world where nuclear weapons do exist and war has not yet been outlawed. He is then apt to wish for a cool and logical analysis of just where he stands on the possibilities of survival.

Much of the information which goes into print contains elements of factual distortion, slanted objectives or emotional bias. It is therefore a welcome occasion to receive a cool and logical analysis of the basic defence issues together with their related economic problems. The "Little Harbor Report" and its predecessor "Project Harbor"' are of this type and are recommended as informative reading.

Canadian readers should realize also that Canada has the option of putting more effort into civil defence activities without in any way disturbing the balance of threat and counter-threat between the greater powers. Nor does this defence option involve this country in mutual defence programs which may become progressively more expensive.

The Little Harbor Report is an unabashed application of common sense and simple arithmetic.

BURKE STANNARD,
Scientific Adviser
Canada E.M.O.

Foreword

The question of whether our nation should mount and maintain an effective civil defense against major nuclear attack has been illuminated by a variety of studies conducted both within and without our federal government. Opinions of highly qualified specialists are divided on the wisdom of committing substantial national resources in an effort to reduce the loss of life and the essential functions of our society.

The National Academy of Sciences has responded to requests of the government to assist those federal agencies which are charged with the responsibility for the national defense. In particular, it has enlisted the services of a dedicated group of individuals who have attempted to bring up to date the findings of the Project Harbor Study of 1963. The results of this effort, reported in the following pages, reflect the group's belief in civil defense as a necessary complement to our military defense. The decision as to whether the actions and programs suggested should be taken involves judgments of a complex kind which are only in part scientific or technical in nature. It is our hope that this report will aid those persons concerned with such decisions in formulating their opinions.

Whatever the decision, the Academy and the national government are indebted to Dr. Wigner and his associates for their useful contribution to these difficult problems.

FREDERICK SEITZ
National Academy of Sciences

Preface

In March 1967, at the suggestion of the Director of Defense Research and Engineering, the Atomic Energy Commission requested the National Academy of Sciences to review and update the Project Harbour Study on Civil Defense. The Harbor Study was sponsored by the Office of Civil Defense and carried out under the auspices of the National Academy of Sciences in the summer of 1963. About 60 scientists (both natural and behavioral) and engineers participated in the six-week study. The final report came to over 600 typewritten pages; its distribution was very limited. A summary report, NAS-1237, was issued and had a wider distribution.

I had the honor of assembling the group to be entrusted with reviewing and updating the 1963 report, and I wish to express my gratitude to my collaborators for the sincerity of their efforts to grapple with the many thorny problems of civil defense and for the unstinted nature of their collaboration. I am especially grateful to Richard Park of the National Academy of Sciences and L. J. Deal of the U.S. Atomic Energy Commission for their constant

and unflagging help.

The members of the study group were:

Harold L. Brode, Physics Division, The RAND Corporation, an expert on modern weapons and their effects.

Lee Christie, System Development Corporation, social scientist.

L. J. Deal, Division of Biology and Medicine, U.S. Atomic Energy Commission.

William J. Hall, Department of Civil Engineering, the University of Illinois, an expert in structural design and the dynamics of blast.

Harold A. Knapp, Institute for Defense Analyses, defense analyst. .

William Osburn, Division of Biology and Medicine, U.S. Atomic Energy Commission, ecologist.

Richard Park, National Academy of Sciences.

John H. Rust, Department of Pharmacology, the University of Chicago, interested in problems of agriculture, health, and medicine, including biological warfare.

Sidney G. Winter, The RAND Corporation, economist. His interest in the problems of economic recovery antedates even the original Harbor Report.

John P. Witherspoon, Oak Ridge National Laboratory, ecologist.

Stephen B. Withey, Institute for Social Research, the University of Michigan, social psychologist. His principal research area is human behavior and public attitudes.

With twelve participants of very different backgrounds collaborating to assess the promise and the problems of civil defense, complete unanimity on every point was not to be expected. We have tried to indicate areas of disagreement in the text.

The study took place at the Oak Ridge National Laboratory from May 23 to June 3, 1967. We are indebted to the Director of the Laboratory, Alvin M. Weinburg, for his interest and for having extended the hospitality and many other courtesies of the Laboratory to us. The Civil Defense Research Project, under the direction of James C. Bresee, made available their library, administrative services, and other facilities. They also gave us a great deal of technical assistance. We are particularly indebted to Dr. Bresee, to Conrad Chester, and to Richard Uher for their help on many difficult questions.

Other consultants and observers were:

Milton Leitenberg, St. Louis Committee for Nuclear Information, represented the point of view opposing civil defense measures.

Julian Levi, Department of Social Sciences, the University of Chicago, advised on problems of urban development.

D. L. Narver, Jr., Holmes and Narver, Inc., advised on the effect of blast from nuclear explosions on structures and construction costs.

Lewis V. Spencer, Department of Physics, Ottawa (Kansas) University, advised on the thinking of the Advisory Committee on Civil Defense of the National Academy of Sciences.

Harry R. Woltman, Planning Research Corporation, advised on defence planning and urban development.

Briefings on the thinking and philosophy of the Department of Defense were given by:

Thomas S. Schreiber, Office of the Director, Defense Research and Engineering.

Robert Rosenthal, office of the Director, defense Research and Engineering.

Ivan Selin, Deputy Assistant Secretary of Defense (Strategic Programs).

The (then Acting) Director of the Office of Civil Defense, Joseph Romm; his Assistant Director of Civil Defense for Research, Walmer E. Strope; and his Deputy Assistant Director for Operations, William E. Crockett, briefed us personally on the policies, problems, and accomplishments of their office. J. M. Googin of the Oak Ridge Y-12 facility spoke to us twice on modern weapons as influenced particularly by the advent of the antiballistic defense installations in the USSR. We are sincerely grateful to all our consultants and advisors for their generous assistance and their patience and willingness in answering our questions.

EUGENE P. WIGNER
Director

Introduction and Summary

In reevaluating and updating the conclusions of the original Harbor Study, the committee did not consider the consequences of all the new circumstances one by one. Rather, our study—known among the participants at the Little Harbor Study—attempted to take a fresh look at the problems, possibilities, and reasons for civil defense. Naturally, the fresh look could not disregard the changed circumstances and these, as well as some changes in our evaluation of the old circumstances, are reflected in several modifications in emphasis and in some modifications in substance of the earlier report. In some instances we felt that the conclusions of the original report had become so generally accepted that they need not be repeated.

On the whole we were surprised by the continued validity of most of the recommendations of the earlier report. The following new or revised recommendations and conclusions reflect the most important changes that have occurred in the situation or in our thinking.

1. We now propose that most of the civil defense personnel who may be needed in an emergency not be fulltime civil defense officers in peacetime.

Rather, they should be personnel from state and local organizations, such as police and fire departments, who have responsibilities for dealing with peacetime emergencies. These persons should receive thorough training, enabling them to function effectively in wartime. This proposal is a significant departure from the civil-defense-cadre concept of the original Harbor Study and applies the dual-use principle to the manpower problem. It is further discussed in the chapters on Immediate Survival and Education and Training.

2. A larger number of people should be made aware of the problems that would arise in a nuclear war. In particular, the basic training of recruits to our armed forces should include instruction on the emergency operations necessary in case of a nuclear attack. The people so trained would substitute for, or at least complement, the Civilian Reserve Corps recommended by the original Harbor Report. This recommendation is further discussed in the chapter on Education and Training.
3. The significance of the relations between civil, or passive, defense and active defense, such as antiballistic missiles, is becoming increasingly apparent. It was not possible to study these relations in detail, much less to determine the combination of the two systems that would be most effective. However, the undertaking of such a study by a competent group of reasonable size is strongly recommended. (See, for instance, the Changes in Strategic Outlook chapter.) This recommendation is particularly appropriate in view of the recent decision to install a "thin" antiballistic defense.

All participants seemed to agree that the acquisition of a strong civil defense would require a large, well-coordinated, and many-faceted effort. It would also involve great expenditures. In a large-scale war, however, it would save an untold number of lives, would improve the morale of the people, and would reduce the severity of the after effects of the war. Most of us also think that, as an evidence of national resolve, a strong civil defense program would render the tactic of nuclear blackmail less promising. This will be discussed further in the Threat chapter. Lesser efforts toward civil defense would have similar effects but of lesser magnitude.

Changes in Strategic Outlook

Listed here are the most important changes in the military situation and some of the changes in the political attitudes which have occurred since the original Harbor Study was undertaken and which are likely to affect the problems of civil defense. As mentioned in the Introduction and Summary, the changes were not the basis for our deliberations; however, they may be useful when reviewing our new conclusions.

1. Confidence in antiballistic defense systems is increasing in the United States and the USSR, and both countries are currently installing some such defense. The significance of this development is emphasized by the way it has compelled our military planners to undertake extensive alterations of the armaments that comprise our retaliatory forces.
2. The interaction between active and passive defense, that is, between antiballistic missles (ABM) and civil defense, was only hinted at in the Harbor Report. Even now the connection is far from being well understood or evaluated with any degree of completeness. A complete evaluation would be of highest importance. Present evidence indicates that expenditures on civil defense would be at least as effective in saving lives as expenditures on presently conceived ABM systems, particularly at low levels of expenditure. However, active defense not only can protect the lives of people but can also enhance the nation's ability to recover from a war by limiting damage to buildings and industrial installations. In addition, the installation of an ABM system may force the opponent to alter his offensive weapons or his targets. The total weight of the ballistic missile capability of the United States is being reduced by the replacement of singly by multiple warheads, undertaken to counter the Russian ABM. Paul Nitze, Deputy Secretary of Defense, in his Congressional testimony (Nov. 7, 1967) gave a perhaps extreme example in which the total explosive power carried by a missile (and hence the total fallout created) would be reduced by a factor of 20. In his example, the area covered by any given overpressure is reduced to 29%. A similar reduction of the total weight of the attack against the United States would render our civil defense measures much more effective.
3. The importance of the problems of long-term survival and recovery after a nuclear war are increasingly recognized. Some of the questions that demand answers are: How should the emphasis of preparedness programs be apportioned between the problems of recovery and those of immediate survival? How would rate and assurance of recovery be affected by the distribution of the survivors in age and occupation? How would it be affected by the level of surviving industrial capacity? How long would it take to rebuild the country after a nuclear war? The answers will depend, naturally, on the magnitude of the attack, its aims and success, and the character and extent of the advance preparations to alleviate the consequences of any nuclear war. These questions will be discussed in the Recovery chapter more

fully than they could be discussed in the original Harbor Report or its Summary.

4. Since the federal activities related to urban affairs are concentrated in the Department of Housing and Urban Development (HUD), this department is the natural authority responsible for the passive defence of the cities. New construction and urban renewal projects could incorporate shelters as such or as dual-use components. Regardless of the choice, the installation of shelters would increase the total cost of the renewal project much less than would be the cost of an independent project of shelter construction. Current and tentative urban renewal plans should be examined in detail to evaluate the passive defense resources which they would create and to identify the components that could be converted to blast-resistant shelters of high quality. Advantages to both sides would be expected to accrue from an interchange of ideas between those parties concerned with passive defense and those interested in urban development. Urban planners may well keep in mind that nuclear weapons exist and that they are not likely to be abolished in the near future. New concepts and practices developed in the HUD programs may also contribute to the solution of some of the problems of post-attack recovery.

   The HUD and the General Services Administration could provide example and leadership for private builders to incorporate shelters into new buildings or at least to make later conversion into shelters possible. With such leadership and perhaps with other appropriate incentives, private construction, which will continue to exceed public construction by a wide margin, could add substantially to the realization of an effective passive defense.

5. The doctrine of "assured retaliation' has continued to gain importance in the past few years and appears to be a basic Department of Defense policy. This doctrine is, nevertheless, dependent on certain assumptions, some of which may be questioned now, while the validity of others may be impaired in the future. In particular, the doctrine depends on the full understanding and acceptance by the adversaries. Any doubt, justified or not, on the part of the adversary could lead to tragic consequences.

6. With respect to China, the doctrine of assured retaliation has been questioned in the Department of Defence. Underestimating Chinese nuclear war capabilities or the purpose and determination of the rulers of China could be catastrophic.

7. The absence of a true defense in the United States, i.e., active or passive protection rather than relation, may provide an added incentive for hostile nations to acquire nuclear arms; the less true defense there is, the more potentially effective are the opposing arms.

   The proliferation of nuclear armaments would raise additional grave problems for the assured-destruction doctrine. Retaliatory nuclear strike plans are less likely to be effective against multiple adversaries than against a single adversary, e.g., the coalescence of relatively minor nations into a single nuclear-armed bloc. Even without this type of alliance, the problem of correctly identifying which of several antagonists launched an attack could seriously compromise the doctrine.

8. An important and somewhat hopeful change is the relaxation of the intensity of the feeling of enmity toward our system of government and economic structure by large segments of the population of the USSR and her satellite countries, particularly by the intelligentsia.

   Unfortunately, our study group remains uncertain whether the more sympathetic attitude is shared by the leaders. The tone of official publications, including civil defense publications, remain consistently hostile and is often quite aggressive. The same attitude is present in the satellite countries.

   The magnitude of the effort to increase the armaments of the USSR, both offensive and defensive, is also alarming if considered as an indica- of the attitudes of the decision makers.

   For the purposes of the Little Harbor Study, it is well to keep in mind that the installation of effective active and passive defense systems would take years; a change in the attitude of our opponents' leadership may become manifest within hours.

New Weapons and Weapons Effects

The committee has reexamined the 1963 Project Harbor conclusions concerning the likely hazards and kinds of weapons to which the U.S. population could be exposed in the event of a large-scale war. Many new weapons of tactical significance exist, but so far few have shown applicability to massive attacks against a whole population. Nuclear weapons still appear to be the most serious threat to life in such attack, and the general features of a civil defense system designed to protect against nuclear attack should remain useful in spite of any changes in weaponry in the next 15 years.

This judgment is in agreement with the 1963 conclusions. In addition to restating some of those conclusions, we have added in the following paragraphs a further assessment of the more significant changes anticipated in weaponry and the implications of these changes as far as civil defense is concerned.

The nuclear powers are expected to acquire weapons

of even greater efficiency. The bulk of the future missile threat could consist of missiles with warheads of tens of megatons each. Furthermore, new and larger missile systems could be developed and made operational in five or six years, so that, if called for by Soviet planners, a few weapons in the 100-Mt class could become available.

The development of an effective antiballistic missile system has been vigorously pursued in both the United States and the USSR for several years. The current installation of such defense around Moscow is one sign of this development. The response to the deployment of active defense is expected to result in a decrease in size but a multiplication in number of the attacking missiles. Thus, to saturate the defense, an attacker faced with an effective active defense might replace a large-yield weapon with several weapons with much smaller yields. Their total explosive power might be only about one-tenth that of the single large warhead. Because of the greater dispersion, however, the area of potential blast destruction would be reduced much less than the total yield is reduced and would remain comparable with that of the original single warhead.

Another response to an effective defense might be an attack with very large-yield weapons, which could cause fire and blast damage even if the weapons burst outside the range of the defense system, perhaps at very high altitudes. An enemy could also explode his weapons outside the protected region, using surface bursts to create fallout on the cities. Such attacks, however, would not be very effective against a sheltered population.

New attitudes about appropriate targets are likely to develop as the number and efficiency of nuclear weapons available to an attacker grow. With many weapons available, an attacker may be willing to throw large numbers of weapons at a single defended target, or he may contemplate nearly complete destruction of his enemies' offensive forces; with lesser forces he might consider attacking just the population.

Attack with *biological agents* against the U.S. population would be much less effective than a nuclear attack. The delivery of biological agents involves difficult logistics, and their effectiveness is subject to large uncertainties introduced by weather, countermeasures, and the varying susceptibilities of populations. Biological attacks upon food animals, either in conjunction with nuclear attack or alone, may not be as difficult; although feasible, animal protection, e.g., shelters with air filters, is not likely to be available at the time of attack.

Chemical agents are far less effective per pound of weapon than nuclear weapons, and they do not share the infectious nature and thus the persistence of biological agents.

Very *large explosions deep in the ocean* could cause waves hundreds of feet high when breaking along hundreds of miles of shore or continental shelf. The coastal inundation could cause extensive damage and loss of life, but both would be very much less than the loss expected from explosions of similar magnitude in closer proximity to the harbors or cities under attack. Shelters capable of providing protection from direct attack would have to be designed, however, with due consideration of this so-called "Tsunami-wave" threat if they are located in low-lying coastal areas.

Large fires might necessitate temporary isolation of shelters from heat, smoke, and noxious gases in the outside air. Provision for such isolation, "buttoning up," should be contained in the plans for blast shelters since it does not seriously complicate their design. In general, asphyxiation and heat exhaustion of people in shelters are not anticipated to be major dangers.

The *thermal flash* from nuclear detonations is capable of starting fires that can lead to large-scale wild-lands conflagrations but only under the special conditions of weather, season, and topography that would favor the spread of fire. It is unreasonable to fear that most of our woodland would be denuded by fire or radiation because weather conditions favorable for spreading fire rarely occur simultaneously over very large parts of the country. Radiation, both prompt and fallout, can neither cover all areas with doses lethal to all species nor prevent all regrowth of the many species known to revive after burnover or radiation exposure.

Fires from large-yield explosions can occur over large areas (1000 square miles from a 10-Mt burst), but the spread of fire into further areas is generally slow. Aside from occasional short spurts, the average rate of spread is about 500 ft/hr, and the extent of spread is seldom more than 5 to 10 miles in any direction, even in areas of plentiful combustibles. In many suburban areas and in most rural areas, fires will not spread at all, and damage is likely to be limited to isolated fires.

Even in urban mass fires the number of casualties has usually been small. Casualties may rise, however, when blast damage accompanies and aggravates fire problems. In the absence of blast shelters, persons could be trapped in or under collapsed buildings and become fire casualties. Similarly, persons driven from shelters that do not provide fire protection could be exposed to other effects.

The most widespread lethal effect of nuclear explosions remains the radiation from fallout, the effect against which protection is least costly. In addition to the sources or danger that have been considered so far, radiation, heat, and blast, the strong transient electromagnetic pulse accompanying nuclear explosions can cause both temporary disruption and permanent damage to electronic systems and to power grids at fairly large distances from the burst. Shelters should, as much as possible, not depend on external power sources, and consideration should be given to minimizing the damage and injury that may affect communication and power equipment.

At distances from the burst point where the blast pressure is above 15 psi, there is an additional hazard from impacts of crater ejecta lofted by the strong updrafts resulting from multimegaton bursts. Shelters below ground with some earth cover, however, face no high risk from this threat.

Immediate Survival

Introduction

The term "immediate survival," as used in this report, includes the problem of protecting people and property during nuclear attacks and of ensuring their survival for periods of days to weeks following an attack; some of this time may be in shelters. Warning, protection against immediate effects (radiation, blast, fire), supplying the essentials of life, communication and control, morale, maintenance of law and order, and preparation for recovery operations are also considered under this heading.

The conclusions in the 1963 Project Harbour Summary Report were reexamined in the 1967 Little Harbor Study. Most of them were still valid. The following discussion includes restatements of those that have been significantly changed or on which added information is available, such as those dealing with manpower requirements and with shelter-construction cost estimates. The most important conclusions from the 1963 Summary are repeated with minor changes.

The Program

A valid program of protection against the immediate effects of nuclear and other types of weapons must contain short-and long-range goals. The planning should consider local factors, e.g., whether the area is rural or urban or in the vicinity of a possible military target. It should be fully compatible with enlightened peacetime planning and with military planning, and it should include, in particular, plans for active defense. The lead time for most major programs is usually long. Hence, additional consideration should be given to the possibility of crises that may occur before the completion of a reasonable civil defense system.

Federal responsibility for the common defense implies responsibility for the protection of the lives of the civilian population, just as it implies responsibility for deterrence and offensive capability. Under conditions of modern warfare, civil defense cannot be divorced from other forms of defense. At the highest level, all defense policies should be coordinated, as they now are, by the Department of Defense, although the implementation of the policies would and probably should continue to be entrusted to appropriate state and local organizations. However, the development of principles, the coordination of planning, the allocation of funds, and the resolution of problems created by local governments are all responsibilities that the federal government must recognize and assume.

The national civil defense program should be summarized in a handbook designed for the layman, similar to the existing pamphlet, *Fallout Protection*, but containing information on all direct effects of nuclear weapons. The handbook should be made widely available at little or no cost to the public. It should contain information on the long-term effects of nuclear weapons, the recovery from these effects, and the national policy. It should also contain detailed recommendations for procedures in an emergency in terms of improvising or seeking available shelter above or below ground when one cannot take advantage of public civil defense facilities. The handbook should be of high quality, regularly upgraded, advertised, and distributed.

The operation of a civil defense system, e.g. planning, communication and control, shelter management, and maintenance of law and order, during the immediate survival period requires a large and skilled manpower pool. All these demands cannot be met with single-purpose civil defense professionals. Rather, most of the manpower must come from such sources as police and fire departments; it may have to be augmented by the National Guard and other military units. In effect, the dual-use concept must be applied to most of the manpower requirements of civil defense operations. This concept will be further discussed in the chapter on Education and Training.

Present Civil Defense Organization

At present, the responsibility for planning civil defense and for executing these plans is widely divided The amendment to the Federal Civil Defense Act makes civil defense a joint federal – state responsibility. As a result, the organizational structure of civil defense is quite complicated and has no well-established lines for communications and decisions.

Most of the planning is done by federal agencies, but much of the execution of these plans is in the hands of state and local officials. Since the federal government cannot order or force the state and city authorities to execute its civil defense plans, the actual level of preparedness shows large variations throughout the country. The control of the federal agencies can be exercised only by imposing conditions for the allocation of civil defense funds. Even when state and local officials wish to cooperate, the complex organizational setup often causes difficulties.

The responsibility for civil defense is widely distributed also within the executive branch of the federal government. The Office of Emergency Planning (OEP) in the Executive Office of the President is responsible for the general coordination of plans and procedures, but it has no operating role. The Office of Civil Defense (OCD) in the Office of the Secretary of the Army is responsible for most operating functions within the federal government. Some of the emergency preparedness functions are, however, assigned to other federal departments and agencies in keeping with their statutory and traditional responsibilities. About 30 departments and agencies have civil defense functions, and the Federal Civil Defense Act discourages the Office of Civil Defense from duplicating functions of other federal agencies. In an emergency, or-

ganizations that had only planning functions in peacetime may have to assume operating roles, and this new role may lead to serious difficulties. Manpower at the "doing" level of civil defense comes largely from the state and local organizations that customarily handle emergencies. The police, fire, and health departments are the most prominent, augmented by other community and public-utility employees, and supported by the National Guard and the federal armed forces.

With regard to quantitative requirements for civil defense operation, approximately 5400 full-time civil defense officials plus 2800 man-years/year of part-time and volunteer people man the regional, state, and local civil defense offices. In an emergency this force could be greatly increased by police- and fire-department personnel, thus adding some 800,000 emergency professionals. As a reserve force, the National Guard and the Army Reserve might be called on for another half-million men, already disciplined and organized. The training of these groups is discussed in the chapter on Education and Training.

The most effective way of meeting the requirements of warning, evacuating, sharing of resources, and similar functions would require a unified command; our committee is concerned that such a command is lacking. Closer liaison between the policy-determining organizations and the local organizations and an effective flow of information from the OCD and the military command offices to the local units (and vice versa) appear to us very important.

Types of Shelters

The main element of physical preparation for civil defense is the equipped shelter. For convenience of discussion, four general classes of shelters are distinguished and tabulated below:

TYPES OF SHELTERS

Class	Overpressure protection, psi	Protection from fallout radiation*	Protection from initial radiation*	Remarks
I	100	10,000	1000	Provides protection from fire and hot rubble plus emergency escape
II	30-50	200	100	Provides fire protection
III	10	100	10	
IV	None designed specifically	$\geqslant$40		Primarily fallout protection only

*Protection is described in terms of a protection factor (PF) which gives the ratio of the radiation intensity in an unprotected location to that in the protected area.

Most present shelters, identified by the National Fallout Shelter Survey, are Class IV shelters. Structures already available have been adapted and marked, and some of them stocked, as fallout shelters.

Upgrading Shelters

Possible approaches to upgrading our present shelter position are:

1. The fallout shelter identification system can be made more effective by surveying residential and nonurban areas to determine capability and capacity for accommodating the population at night as well as during daytime. Such a program is now underway, in part, through the Home Fallout Protection Survey (HFPS).
2. Since a fully developed system may not be available at the time of need, the handbook described earlier should illustrate methods for constructing hasty shelters capable of resisting at least low blast pressures and capable of being constructed by the average citizen in a relatively short time with materials at hand. Such shelters would not provide as much protection as a permanent shelter but would offer considerably better changes for survival than the average home or small structure.
3. There should be a survey of existing shelters to locate those that already are, or can easily be converted to, Class III shelters. The conversion should be carried out if economically feasible. The upgrading of existing shelters to withstand overpressure in excess of 10 psi is limited, in general, to shelters below ground; and even here, generally, upgrading above about 30 psi will be quite costly.
4. Protected storage depots for food, medical supplies, and recovery hardware, including equipment, supplies, and provisions for decontamination, should be established throughout the country. These depots may be associated with currently operating industrial, utility, and hospital facilities and should be capable of serving during an attack and in the postattack environment. The depots should also house vehicles that can be operated during and after an attack to enable maintenance of order outside shelters, to engage in minor fire fighting, to help in evacuating people where required, and to maintain communication.
5. On the basis of system studies and national goals, aciton should be instituted for incorporation of Class I, II, or possibly III shelters into new buildings as they are constructed, and incentive payments should be provided as necessary. If this plan is implemented, most new shelters will be useful also in peacetime i.e., they will be dual-use shelters. The slanting* of such construction to provide 10-psi protection would require only nominal additional cost. However, as protection is increased beyond this pressure, the structural

*"Slanting" is a general term denoting incorporation at low cost of certain architectural or engineering features into new structures or, alternatively, making possible quick structural alterations to improve protection of people and supplies from the effects of an attack.

costs will increase significantly, whereas the cost of incorporating the necessary facilities will not increase greatly. If one wants to postpone this additional expense, blast protection, e.g., added shoring, special doors, etc., could be provided when an emergency arises.

6. Information should be provided for individuals, corporations, and groups who wish to undertake private construction of shelters in the absence of, or delay in, federal action on such programs.
7. Information should be provided to permit provision of protection for farm livestock and other commodities to the extent possible. This could be coupled, if necessary, with offering incentives for the implementation of the program recommended.

New Shelters, Single and Dual Purpose

The possibility of improving the protection provided by present shelters should not obscure the fact that even more complete protection could be provided if a program of building new shelters were inaugurated and if new public facilities, such as underground transportation and communication systems, were so designed that they might be converted to shelters in periods of emergency.

The cost of new single-purpose shelters is difficult to estimate until a formal policy of desirable features has been set. Single-purpose shelters can range from low-cost, austere, isolated units having manually operated doors, manually driven ventilation systems, buckets for sanitation, two-week-stay capability, to the more elaborate interconnected systems with automated doors, rest rooms, air condiitoning, medical facilities, a month's stay capability, etc. Because of the number of persons to be protected, the cost of shelter systems will represent a large sum. Therefore, an austere system affording the desired protection with a minimum provision for human comfort is the most likely one to be adopted.

The following table gives cost estimates for the relatively austere single-purpose shelters. The estimates are based on present-day technology and include engineering and inspection costs but omit real estate and stocking costs.

COST/SPACE

Size of shelters	100 psi	50 psi	10 psi
100 spaces with 10 sq ft/space	$600/space	$500/space	$400/space
1000 spaces with 10 sq ft/space	$300/space	$270/space	$220/space

These cost estimates are considerably higher than those given in the Harbor Summary ($300 and $175, respectively, for the 100-psi case), but they do not necessarily contradict them. The present estimates are based on current technology, which makes the estimates more reliable; the costs given in the Harbor Summary assumed improved techniques and mass-production methods. The cost of a Class I shelter system, which according to the Harbour Summary would assure the survival of 80% of the population in case of a 3000-Mt attack, was based in the Harbor Summary on a cost of $267 per shelter space.

Dual-purpose construction, which appears quite feasible, would require significantly less federal, state, or local investment than would single-purpose shelters. Dual-purpose-shelter costs are difficult to estimate because of the latitude possible in ascribing the relative share of total cost to the different uses. However, the civil defense increment can be expected to be less than the cost of single-purpose shelters, although the total cost of dual-purpose construction might well be significantly greater than the cost for providing for either of the purposes individually. Further advantages of dual-purpose shelters are the probable reduction in upkeep and maintenance expenses and the more efficient utilization of space.

As an example of the cost of a particular shelter system, the cost of the interconnected-tunnel-grid system, described in Oak Ridge National Laboratory reports, is about $400 per person. This shelter system includes automated doors, rest rooms, air conditioning, a month's stay capability, and 100-psi protection. About $150 per space of the $400 is the cost of construction, the rest, i.e., $250, is for ventilation, refrigeration, sanitation and food-preparation facilities, and similar items. The possibility of tunnel breaching may require blast doors at selected intervals and would increase the cost slightly. Certain utility and service ducts, on the other hand, could be incorporated into such a shelter system in a dual-use service and thus reduce the cost charged to civil defense.

Protection by Blast Shelters

A Class I shelter protects its occupants against the blast from a 1-Mt weapon exploded straight overhead at 5000 ft or higher or from a 10-Mt weapon at 11,000 ft or higher. The corresponding altitude for a 100-Mt weapon is about 20,000 ft. Weapons would have to be exploded at an even lower altitude to cause the maximum number of fatalities. The area in which the Class I shelters would be breached by an explosion at the worst possible height is less than one-tenth of the area in which Class III shelters would be breached by an equally large explosion at a much greater height.

Prototype Systems

For acquiring a more complete understanding of the problems connected with the operation of shelters and for ensuring that no significant factor in their design has been overlooked, prototypes of both single- and dual-purpose shelters should be built and staffed. A certain amount of additional research would have to be undertaken before this pilot-plant operation could be most usefully executed. At the same time, a moderate shelter-upgrading program could be undertaken.

In the absence of a prototype system, the results of

computer studies of highly idealized shelter programs can be accepted only with reservations at best. Although model shelter studies are required for national planning, detailed system studies necessarily will have to analyze the regional and local situations.

Urban Structure and Vulnerability

The trend in the distribution of the population in the United States is toward (1) an increase in the fraction of the people living in metropolitan areas and (2) an expansion of the metropolitan areas to such an extent that the density of people inside these areas decreases in spite of the increase in their total number. The centers of cities for the most part exhibit either population stability or population losses, whereas suburban growth at much lower population densities proceeds. The composition of central-city populations continues to shift toward the socially and economically less-advanced groups. Provisions for guiding and controlling people in shelters in these areas may be more difficult than presently envisioned. This problem deserves study.

Since low population density in the suburbs tends to be reflected in building types, e.g., predominantly frame or masonry instead of massive concrete and steel construction, the average structural hardness of low-density areas is considerably lower than that of metropolitan centers. As a result, the fallout protection identified in existing buildings by past and continuing surveys is heavily concentrated at the centers of the cities where it may exceed the requirements for that area. In terms of civil defense needs, suburban areas require significantly more shelter space with blast and fire protection than now exists. The potential is high for incorporating dual-purpose shelters in schools, public buildings, apartment houses, shopping centers, other commercial and community structures, and as part of underground utility tunnels.

Recovery

Introduction

The problems of recovering from a nuclear war are more complex and not as well understood as those of protection against the direct effects of an attack. The latter problems are essentially, though not exclusively, physical in nature, whereas the more important problems of recovery are in the realm of economics and the social sciences and include the lasting emotional effects of having gone through a holocaust.

This chapter is divided into three parts dealing with economic, ecological, and medical-radiological problems. Physical problems, such as debris removal and decontamination, are of recognized importance but are not covered by this discussion. Social and emotional problems are not considered in detail either.

This review of postattack-recovery problems is structured somewhat differently from that in the original Harbor Summary. We concur with the main, though perhaps not all, conclusions of the Harbor Summary, however, and in particular are reemphasizing the first conclusion: continuing research is needed to define postattack problems in quantitative terms and to evaluate the relative effectiveness of proposed measures to alleviate postattack situations.

General Remarks on Recovery

Civil defense is not restricted to protecting the population from the effects of weapons. It must also ensure that the immediate survivors are not decimated because of failures to provide sustenance, to control disease, and to maintain order. It should also provide the prerequisites of recovery. Although the meaning of recovery cannot be made entirely precise, the dissolution of the United States as a political entity, indefinite continuance of standards of living close to subsistence levels, or the inability of the nation to cope with subsequent external threats would each clearly constitute a failure to recover.

The emphasis on problems of long-term survival and ultimate recovery should depend on the level of the total civil defense program and the range of threats at which that program is directed. At very low levels of expenditure, such as the present federal level of about $0.40 per person per year, the greater vulnerability of unprotected people compared to unprotected productive facilities warrants a high concentration on the survival of people. However, if all the population has good fallout protection and the urban portion has some blast protection, the amount and character of preparedness needed to complement this protection become quite sensitive to the level of attack on urban targets.

Economic Recovery

Up to a certain level of attack, the large preattack value of productive resources per capita provides reasonable assurance that recovery can be achieved if organizational problems and specific localized bottlenecks can be overcome. Accordingly, preparedness measures should focus on organizational arrangements and the identification and elimination of potential bottlenecks. As the hypothetical attack weight successfully delivered on urban targets is increased past the level of about 2000 Mt, extensive preparations become increasingly necessary to permit recovery within a reasonable period. Specific bottlenecks give way to more and more generalized scarcity of resources. If preparation were limited to organizational arrangements, an attack of 2000 Mt successfully delivered against a critical set of industrial targets might severely impair the ability of the economy to support survivors, and the ability of the nation to defend itself against further threats. The damage would

be aggravated by any further increase in the weight of the attack; and several critical industries might be virtually eliminated. Preparedness measures required at this threat level therefore involve extensive programs of stockpiling basic machinery and other items. Unless such preparations were made, the economic difficulties following an attack of the indicated magnitude against a well-sheltered population might vitiate the protection afforded by the shelters.

These generalizations relating preparedness measures to attack weights on urban targets are essentially a way of quantifying the obvious fact that the nation's industrial capacity is contained in a finite area and is much more highly concentrated than the population. It is also more difficult to protect than are people. No judgment as to the military feasibility or strategic plausibility of such attacks is implied. Judgments on these matters would obviously have to be on the basis of detailed consideration of the objectives, capabilities, and probable strategies of the two sides. In particular, the presence or absence of active defense, the reliability and retargeting capabilities of the attacker's missiles, and the stage of war at which attacks on cities occur will have a very significant bearing on the attacker's ability and intention to inflict a large and deliberately patterned damage on the economy.

Whatever the plausibility of multithousand-megaton attacks on urban targets, it is clear that for the present and foreseeable future a large range of possible contingencies remains in which much smaller attacks on urban and industrial targets could occur. Continuing programs of economic preparedness at the $0.5 to $1 billion per year level could make a very significant difference in the vulnerability of the economy to these smaller attacks. Such programs would effectively complement shelter construction and other programs if the latter were going forward at an expenditure rate of $2 to $3 billion a year. However, much larger expenditures would be necessary to protect the economy significantly against large attacks.

The present research base for a detailed analysis of economic-preparedness policies is seriously inadequate. Analytical tools now coming into use should produce important achievements. In particular, substantial refinement of the crude estimates already mentioned, indicating the levels of attack at which preparedness requirements rise sharply, should be possible within the next year or two. Identification of industrial sectors on which preparedness should focus will also be improved. Many areas of policy remain, however, where research and the formulation and execution of a program would have to go forward more or less simultaneously. Research is sometimes needed to make policy decisions, but in other cases research is more productive if some policy decisions have already been made.

Two Types of Economic Preparations

There are two types of economic preparations: those aimed at assuring the necessities of life until production of basic commodities can be resumed, and those aimed at facilitating the resumption of such production. The first type essentially buys time for the population to cope with its postattack problems, including the problems of resuming production. Hence, the more extensive the preparations of the first type, the less need for those of the second to achieve a given level of performance.

Preparedness measures in the first category have two great advantages which justify giving them primary emphasis in programs at the $0.5 to $1 billion per year level. First, they are inexpensive compared with measures in the second category. Second, their usefulness is comparatively insensitive to the level and pattern of attack. For example, large food supplies and quick restoration of electric-power distribution will enhance economic performance under almost any attack circumstances.

A spectrum of realistic plans for the restoration of some form of economic organization is needed to carry out preparations of either category. In particular, providing the two most urgent necessities of life, food and shelter, must not depend on the creation of organizations during the sheltering period or thereafter. In areas of heavy bomb damage, the various types of shelters will have to furnish the second necessity well in excess of the period of danger from enemy action. Citywide interconnected shelters would alleviate the problem of communication and render preparations to face a hostile environment outside easier.

The importance of distributing much of our food supply over the United States and of storing it safely and accessibly will be reemphasized later. Some plans for food-distribution centers at least should be made ahead of time. It is necessary also to prepare for the possibility that Washington may be hard hit and federal offices there may cease to function, at least temporarily. Current efforts toward these preparations should be greatly increased. Also, plans should be formulated for dealing with the difficult problems of restoring solvency, clarifying property rights, and reconstituting an exchange economy; these plans must offer reasonable promise of forestalling cumulative economic disorganization. All the plans should be tested by simulation exercises involving people who might actually perform these activities in the aftermath of an attack.

To date, planning for economic organization in the aftermath of nuclear attack has been based on the creation, as soon as possible after the attack, of an apparatus for government control of the economy rather more extensive than that which existed in World War II. It seems unlikely that such an apparatus could be created after attack in time to affect the course of events significantly when the survival of much of the population is at stake. The arrangements that would prevail during the crucial period remain very vague indeed.

Buying Time: Stockpiling

Even if surviving resources are generally abundant, some time to achieve viability will be needed, i.e., time to reorganize, to relocate population and resources, and

to solve a large number of particular problems of production. Rather than attempt to identify and solve all such problems in advance, preparedness policy should attempt to provide the survivors with enough time to solve the problems themselves. Time is bought by increasing the surviving inventory of consumer goods, of which food is much the most important component. Large, well-distributed, and protected food supplies would enhance recovery under all circumstances. They would make the resumption of agricultural production and the transportation of its products less urgent. By assuring the availability of the next day's bread, they would create more favourable conditions enabling people to devote their energies to rebuilding the economy.

In recent years, success in reducing surplus stocks of grains has substantially reduced the magnitude of the nation's most important reserve. As of July 1, 1967, roughly the time of the seasonal minimum, the national food supply represented about 19 months' requirement for the entire population. (It has greatly increased since then as a result of the good crop of last year.) The composition of the food supply, even assuming that it is properly located, which is not the case now, left a good deal to be desired. More than half the total was represented by feed-corn stocks.

A one and one-half year supply of food for the entire population at the seasonal minimum is probably an acceptable level. That supply, however, should be of reasonable composition. Not only should it meet reasonable physiological standards, it should also reflect existing consumption patterns. Such was not the situation in July 1967. Thus, in the case of feed corn, even allowing a tenfold increase over present per capita consumption of corn meal and other corn products, the corn would have outlasted all other food stocks.

Buying Time: Dealing with Disruption and Local Scarcities

Transportation, communication, and utilities share a number of important characteristics. They are clearly crucial to an effective utilization of production facilities of all types, to achieving effective economic organization, and to providing time to solve problems. The assessment of the total economic implications of a substantial attack on any one of these industries is simply beyond the state of the art in economic analysis and is likely to remain so for some time to come. Individual items of the networks involved are specifically located; e.g., a surviving bridge across the Ohio cannot readily perform the functions of a destroyed one across the Mississippi. An analysis which adequately reflects this fact must also reflect similar facts in all related economic activities. With the transportation system intact, the total capacity of the surviving steel plants matters a great deal more than their location. But, if transportation is badly damaged, both the locations of the surviving transportation links and the locations of the surviving steel plants become highly relevant.

Few of our industrial plants produce their own power; most of them rely on power furnished by utilities. Hence, the importance of restoring utility plants and their transmission lines. Preparedness programs should include, first, special shelter programs for workers and their families in transportation, communication, and utilities industries located close to the place of work; and, second, stockpiles of supplies, tools, and components needed for repair and patchup, the amounts determined by careful analysis of system vulnerabilities to a foreseeable range of attacks. In addition, consideration might be given to the creation of hardened regional emergency organizations prepared to handle a variety of crucial repair and patchup tasks.

The problems of utilities is partly alleviated, partly aggravated by the recent trend toward nuclear power: nuclear power plants are less dependent on fuel transportation than conventional power plants and are smaller. Hence they could more easily be protected. They could be operated for extended periods even if the transportation system were significantly impaired. On the other hand, unless they are protected, their destruction may result in the spreading of large amounts of radioactivity. The protection provided at present could be strengthened, for instance, by locating the plants underground in structures similar to those used in Sweden.

Transportation, and to a lesser extent electric-power generation, is dependent on supplies of gasoline and distillate. Stocks of these items are normally quite low, not more than a two- or three-month supply. Essential postattack demands would be a small fraction of current consumption rates, but a substantial fraction of stocks would be destroyed if petroleum refineries were hard hit in the attack. Thus, some stockpiling of refined petroleum products in dispersed locations is probably a high priority measure even at fairly low budget levels for economic preparedness.

Preventing Capacity Shortages in Critical Industries

Programs for dealing with over-all shortages can be considered only at high budget levels and on the basis of extensive analysis.

The identification of the most critical industrial sectors should be based on an examination of the path the economy might take to achieve viability after attacks which an adversary might be able to mount. What determines criticality is not just the level of damage or even the relation between surviving capacity and requirements, but rather the relation between supply and essential requirements after all feasible adjustments on both sides of that balance have been allowed for. Given a determination of critical sectors, the difficult and complex question remains of what measures, such as stockpiling end products, subsidizing underground construction by private firms, and stockpiling machinery or critical components, would afford the most preparedness at a given cost.

On the basis of existing knowledge, the following industries seem to be likely candidates for major preparedness programs: (a) Petroleum refining. Petroleum products are needed in transportation, agriculture, and power generation. In addition, the industry is sufficiently concentrated to be a logical candidate for selection by the enemy as a target. (b) Chemical industry. Chemical plants, especially those producing insecticides, pesticides, drugs, and tetraethyl lead, are potential targets. Tetraethyl lead is included because, in the event the refineries are destroyed, it could be used to enhance the octane of natural gasoline, which then could be used in place of refined gasoline. The other chemical industries are included on the grounds that essential postattack demands could easily be as high as preattack demands, but supply may be greatly curtailed. A similar supply to demand ratio may apply also to various other components of medical and public-health services.

Ecological Recovery

Although uncertainty exists about the severity and precise character of the long-term impact of a nuclear attack on our environment, particularly at levels of attack exceeding 10,000 Mt, no known effects would preclude ecological recovery. Man and many species of plants and animals have repeatedly demonstrated the persistence of species under highly adverse circumstances. The most devastating nuclear attack that the study considered, ground burst totalling about 12,000 Mt would leave areas of landscape surviving amidst destruction; smaller attacks would leave areas of destroyed landscape surrounded by less-damaged land. Many serious short-term environmental problems would result. Their severity is related to the timing and magnitude of the attack. Available knowledge indicates that advanced planning can be effective in enabling man, if protected by a shelter program, to emerge from his shelter to survive in a damaged environment and to cope with environmental problems.

Radiation Effects on Plants

Radiation from fallout can kill or otherwise affect many plants. Crop plants are damaged by exposures varying from 2000 to 35,000 r of gamma radiation, and this radiation may seriously affect the agricultural production in the year of the attack. However, the next crop should be essentially normal if viable seeds are available. None of the smaller, more plausible attacks could produce long-term protracted exposures from residual long-lived contamination sufficient to cause major damage to large area of the United States.

Radiation exposure of 1000 r would destroy coniferous forests, an exposure of 10,000 to 20,000 r would destroy a deciduous forest, and 20,000 to 40,000 r would kill a grassland. According to present information, even an attack of 12,000 Mt, ground burst, would not damage more than 10% of our forest land so severely that the recovery would take a period of the order of decades. Field studies in experimentally irradiated tropical rain forests, in several eastern hardwood and mixed hardwood and conifer forests, and also in the Pacific Islands damaged by weapons testing, have all indicated rapid recolonization by vegetation.

A reasonable conclusion, therefore, is that long-term ecological effects would not be severe enough to prohibit or seriously delay recovery. Areas of uncertainty that could be critical do exist, however.

One such area of uncertainty is the effect of beta rays from fallout particles. Present information is far from adequate. The committee advocates increased research effort in this area. Knowledge of the effect of beta particles upon food and forage crops is particularly meager. Beta rays seem to create a greater hazard than was originally supposed.

Radiation Effects on Animals

Domestic animals are killed by acute exposures of 500 to 1000 r. This is the $LD_{50/30}$, the exposure that has lethal consequences within 30 days for 50% of those subjected to it. Animals that receive sublethal exposures from external radiation and ingested radioactive elements would remain suitable as food, and many of them suitable for breeding.

Totally destructive insect plagues are not to be expected. Exposures 10 to 100 times greater than those necessary to kill birds are required to produce lethality in adult insects. However, insects in their larval stages are more radiosensitive than adults, and exposures high enough to kill birds would likely be lethal to many segments of insect populations. Insects are controlled by predatory insects, birds, insecticides, the availability of specific plants for food, weather conditions, etc. The interactions of these factors imply that radiosensitivity alone cannot be used to predict major fluctuations of insect populations. Field radiation experiments to date have shown no clear tendency toward a large increase of the insect population. Historically, the pine and spruce forests or the single-crop agricultural areas have been most vulnerable to insect attacks. Control of crop pests during postattack recovery may be primarily an economic problem involving the cost of insecticides, as it is now.

Fire

The spread of fires, as it affects people and shelters, was mentioned in the preceding chapter. The vulnerability of forests and agricultural land depends on their geographical, climatic, and floristic features. Whether or not large fires would result from a nuclear attack would depend on these features as well as on the mode and magnitude of the attack. Although some areas would be vulnerable, few large-scale forest fires would be likely. The increased flammability of vegetation killed by radiation, however, increases the fire threat in areas of heavy fallout.

Ecologically, fire is not always damaging in the long run. In fact, frequent fires are necessary to maintain certain grazing lands and pine forests. These aspects of fire must be considered in assessing total ecological effect.

Fallout and Residual Contamination

The problem of food contamination is restricted largely to contamination from two relatively short-lived fallout radionuclides, iodine-131 and strontium-89 (half-lives 8 and 50 days, respectively) and two longer-lived radionuclides, strontium-90 and cesium-137 (both half-lives 27 years). Although eating contaminated food is obviously preferable to starvation, both contingencies can be avoided if sufficient food is stored so that it is protected from fallout. Uncertainty still exists regarding the long-term effects of these radionuclides on plants, animals, and man. Continued research on this subject, as well as on the general subject of the transfer of radioactive nuclides from soil and water to plants, from plants to animals, and from animals, if they are eaten, to man, is highly desirable.

Countermeasures

Protective countermeasures against the immediate effects of nuclear war are more important at present than those against long-term effects. Current technology makes it possible to enumerate countermeasures that could be used to aid short-term agricultural recovery as well as the recovery of wild lands. However, the methods and cost of such measures cannot be estimated until we have a better understanding of second-order effects, such as the movement of soluble radionuclides in nature, erosion of land denuded by radiation or fire, and the time needed for natural repair and recovery mechanisms to become effective.

To minimize short-term problems and enhance recovery, the committee recommends that:

1. Existing or future civil defense organizations formulate plans and train personnel in environmental defence.
2. Seed, insecticides, and basic agricultural equipment be stockpiled.
3. Existing agencies responsible for erosion control, watershed protection, and reforestation familiarize themselves with postattack problems and possible countermeasures.
4. Food stocks not be allowed to drop below an 18-month supply, and local and state planning authorities become familiar with the locations of the stockpiles.
5. A study be undertaken on the possibility of using jobless migrants for conservation operations and preparedness measures in areas where postattack problems are foreseen.
6. Current research on the behavior of fallout particles and beta radiation in land and water systems be continued to arrive at better estimates of radiation effects and contamination. A real-time monitor – warning system for fallout should be studied for feasibility.

Medical Recovery

It is important that the medical program for the postattack period be carried out with close attention to the changing military and civil defense needs. We wish to reemphasize the importance of continued attention to the following tasks:

1. Plans and continued research on interacting secondary disaster medicine, human rehabilitation, and animal diseases likely to result from the disrupted economy.
2. Development of a variety of plans for the medical care of economically distressed and displaced persons.
3. Estimation of the consequences and the possible means of alleviation of changes in food patterns and in the availability of essential varieties of food. In particluar, attention should be directed toward the deficiency diseases which may develop during protracted periods of deprivation. The problem of feeding babies during the critical immediate-postattack period when hazardous amounts of radioiodine may be present in milk should receive added thought and attention.
4. Support for and encouragement of vaccination and immunization programs for the diseases of man and food-producing animals, which may become a hazard either by reason of biological warfare or because of loss of ordinary public-health control. Where booster vaccines are known to be useful, they should be suitably stockpiled. The spread of many diseases can be prevented. Control or preventive measures other than vaccination and immunization should also be explored and considered whenever health plans are formulated. Diagnosticians and pathologists often show a lack of awareness in the recognition of diseases which are rare in our present circumstances but could spread widely as a result of population dislocations caused by a nuclear attack. An educational program to make them aware of and able to recognize the diseases in question might well be instituted for physicians and veterinarians.
5. A study of the economics and logistics of vaccine, antisera, etc.; producers; pharmaceutical manufacturers; and the fabricators of medical equipment and instruments should be undertaken to identify bottlenecks that may develop during a disaster. Such bottlenecks may well be caused by the particular location of the industry or the short supply of key items or because a foreign source has been closed. Alternate sources of supply or

(Continued on page 17) **HARBOUR**

EMERGENCY BROADCASTING SYSTEM

Prepared by the Office of the Director of Special Projects,
Canadian Broadcasting Corporation

Concept

In the event of a National Emergency it is imperative that Canadians be warned and informed as quickly as possible. We are in an age of communications which in itself has created orderly patterns of listening to radio and watching television in the home as a form of relaxation and source of information. These habits have been recognized and employed in establishing the guiding principle of the Emergency Broadcasting System. Radio and television are part of our daily lives, with the result that during times of special interest or emergency the individual reacts by turning on a radio or television receiver to find out what is going on, or to satisfy the need for information of an immediate nature. Radio network broadcasting was appreciated during the early days of civil defence planning and considered most essential for the development of an Emergency Broadcasting System. For this reason broadcasting has been allocated top priority as the primary means of disseminating warnings and instructions to the public.

Coverage

Broadcasting in Canada today reaches roughly 98.6 per cent of the population. Any improvement in coverage by the installation of new radio stations would only increase the percentage by a fractional amount. The E.B.S. has been in operation since 1962 and currently involves nearly 900 licensed AM and FM radio and television stations with a capability to provide emergency warnings and other information. The interconnecting network arrangement for emergency broadcasting takes the form of provincial configurations which provide for decentralized control by those in charge at Regional Emergency Government Headquarters. Each emergency provincial headquarters will be located in a shelter to provide protection against high-intensity fallout radiation. The emergency radio control studios in these shelters are complete with technical equipment to provide provincial emergency measures organizations the facilities for co-ordinated broadcasting to the public.

The original Emergency Broadcasting Plan asserted the need to protect key high-powered radio stations associated with the regional control studios. This was accomplished by a program of "hardening" essential transmitting stations in Alberta, Saskatchewan, Manitoba, Ontario and Quebec. Underground fallout shelters with control and living accommodation were constructed at each location and the station equipped with standby generators ready to take over in the event of electric power failure.

These regional broadcasting stations cover a population of more than fourteen million people at a "hardening" capital cost of $750,000 dollars. The cost for this protection is less than half-a-cent per person. The "hardening" of these key radio stations was completed as the first stage of a three-phase program to provide a factor of survivability within the Emergency Broadcasting Plan.

Planning

The second phase of the planning program was appraised during the 1967/68 Project "PHOENIX". A five-year program was established to develop additional protection of radio stations operating in the areas of high risk from fallout. This region of heavy fallout extends in a pattern along the St. Lawrence Seaway system from Windsor, Ontario, through to Halifax, N.S.

The population of Canada residing in the region of possible heavy fallout is roughly thirteen million people. The Province of Quebec has two radio stations in the "hardened" category to provide simultaneous bilingual service — CBF for coverage in the French language and CBM for English broadcasting. These two stations cover the population of Quebec in the high-risk area along the St. Lawrence River.

In Ontario, radio station CBL transmitter has been "hardened". It provides coverage to a population of four-and-a-half million people in the high-risk southwestern and central sections. A limited portion of the eastern section of Ontario extending from Kingston to the Quebec boundary has a population of some two million, but has not yet been protected by survivable radio stations. A similar situation exists for the extreme southwestern part of the province. This factor has been studied, and stations in these areas will be considered for protection in the second phase of the program of "hardening" selected radio stations.

The third phase of the Emergency Broadcasting Plan has been studied in the overall emergency broadcasting plan of providing fallout protection to other selected radio stations in Canada. This study has evolved a program of priority for stations in lower-risk regions with a criteria established for non-duplication of coverage and overlapping broadcast patterns.

Warning

In wartime all national telecommunication systems, including radio and television, will be controlled by the Emergency National Telecommunications Organization (ENTO), a body formerly responsible to the Minister of Transport, but to be transferred to the authority of

the Minister of Communications. Under the authority of ENTO, the CBC has been delegated the responsibility for developing, organizing and operating the Emergency Broadcasting Plan through the facilities of all AM and FM radio and television stations in Canada, both public and privately-owned. The government authority for licensing of radio stations informs each station that it will automatically become part of the Emergency broadcasting System and that the CBC will arrange for connection and the installation of an alerting device. This device is installed in the main control room of each radio or television station to warn that emergency broadcasting is in progress. The emergency alerting system is tested bi-weekly and all stations must report on the operation of the unit to a central agency for appraisal and maintenance purposes.

The operational procedure of the warning system is predicated on official messages through the NORAD organization to the Federal Warning Officer and the Canadian Forces National Survival Attack Warning System (NSAWS). The activation of the National ATTACK WARNING system means that the Federal Warning Officer has confirmed that an enemy attack ôn North America is taking place, or an attack is imminent. Under NSAWS instructions the Federal Warning Officer and Provincial Warning Officers notify the CBC by direct line to activate the Emergency Broadcasting System. The CBC immediately issues emergency network orders through direct communication with the Trans-Canada Telephone System and to key CBC locations that the Emergency Broadcasting System has been ordered into operation and to immediately broadcast the National ATTACK WARNING announcement.

The operational procedure only takes a matter of minutes for the Emergency Broadcasting System to reach full broadcasting capability. All stations in Canada must, under law, discontinue local programming and switch to the Emergency Broadcasting System for unified and offiical announcements. Radio broadcasting will be the instrument to provide immediate service for survivability under wartime conditions.

Systems

The Emergency Broadcasting System is in a continuous state of physical readiness through the permanent connection of all broadcasting stations to the emergency networks. The existing CBC English and French Networks, connecting CBC-owned and privately-owned stations affiliated with a CBC radio network, are the backbone of the coast to coast emergency radio system following the pattern of normal CBC day-to-day operations. This system covers Canada from Victoria, B.C. to St. John's, Nfld., and north to Inuvik and Dawson in the Northern regions. It also connects other radio and TV stations into the network configurations by microwave and landlines so that a saturation readiness capability can be automatically established. Normal CBC network programs are fed to all non-affiliated private stations in Canada by the permanent emergency line connections for the purpose of monitoring the program circuit which would carry the emergency broadcast messages.

Planning for network broadcasting in war has proved most beneficial during peacetime crises wtih the Emergency Measures Organization utilizing systems to provide instruction and information in time of disaster. As an example of this capability, during Manitoba Flood emergencies of 1966 and 1969 an emergency network of all Winnipeg and area radio stations was established, with other provincial stations connected when necessary.

Since March 1968, in order to reduce operating expenditures, the emergency radio system faces a period of reduced state-of-readiness during the night when CBC stations sign off and key control stations are not manned. There would be a delay in re-establishing technical operations which, during a time of imminent attack, would result in some delay in instituting the ATTACK WARNING announcements. In the event of an indicated build-up of wartime climate the network and stations would, in all probability, establish 24-hour operation for news and information programs, and a full state-of-readiness would be in effect.

Existing network facilities have a closed radio circuit connecting all provincial control studios to a Federal control in Ottawa. This provides for simultaneous broadcast of Federal announcements over all radio stations without complicated network switching.

All network broadcasting circuits are routed and controlled by Trans-Canada Telephone System provincial centers who, upon receipt of an emergency order from the CBC, all circuits within a province will be automatically switched into a provincial configuration with studio broadcasting controlled from the key provincial CBC location or, if time permits, from the protected REGHQ. The emergency provincial control studios are completely equipped to carry on broadcasting until such time as normal broadcasting is resumed and are connected to the "hardened" key transmitters (referred to in Section 2) by safe-routed circuits which by-pass likely target areas.

ATTACK WARNING messages and survival announcements have been pre-taped and are held in a ready position at all Federal and Provincial peacetime and emergency broadcasting control locations. The content of emergency broadcasting will take several forms depending on situation needs. There are three prerequisites for using broadcast facilities: First, the alert or warning function; then the instructive or advice phase for survivability; finally, information and news of a general nature.

Personnel assigned to the broadcasting function in emergency government control studios will be CBC employees — specialists in their work assignment, such as news editors, announcers, technicians and administration officers, all with a working knowledge of network broadcasting operations. These people will work in co-ordina-

(Continued on page 27) **BROADCASTING**

AGRICULTURE PLANNING COURSE

by
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Emergency Measures, Canada Department of Agriculture

Agriculture is a vital industry in Canada under normal conditions; after a nuclear attack, food production would become even more vital. It is extremely unlikely that an enemy would blanket Canada's entire food-producing land mass with nuclear blasts. Instead, an attack would centre on key locations within the nation and large areas would be left untouched. These are the areas where Canadians would be called upon to deal with the emergencies that follow nuclear warfare, where the surviving population must turn to for its salvation. One of the first things they would look for is an adequate supply of wholesome food. That's why all agricultural emergency planning and training is geared to one overall aim — the production of an adequate supply of wholesome food.

There are two things about Canadian agriculture that must be understood. First, there is a tremendous variation in the type of farming that is conducted in Canada. In British Columbia, the Fraser River Valley has a lush growing season and produces a high percentage of Canada's frozen vegetables. There is a prosperous dairy industry in the valley. A few miles away in the Okanagan Valley, farm production features tree fruits, mainly apples. There are other British Columbia valleys that are almost exclusively devoted to beef cattle production. Moving east, Alberta has a huge cattle industry and a wide variety of crops such as wheat, barley and forages. There is also a growing vegetable industry based on irrigation. In Saskatchewan and Manitoba, there is more emphasis on cash crops such as wheat, barley, rapeseed and flaxseed. Manitoba's growing livestock industry features hogs, poultry and dairy herds. Ontario has perhaps the widest range of agricultural production in Canada. It includes everything — all forms of livestock, vegetables, cash crops such as corn and soybeans, tree fruits such as peaches and apples, and vineyards. Quebec features dairy production plus a wide variety of crops. The Maritimes have a huge potato industry and mixed farming. There are other special problems. For example, Newfoundland has several diseases that have not spread to the mainland because strict quarantines are enforced. In a nuclear emergency, should this quarantine be kept in force? These are some of the problems agricultural experts face.

The second factor about Canadian agriculture that is essential to an understanding of the nation's plans for an emergency is the nature of government. Agriculture is controlled by two levels of government — federal and provincial. During the past 100 years, a network of co-operation has evolved to make this Constitutional division of powers workable. In an emergency, co-ordination of agricultural planning and action in government will be vital. The provinces of Canada have jurisdiction over extension work in agriculture — getting information into the hands of farmers and helping them solve their individual problems.

This help ranges from advice on crops and livestock to advice on management and credit. The provinces, therefore, have established a network of extension experts who are in daily contact with farmers and are familiar with regional differences and problems. In an emergency it is likely that the farming community — including farmers and agri-businesses — will turn to these extension people for advice.

This is why the Canada Department of Agriculture has implemented a new approach to training personnel who would handle the emergencies of nuclear warfare. It was felt that the Department's energy, time and money were being spread too thinly in attempting to offer courses for a broad spectrum of people involved in the agricultural industry. Until this year, the Department offered orientation and introductory courses to personnel from both within and outside the provincial and federal government. Now training efforts are being focussed on the government employees who will be in key positions and who would be the agricultural leaders in a nuclear emergency.

As part of the planning for such an emergency, the Department has compiled computer data which identifies all federal civil servants involved in agriculture. The CDA knows precisely how many people it can call on in any region, what their training and background is, and what duties they could be expected to perform. This data is updated four times annually, or as required.

Besides having this information available for emergency use, it has been useful in the selection of candidates for courses. The level of training in emergency measures is part of the data that are kept on computer record. Referring to it the CDA can quickly and easily spot weaknesses and areas where more training is needed, both in terms of geographical regions and specialties. There is also a computer inventory of all CDA office space and resources, right down to the number of shotguns, if any, that are available at a Research Station. This inventory is updated twice a year. It could be obtained during an emergency both at central and local headquarters and it would provide agricultural personnel with an invaluable tool in coping with an emergency situation.

Emergency measures experts have estimated the condition of the country under 100 different levels of nuclear attack, varying from the heaviest to the lightest bombings considered likely. If a nuclear attack should occur, trained personnel could refer to these estimates and from them anticipate the type of emergency situation they would face immediately after — and over a long term — following the attack.

The CDA offers the new training course in both English and French because Canada is a bilingual nation. Each group averages about 40 people. Half are provincial civil servants and the other half federal government employees. To date, four week-long courses have been held at the Canadian Emergency Measures College at Arnprior near Ottawa, the nation's capital. Six courses are planned for the upcoming fiscal year, two in French and four in English. Experience gained during the first courses which were held from mid-January to early February will be useful in planning future course outlines.

The general aims of the course are:

- to assist the agricultural components of the regional, zone and municipal emergency government headquarters in the development of a capability to perform their emergency function.
- to introduce these components to the planning required at each level of the agricultural emergency organization.
- to introduce the principles and techniques of organizing, directing, training and operating their respective emergency units in a civil emergency.

The January course included reviews of the current nuclear threat to Canada, agriculture's emergency plans, advances in weapon effects and fallout, and the resources Canadian agriculture has available to cope with in a nuclear emergency. Lectures outlining the principles of planning for emergency operations, map using and emergency communications systems and their use, were other highlights.

One of the most valuable training sessions during the course resulted from discussion groups formed on the last day. Groups of students were each given a hypothetical war emergency situation and asked to work out plans of action as it would relate to their specialty and to a particular level of emergency government. The students used this session to apply the theory they learned during the week to a hypothetical situation. In some cases, discussion groups found serious loopholes in existing emergency plans for their provinces and zones. For them, the training was of immediate benefit because they took steps to correct the weaknesses in their emergency planning.

The CDA also learned that when students attend the course in a group — the same group that would be working together in the event of a nuclear emergency — the training course was more valuable. An outline of the type of emergency government organization that would be adopted in Canada will illustrate this point.

The top agricultural authority in each province would be the deputy minister of the provincial department of agriculture. He would have permission to supervise all federal agricultural programs in addition to his normal duties as head of the provincial department. He would have a team of advisors and helpers, including three federal civil servants and three provincial civil servants, each group of three served by one staff officer. At the zone level, the five men in charge would include a federal government veterinarian, a federal employee well-versed in provincial agricultural affairs, a provincial livestock specialist, a provincial field crop specialist, and a staff officer. At the municipal level, a veterinarian and a field supervisor would work with the Municipal Agricultural Emergency Measures Committee. Each unit must be able to act independently without help from other units during an emergency.

This organization would be responsible for farm production, including advice and guidance to farmers on the protection of farms, crops and livestock against such wartime hazards as radiation. Inspection and regulatory functions would be maintained to scrutinize the quality and wholesomeness of food, to assess its freedom from an unacceptable degree of radioactive contamination and to control plant, animal, and insect diseases. The organization would operate hand in hand with a detailed agricultural survival plan, predicated on the particular needs of the province concerned. Because these units are working together in an emergency, they receive the most benefit from the CDA training course if they attend as a group.

On the basis of the experience gained so far, the Department feels confident that the training course will help train key people to deal with the agricultural industry during a nuclear emergency. The Department thinks it is wise planning to create a top-notch pool of personnel to deal with such an emergency because, in an emergency, Canada's most valuable asset will be people. ▲

HARBOUR *(Continued from page 13)*

other means for speedy restoration of production should be developed.

6. The program of the Department of Health, Education, and Welfare to institute emergency hospitals and to equip existing ones for emergency service should be further encouraged. Preparations should be made for the repair, restoration, and decontamination of deactivated hospitals. Medical and paramedical institutions and schools must be reactivated to ensure an orderly replacement of medical personnel and technicians. It should be kept in mind that most medical and paramedical institutions and schools are located in the inner city and that their loss could place a serious burden upon the recovery process.

The final three chapters will be published in the next edition of the Digest.

NON-PROLIFERATION

Advancing nuclear technology is creating enormous political problems, not least because of its spread ot many countries. In this article, Leonard Beaton expressed deep concern at the dangers surrounding a projected international development of the gas centrifuge method of uranium enrichment. The leading editorial, from the same issue of The Times, takes up Mr. Beaton's fears.

Controlling the Atom Menace

by
Leonard Beaton
The Times, 23 January 1969
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The steady advance of nuclear technology is creating enormous new political problems. Nobody has yet worked out an effective policy to handle the spread of plutonium into many countries as a by-product of nuclear reactors supplying power.

It is true that an international inspectorate is being slowly developed; and the non-proliferation treaty should commit many governments not to convert their growing plutonium stocks into bombs. But the inspectorate is not backed by force, and a treaty signed by one government can be denounced by its successors. As the years go by, more and more governments will, on present arrangements, be given the basic materials for the kind of atomic bomb which the Americans used against Nagasaki.

While this problem is gradually becoming more disturbing and more obvious, the technologists are producing a new and far more menacing situation. It is being claimed that with a few years of strongly financed and vigorously managed development, the gas centrifuge method of enriching uranium can be made to work — and to work economically. As with nuclear reactors, this has important economic implications; but it has even more profound political and military risks.

Reactors produce plutonium and the Nagasaki-type bomb. But enriched uranium, which was the basis of the Hiroshima bomb, has also proved to be the appropriate material for hydrogen or thermonuclear weapons.

The fact that only five countries have decided to manufacture nuclear weapons so far may be due to a general lack of will; but one element in this undoubtedly has been the difficulty and expense.

The successful development of the gas centrifuge could change this situation. The export of centrifuges or the granting of licenses to build them would bring enriched uranium within the resources of many countries. The road to thermonuclear explosives would not then be long.

Uranium is a fairly plentiful mineral, though large and economical reserves are so far known only in Canada, the United States and South Africa (at a somewhat higher price, Sweden also has large reserves). Many countries have modest quantities, including France, India, West Germany, Portugal, Australia, and Argentina.

All of this natural uranium, however, consists of one part in 140 of the isotope uranium 235 and the other 139 parts uranium 238. A nuclear explosive can only be built if the U-235 can be largely separated from the U-238, which is very difficult because they are the same element and have the same chemical properties. The only important difference is that they are of slightly different weight, and to separate them an industrial facility must be built which can exploit the slight differences.

This was fully understood in 1940 and 1941, when it was realized that a nuclear explosive was possible using U-235. All the possible solutions were also understood (the centrifuge principle, for example, was being used in 1919). The problem was to find a solution which could achieve the necessary performance and reliability with the one gaseous compound of uranium which was suitable, uranium hexafluoride. This material happens to be exceedingly difficult to handle. The differences in behaviour between molecules containing U-235 and those containing U-238 are tiny: but the lighter molecules have a higher average speed than the heavier ones, the gravitational pull on them is slightly less, and in special circumstances the electric, magnetic, inter-atomic or intermolecular forces can be different.

Seven ways of exploiting these differences presented themselves in those early days, and it may be doubted if any more have been discovered since. Only four seemed suitable for uranium separation, and all were tried by the Americans between 1941 and 1945. One was the gas centrifuge — which, in essence, was a means of creating huge pseudo-gravitational forces and so exploiting the difference in weight between U-235 and U-238. But the force had to be very great and the machines had to be run very fast indeed for long periods without breakdowns.

A pilot plant was constructed and operated successfully, but the technology of the day was not adequate to the job. To get efficiency the rotors had to be four metres long, but the vibration problems when accelerating through certain speeds were too great and there were many other engineering difficulties. Rotors one metre long made the problem simpler. A complete plant on this basis, however, was thought to need more than 40,000 high-speed centrifuges, and to keep all these running at

once was inconceivable. The project was finally cancelled.

The British Maud committee, which reported in mid-1941, saw all this without experiment. Centrifuging, they said, was based on principles which had long been understood and could be easily calculated, but the high-speed centrifuge was still only a laboratory instrument and demanded too great a degree of precision in its machinery. Britain embarked on another solution, gaseous diffusion, which exploited the higher average speed of the lighter (and desirable) molecules. The British programme was finally absorbed into the American programme, and the Americans ultimately put all their uranium enrichment efforts into gaseous diffusion.

Britain did not try to enrich uranium in her early post-war weapons programme (which was based on plutonium). The Capenhurst gaseous diffusion plant was finally built, however, in the 1950s to make thermonuclear weapons available to the Royal Air Force.

Apart from its basic production problems, a gaseous diffusion plant must be very large and is not easily concealed. Its power consumption is on a scale which can only be described as unbelievable. Both first costs and operating costs are crushingly high.

It is not surprising, therefore, that no country has built one of these plants without the demands of a military programme. The Americans have three; the Russians are said to have two; France and Britain each have one small plant; and China is assumed to have one. Nobody else can enrich uranium. The prospect of a new and cheaper method of uranium enrichment should be seen in this context.

From what has been published about gas centrifuges it seems likely that their development costs will also be substantial and that the development effort might still take from three to five years. Once the plants for producing the machines have been built up, however, the centrifuge method of uranium enrichment may differ from gaseous diffusion in important respects. In the first place, it seems that the electricity cost will be only a fraction of that required in a diffusion plant.

Secondly, centrifuge cascades can work on a much smaller scale and so can be progressively built up over a period of time. This also means that they could be easily concealed. Thirdly, it is likely that a centrifuge designed to do the early stages of uranium enrichment — that is, what might be needed for nuclear reactors but would not be adequate for explosives — could be adapted for the higher enrichment stages. The centrifuge could therefore greatly simplify the problem of uranium enrichment for many countries. To say this is to say that the problem of building hydrogen bombs would also be greatly simplified.

The fact that uranium enrichment has been so difficult and so costly has had important implications for civil nuclear reactor development. The Americans, with their large enrichment capacity, have designed their nuclear reactors around uranium with between 2 per cent and 5 per cent U-235 (the rest being U-238) which means a fair amount of enrichment over the 0.7 per cent of natural uranium. Britain, France, Sweden and Canada built their first generation reactors around natural uranium.

Now, however, there is a strong conviction that the next generation of reactors will use enriched uranium and quite enormous figures for the requirements are being quoted. The United Kingdom Atomic Energy Authority is particularly anxious to be able to offer the complete range of services to customers: reactors, natural uranium, enriched uranium, plutonium separation and so on. Britain's gaseous diffusion plant has been modernized to do low enrichment work, but the capacity is too small in relation to the present hopes for the market. The AEA believes that the provision of enrichment is the weakest link in the British chain.

It should be said that this argument is by no means unchallenged. There is a school of opinion which believes that the future lies with plutonium and the breeder reactor, which will produce more plutonium than it consumes. If this comes on as rapidly as its advocates hope, it could divide the converging streams of H-bomb and power station technology.

At the moment, however, powerful economic interests are seeking uranium enrichment facilities, even with no thought of H-bombs. In the Netherlands, in West Germany, and more recently in Britain, these interests have been proclaiming that they are within sight of conquering the problems of the gas centrifuge. Major work has also been going on in Japan, and some work in Australia.

With the occasional bursts of energy with which they try to assert continuing responsibility for an international order, the Americans have tried to discourage centrifuge development.

When it was first suggested some years ago that progress was being made in designing workable centrifuges in the Netherlands and West Germany, there was an insistent American demand that the work should be done in secret and subject to stringent security. This was reluctantly accepted. It now appears that serious work was also going on in Britain, although this had not been generally known. British and Dutch interest is undoubtedly economic rather than military. It is reasonable to conclude that in the German, Japanese and Australian cases there is an inevitable temptation to provide the capacity within the country to produce nuclear weapons should this be decided by some future government.

In this situation, official conversations have begun by three governments — the British, Dutch and German — 'to consider the possibilities of establishing collaborative arrangements for the exploitation of this method of uranium enrichment'.

The collaborative arrangements could be of many different kinds. Dr. N. L. Franklin of the Atomic Energy Authority, writing in The Times Business News on 10 January, mentioned three possibilities:

1. The exchange of research and development information.

2. The establishment of an international organization for the development, design and manufacture of centrifuges or centrifuge plants.
3. The international construction and ownership of plants for the sale of enriched uranium.

Passing information opens the question of secrecy both for the near future and for the distant future — when the material facts will be as true as they are now. Finally, there is the export policy which each country will pursue for enriched uranium and for the centrifuge machines themselves. It may be doubted whether an exchange of information could involve any binding commitments on these issues.

International manufacture of the machines themselves, or of the plants to manufacture them (following a joint development programme), suggests a determination to export. Success in this would spread around the world the capacity to enrich uranium.

A decision to construct jointly owned plants for the sale of enriched uranium was suggested by Dr. Franklin as the ultimate possibility in collaboration. This would seem much less dangerous, however, than the sale of the machines, as long as the technology is kept secret. Uranium enriched up to perhaps 5 per cent is of no value in itself for bombs, and a country which did not have a centrifuge plant or a gaseous diffusion plant would not be able to take it the next stage on its own.

A joint plant of this kind seems to be the main objective of the British Government at present. In their first stage, it would probably not be built on West German soil (for obvious reasons), and the Netherlands might be the compromise solution. Over a period, however, the first plant will appear in retrospect as a pilot plant where the technique was proved. In the second phase, other participating nations which still had a requirement for enriched uranium might expect to build their own plant. The collaboration might then die away.

Neglect of the national implications of international collaborative agreements especially when it is thought that a new Europe is being helped along, has been characteristic of the British Government's approach to European agreements on advanced technology.

The British approach to the dangers of gas centrifuge development, as to those spreading plutonium around the world, is based on faith in the political power of the non-proliferation treaty.

What the treaty provides is that nuclear explosives should not be transferred from or to any signatory — and that is not in question. It also provides that signatories should have their peaceful nuclear facilities inspected. They can accumulate immense stockpiles of enriched uranium or plutonium provided that these are inspected; and the treaty neglects the possibilities for diversion and (much more important) for its denunciation at some later date.

The Government regards this as the best treaty that can be achieved in the present circumstances. That is a difficult case to dispute. Clearly, however, the issues raised by a decision to put resources and skill into the development of gas centrifuges demand not that the treaty should be the best available, but that it should be adequate to the weight being thrown on to it.

The distinction has not emerged from any of the indications of the Government's thinking now available. The treaty is being used to dispose of the brutal political and military realities, and the whole question is being presented as commercial and technological. This follows the precedents set in the export of nuclear reactors.

It remains to ask what policy would be open to a British Government which accepted the security implications of what it is doing and which thought these more important than possible (though by no means certain) financial gains from centrifuge development.

Who Shall Have the Bomb?

The Times, 23 January 1969.
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The problem of nuclear proliferation must start from the point that the past twenty-four years have seen five different nations independently achieve a military nuclear status. This total will certainly increase by as much again, if not more, during the next generation, unless some new influence is brought to bear on both the political and technical factors involved. It is not easy to isolate any particular aspect.

The Non-Proliferation Treaty mainly recognizes the political considerations without introducing strong enough rules to govern all the technical factors involved in the spread of nuclear knowledge. But the technical aspects of nuclear proliferation have anyway been bedevilled, perhaps beyond repair, by the artificial criteria which have been applied to the question whether or not a nation is a nuclear power in the military sense.

Unfortunately, the first nuclear explosion is still accepted as a reasonable moment at which to acknowledge a country as a nuclear power. But the development of nuclear technology has already become so diversified that these distinctions between nuclear and non-nuclear now no longer apply. Possession of an explosive device is only one stage, often far short of the ability to deliver that same device on to a target. But non-nuclear countries, as they are called until they have detonated such a device, often possess as broadly based nuclear industries and technologies as nuclear ones, and it is too late to inhibit their military pretensions long before they reach the explosive stage.

Mr. Leonard Beaton has written previously about the dangers of allowing an disciplined increase in the number

(Continued on page 28) **NON-PROLIFERATION**

C.D. IN THE U.S.S.R.

by
Joanne Levey

Reprinted from Survive, an American Journal of Civil Defence, Vol. 2, No. 1, January-February 1969

An American specialist in Russian civil defence — and Russian culture — unveils the intricate pattern of a highly systematized Soviet survival plan. Mrs. Levey's exhaustive research includes first-hand study and analysis of over 60 Russian publications.

Why Study Soviet Civil Defence?

The Soviet Union does not rely wholly on its ballistic missiles to deter enemy attack or to defend against such attack should it occur. Thus, in addition to ballistic missiles, it has two other arms of defense: an antimissile defence system and a civil defence program.

United States opponents of a solid civil defence claim that such a program would be provocative and ineffective. Evidently, the responsible circles of the Soviet Union do not think so. Let us see, therefore, just how effective the Soviet civil defence program is. And why is it important for us to know this? If Soviet military strategists could protect their urban population from the effects of nuclear weapons either through substantial urban blast shelters or preattack evacuation to rural areas plus fallout protection on arrival, they would have a decided strategic advantage over an enemy that could not do likewise. The Soviets, for obvious reasons, do not emphasize this in their unclassified literature. But they do indeed make other claims for the strategic importance of civil defence. Civil defence makes it possible:

- To mobilize the armed forces during the initial period of war;
- To support troops with equipment and weapons as the war runs its course; and
- To protect and repair industrial, transport, and communication facilities.

Unclassified Soviet military literature abounds in articles on all areas of civil defence; thus, to read a fair amount of this material is one way of getting at least a layman's sense of the Soviet civil defence program — its scope, its quality, and its emphasis. Such a reading, admittedly, does not reveal the exact number of Soviet shelters or their effectiveness. Yet even in areas such as these, certain clear-cut inferences may be drawn. For example, the abundance and extent of shelters is inferred when numerous articles instruct people to go to the nearest shelter on receipt of the "Air Alert" signal and indicate further that such shelters exist everywhere that people live and work so that when they hear the signal, they may take cover quickly.

ABOUT THE AUTHOR

In searching for a qualified writer to do an authentic study on Soviet Civil Defence, Survive found its solution at the Oak Ridge National Laboratory, Mrs. Joanne Levey of the Oak Ridge Civil Defence Research Project has been under contract with OCD and the Atomic Energy Commission for the past two years to help organize civil defence research literature and information retrieval. From this will develop a computerized national civil defence information center. As an avid student of Soviet literature for over twenty years, Mrs. Levey found Soviet civil defence publications a fertile source of information for American civil defence analysts.

Aims of the Soviet Civil Defence Program: An Overall View

Civil defence in the Soviet Union encompasses — at least in some degree — all aspects of protecting the population from the consequences of enemy attack and involves every citizen from top party officials to the man-in-the-street. The program is endorsed by both the Central Committee of the Communist Party and the Ministry of Defence and is implemented through an enormous organization which reaches down into every region, city, village, collective farm, and industrial establishment. While the Soviet civil defence program represents a massive effort, it is not a crash program; its strength is cumulative, lying in a steady attempt to expand and upgrade every facet since its inception, in its present form, in 1961.

The basic objectives of the program are:

- To safeguard the population from nuclear, chemical, and bacteriological weapons;
- To protect industrial installations and maintain production;
- To protect agricultural resources; and
- To undertake massive rescue and reclamation operations to liquidate the effects of an attack as quickly and effectively as possible.

More specifically, protection of the population is achieved by:

- Building shelters;
- Providing the population with individual means of protection (such as gas masks and protective clothing);
- Evacuating the population in the event of escalating crisis;
- Training the population to make use of the available means of protection;

- Warning the population and the national economic establishment of attack;
- Conducting rescue and repair operations in stricken areas;
- Rendering medical aid to the injured; and
- Preventing panic.

Civil Defence — No Matter of Controversy

There is little question about the inportance of civil defence in the Soviet Union. "Defence of the Socialist Motherland" includes both active and passive defence and is regarded as everybody's business — party and government, armed forces and civilians. It is not a matter for debate, partly because the Soviet system of totalitarianism discourages controversy, and also because many Russians living today have had firsthand experience with enemy attack on the homeland during World War II. People who have pulled incendiary bombs out by the fins and seen Red Square on fire and the Kremlin ablaze "have been there before." They need no convincing.

A Trained Population

Civil defence training in the Soviet Union is compulsory and universal. Everyone is exposed to it — school children in grades five through nine, both in classrooms and in summer camps, pre-draft-age men in military-sport camps and in educational institutions, industrial workers at their places of employment, and members of collective farms. There is multiple exposure in that civil defence is publicized at movies, on radio and television, and in magazines, newspapers, and factory publications. Civil defence courses are tailored to the needs and ability of the trainees. Farm children, for instance, are taught how to protect cattle, forage, food and water supplies as well as themselves. Factory employees learn rescue and reclamation operations and ways of reducing the vulnerability of their shops. All Russians are trained to identify and make the appropriate response to the seven warning signals (Air Alert, All Clear from Air Alert, Threat of Radioactive Contamination, Radioactive Contamination, Chemical Attack, Bacteriological Contamination, and Threat of Flooding). They are also instructed on how to respond to surprise attack and to the pre-attack government order to evacuate their cities. Instructions are specific and concrete. For example, if at home when the "Air Alert" is given, citizens are told to get together individual protective equipment (gas mask or dust mask, raincoat, and rubber boots), close the windows, turn off heat, gas, stoves, and lights; take the previously prepared supply of food, water, and personal documents, and head quickly for the nearest shelter, warning their neighbors (who may not have heard the signal) on their way out.

Realistic Exercises

Soviet civil defence training for male youth and adults puts emphasis on going into disaster areas almost immediately after attack to perform rescue and reclamation operations. They are taught to use cranes, bulldozers, and other heavy equipment to dig people out of caved-in shelters, to build emergency passageways in buried shelters, to extinguish fires, to administer first aid, and to evacuate the injured. Training exercises for these complicated operations are realistic with actual protective clothing and heavy equipment being used. Realism extends in other program areas to the simulation of chemical warfare agents from inexpensive materials available in any drugstore and to the practice evacuation of the mothers and newly delivered babies of a maternity home to a kindergarten 37 kilometers away.

Detailed Plans

Besides being realistic, civil defence plans are thorough-going. Soviet military literature describes, for example, plans to protect the employees of one large industrial enterprise having 57 buildings. The plant director has arranged personally with the help of his civil defence staff to settle all plant personnel in the country if international crisis should develop. Plans have been made to billet these workers and their families in homes in the surrounding villages, to increase the food supply of the stores at which they would get groceries, to provide water for the additional members of the communities (in one village an artesian well was dug on the spot when it was apparent that water was in short supply), to arrange for the post office to deliver, on short notice, mail and pensions to the evacuated population at their new addresses, and to stock shelters in the villages to accommodate the additional shelterees.

Evacuation

Preattack evacuation of large segments of the urban population to rural areas under certain conditions of crisis escalation is an important plank in the Soviet civil defence platform. Industrial workers in cities are to remain on the job and take refuge in special shelters at or near their place of work; but nonessential workers, school and preschool children, and retired people are to be transported to the country. Upon arrival, the evacuees are to assist their rural hosts in constructing hasty fallout shelters on sites that have already been surveyed for this purpose. Plans for evacuation are detailed, including, for example, time schedules for departure to collecting points; the presence of a doctor or nurse on each evacuation train (or with every convoy of trucks); instructions on what each family should bring (depending on climate and season); and special evacuation passes with a stub and a detachable slip for each person. Experience dates from World War II, when over ten million people and over 1,300 basic industries were successfully transferred from vulnerable areas to the interior. Since then, Soviet transport capability has moved rapidly forward. The system of railroads alone — the backbone of the USSR transport system — adds about 600 miles of new line and converts 1,600 miles of existing line to electric motive

power per year. Motor transport and maritime transport have also made great strides, and the Moscow subway system, initiated in 1932, has grown in the past 35 years to 75 miles with more than 80 stations erected. Subways now also exist in Leningrad, Kiev, Tbilsisi, and Baku. The daily number of subway passengers in Moscow is over 4,000,000. In addition to having the experience and capability for evacuation, the Soviets have developed a new civil defence transport service, operated by a specialized staff.

Rural Civil Defence

At the other end of the evacuation plan for urban dwellers is the reception and protection of these evacuees in the country. The Soviet rural civil defence program has this and three other important aims:

1. Furnishing manpower for rescue and emergency restoration work in the city;
2. Assuring the output of agriculture in wartime; and
3. Protecting people, livestock, food, fodder, and water supplies against radiological, chemical, and bacteriological weapons.

Emphasis is on protection against fallout in the country. Thus, there are explicit manuals with detail instructions, both on erecting vegetable bins to fallout shelters. There are also instructions for providing fallout protection for livestock both by adapting farm buildings as shelters and by driving the cattle into forests and other sheltered areas away from the probable direction of the advancing radio-active cloud. Builders of individual houses are encouraged to construct simple "cover" in basements with bricks allotted to them for this purpose.

Shelters

Soviet authorities emphasize the importance of shelters as the most effective means of defence against nuclear weapons. There are numerous kinds of shelters, such as subways, which are equipped with heavy blast doors; substantial, isolated, single-purpose shelters (largely for key government and party personnel); and basement shelters in apartment houses and public buildings. Certain mines have been designated for use as shelters.

Large public shelters are equipped with heating systems and with filter-ventilation units that keep out radioactive dust and chemical and bacteriological agents. In addition to water, food, toilets, medical chest, and bunks, they contain crowbars, picks, and shovels for breaking holes in the walls, if necessary, and for dismantling obstructions. There is a box of clay for sealing cracks. There are burlap, rags, and binding wire for wrapping patches on damaged air ducts. Standard equipment also includes radiation measurement instruments and protective clothing to enable selected personnel to make radiation reconnaissance missions and to conduct the urgent operations outside the shelter. Portable radios are on hand to establish communications with local civil defence headquaters and with rescue units.

Detailed articles with tables and diagrams appear in the Soviet literature on adapting building basements as "cover". "Cover," unlike shelter, does not protect against chemical and bacteriological weapons. Householders are expected to bring along their own food, water, and first aid kits. Ceilings in conventional building basements support only their useful loads and can therefore withstand only the load from very weak shock waves. Thus, in setting up cover in existing basements, ceilings are reinforced to withstand loads from moderately strong shock waves and possible building cave-ins.

Soviet shelters are provided with emergency exits for getting out of the shelters in the event that the main entrance is blocked by building fragments. The emergency exit consists of a covered underground passage protected against debris of falling buildings. This exit is located at a distance of at least half the height of the building and is at least three meters away from each of the surrounding buildings.

Shelter control units, composed of five to seven men, are selected from among the workers in every industrial establishment and institution and from the technical and services staff of the housing operations office for apartment buildings. This shelter crew must have intimate knowledge of the layout of the shelter, the emergency exit, and the location of water, sewer, telephone and power lines. The unit commander, in particular, must be thoroughly familiar with the emergency power system and the filter-ventilation system, for he will be the one to make such possibly crucial decisions as when to turn on the ventilation system. Should he delay too long, the temperature and humidity in the shelter could rise to dangerous heights, whereas were he to act too soon, the filters could become clogged up with dust from the surrounding destroyed buildings. He must also decide when it is the best time to send out a reconnaissance crew and when it is safe for everybody to vacate the shelter.

Protection Against Chemical and Bacteriological Agents

If attacked, the Soviets expect nuclear, chemical, and bacteriological weapons to be used. For this reason equal billing is given to protection against all three types of weapons, and Soviet citizens are instructed to use such individual means of protection as gas masks, rubber boots, raincoats, and rubberized gloves. There are also explanations of the procedures in an area which is put under quarantine because of bacteriological attack. The civil defence medical service, for example, introduces prophylactic measures for the entire territory, giving injections to all residents. Clothing, household articles, and residential premises are disinfected; anyone showing symptoms of illness is immediately isolated; and those caring for the sick are taught to exercise precautions both on entering and leaving the sick room.

Protection of Industrial Operations

To secure the survivability of industrial installations, Soviet planners urge dispersion of industry, duplication of production missile defence and the removal, in some cases, of the most essential industrial plants to the interior at the beginning of war or when war threatens. Industrial vulnerability is also reduced by strengthening the plant buildings and their contents against possible damage from nuclear weapons. Thus, we come across recommendations in Soviet literature that civil defence chiefs at various installations organize qualified groups of people to determine the vulnerability of basic units, assemblies, and equipment on the basis of prognosticated damage assessment and to consider ways to reduce it. One way is to "slant" new construction toward this end.

Among the most readable articles in the unclassified Soviet military literature are those describing how individual directors of large enterprises secure their establishments. An example is the account of Gregory Petrovich Garmash, assistant director and designated civil defence chief of a large Kharkov tractor plant. Comrade Garmash, the article points out, knows that "the important thing is to prevent panic." "Experience suggests," he remarks, "better to see once than to hear about ten times." With this practical guidepost in mind, Comrade Garmash organizes civil defence teams in each shop and section — four decontamination teams from the test experiment shops, six medical detachments from the fuel equipment shop, and a team for technical emergency work from the repair machine shop. In all, ten civil defence services are established at the tractor plant. Elaborate plant exercises are organized in which 800 people participate. That Comrade Garmash means business is shown by the following quotation. "Several times Comrade Garmash told the chief of the Housing Service Section: 'Put the shelters in order.' The chief promised. But he did not act. Then he was punished by the director. Now the shelters are in order." There are many similar accounts of civil-defence-conscious plant directors in Soviet literature.

Prevention of Panic

One fundamental and publicly underscored goal of the Soviet civil defence program is the prevention of panic. Leading Soviet strategists like V. D. Sokolovsky recognize that the explosion of nuclear weapons could easily cause an outbreak of panic. Should this occur, uncontrolled streams of refugees could disrupt the deployment and mobilization of the armed forces, and, further, the effectiveness of rendering aid to the civilian population itself would be seriously hampered.

The most recent effort to promote love of country and loyalty among the young was the passage of the "Law of Universal Military Obligation" in October, 1967, by the Twenty-Third Session of the USSR Supreme Soviet. This law seeks to "achieve a profound understanding of personal responsibility for the Soviet state by future servicemen" (the young people in the new compulsory pre-service training program), by "patriotic indoctrination" and to "strengthen ideological conviction and unflagging loyalty to the motherland." The law is also designed to bring about "a further improvement in the work on military-patriotic education of the Soviet people, and the formation among them of the necessary moral and psychological qualities which permit withstanding, if necessary, the severe tests of war . . ." Leaders like O. V. Tolstikov believe that "civil defence will be much stronger if the morale and political unity of the citizen is strong and the citizens are rallied around the true ideas which can inspire people to heroic deeds and sacrifices."

Training and Inducements

As a result of the new Law of Universal Military Obligation, the Soviet civil defence effort has taken a marked thrust forward during the past year (1967-1968). Basic military training of youth has been introduced in the high schools and the trade schools, as well as at factories, institutions, and collective farms. The instruction includes knowledge of the properties of weapons of mass destruction and methods of protection against them. Compulsory civil defence education has been introduced into the fifth, sixth, and seventh grade classes of the secondary and eight-year schools of general education.

In an article about civil defence training of school children, a Leningrad school was described where instruction included training in the use of small arms, motorcycles, and even parachutes. Other inducements for learning about civil defence include visits to national monuments and shrines and sessions with war heroes and with civilians who participated in the heroic defence of Moscow in World War II. Instructors are told outright to link bravery and heroism not only to the field of battle but also to defending the peaceful population behind the lines — in the rear. It is an interesting sidelight to Soviet pedagogy that while teachers are instructed to capitalize on their pupils propensity for partiotism and to enlist their interest with such glamorous equipment as motorcycles, they are nonetheless cautioned: "It should not be forgotten that studies are work and not fun. Like any labor they require willful physical and mental strain."

In summer camps, where emphasis is on putting into practice what the children learned in the classroom, pennants, citations, and buttons are awarded for excellence in civil defence drills and exercises. The best detachments are singled out for gifts, and there is occasional television coverage of the exercises so that the children can see themselves on the TV screen.

At industrial plants, contests are held among civil defence squadrons with awards for the winners. Distinguished performances in all areas of civil defence are cited in the press. Directors of large industrial establishments, shop heads, instructors, and ordinary factory workers have an equal chance to be named, for example, in the magazine Military Knowledge. Coversely, those who flagrantly shirk their civil defence responsibilities

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FLOOD PREPARATION – 1969

Observations concerning the southern Manitoba spring flood preparations

by
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During March and April 1969, the Red River Valley in southern Manitoba became the scene of extensive preparations for a spring flood threat. The source of the flood threat, Red River with its headwaters in the northern United States, flows northward through southern Manitoba emptying into Lake Winnipeg. This river and its tributaries cover 110,000 square miles of drainage.

Located on Red River 60 miles north of the American border is Greater Metropolitan Winnipeg. Metro Winnipeg is the fourth largest urban community in Canada with a population in excess of 500,000. The area is composed of twelve municipalities including Winnipeg, St. Boniface, St. James, Assiniboia, and others.

Also located in the Red River Valley south of Winnipeg are the Roseau Indian Reservation and several towns and villages including Emerson (834 residents), Letellier (257), Morris (1,339), St. Jean Baptiste (541), and St. Agathe (311). These rural centers are situated in an agricultural area consisting primarily of large grain farms with 1,400 to 1,500 farmers living on the flood plain.

Four political-geographical levels of organizational response were involved in the flood preparations: (1) federal, (2) provincial, (3) metropolitan, and (4) municipal. Governmental agencies and departments at both the federal and provincial level became involved, as did organizations from Greater Metropolitan Winnipeg. In addition, the rural municipalities along the Red River south of Winnipeg were also involved in preparations.

On April 6, 1969, a Disaster Research Center (DRC) field team member was dispatched to Winnipeg, Manitoba for five days to ascertain the nature of spring flood preparations in southern Manitoba. The following report is based on field observations, disaster plans, written records, minutes of meetings, reports, newspaper accounts, and data from interviews and conferences with respondents from twelve organizations.[1] This account is intended primarily to illustrate the types of preparations made in anticipation of widespread flooding in the Red River Valley from the American border to the city of Winnipeg. As such, this report does not represent a systematic study but a case illustration that might be suggestive to other communities faced with similar problems.

ABOUT THE AUTHOR

Arnold R. Parr, formerly of Calgary, Alberta was the first recipient of an annual Canada Emergency Measures Organization fellowship to study at the Disaster Research Center, Ohio State University. Now nearing the completion of three years with DRC he has accepted an assistant professor position at Loyola College, Montreal where he will teach methodology and social psychology..

The Emergency Context

The Red River Valley has experienced numerous prior floods. In 1950 and 1966, for example, extensive and severe flooding occurred. At these times a temporary lake 70 miles long and 40 miles wide inundated the valley. Since the Red River flows through a level area in southern Manitoba, a vast amount of farm land area rapidly becomes flooded when the river level rises.

Elements of a disaster subculture have developed in southern Manitoba in response to the recurrent flooding and flood threat. That is, standby measures have been developed to mitigate the harmful and disruptive effects of a flood emergency. For example, a massive floodway has been built around the eastern side of Metro Winnipeg which has the capacity of diverting 60,000 cubic feet per second of water from flowing through Metro Winnipeg during flood periods. In addition, the city of Winnipeg has installed a number of pumping stations which control sewage backup during high water periods. Further south in the Red River Valley some of the towns such as Emerson and Morris have been ring-dyked with permanent earth dykes. Thus, during a flood emergency, these centers are fully protected once openings in the dykes for access routes have been closed with earth fill.

Extensive flood disaster plans have been drawn up for the Red River Valley. The flood fighting plan delineates the duties and responsibilities and operating procedures of each organization expected to respond to the emergency.

A report on the 1966 flood was prepared by the Manitoba Emergency Measures Organization. This report covered the involvement of federal, provincial, and municipal departments of government and other agencies in the 1966 emergency and it became the basis for much subsequent planning to cope with flooding. We now turn our attention to the planning and preparations for the 1969 flood threat.

The 1969 Flood Preparations

During the 1968-1969 winter season, very heavy snowfall occurred in the watershed region of the Red River, thus creating the potential for high water runoffs during spring thaw. One of the first concrete preparations for the anticipated high water levels was the issuing of a flood operation order on March 14, 1969 by the provincial premier. This order outlined the organization and operational plan to meet a flood threat from approximately April 7 to 26. It designated that Manitoba EMO establish a flood control headquarters and several subheadquarters.

The central flood control headquarters was set up immediately in a room in the Legislative Building in Winnipeg, and subheadquarters at Morris and Emerson were also established. Representatives from the key emergency organizations operated out of the central flood control headquarters. The headquarters began to function on March 17.

One of the major activities carried on at flood control headquarters was the holding of weekly meetings of the Red River Valley Flood Committee. The coordinator of Manitoba EMO was designated as chairman of the committee and he was directed to have the committee institute immediate action by the provincial departments, agencies, and utilities to meet the threat. These meetings served several important functions. The representatives from the various involved organizations usually presented reports of their respective preparatory activities.[2] Through these reports each organization became aware of what other organizations were accomplishing, and consequently omission or needless duplication of crucial tasks did not occur. Problems arising during daily operations were considered at the meetings and generally through discussion a consensus was reached resolving the problem. Plans of action for the upcoming week were frequently discussed and formulated. In conclusion, these meetings facilitated overall control and coordination of all flood preparation activities.

The communication facilities at the central flood control headquarters were limited to telephones although plans had been made to move in radio facilities if required. There was one direct line from the main operations desk in the flood control headquarters to the permanent offices of Manitoba EMO where the radio communication facilities were located. A telephone switchboard at the flood control headquarters could handle twenty-two calls simultaneously and each office in the headquarters was equipped with two or three phones.

Certain preparations were undertaken to cope with the physical aspects of a flood crisis. The Department of Highways was supervising the filling of sandbags which were issued to farmers along with polyethylene for the protection of farm buildings. The Indian Reservation at Roseau was having an earth dyke built around it in early April.

At the request of provincial officials, Metro Winnipeg EMO had established an emergency reception centre where all avacuees from southern Manitoba coming into Winnipeg would be registered. Metro Winnipeg EMO also checked about the availability of feeding and shelter facilities in Winnipeg in the event that such services would be required.[3]

The setting up of the flood control headquarters and the holding of weekly meetings facilitated excellent working relations among the various involved organizations. Interorganizational relationships were well coordinated, primarily through the efforts of Manitoba EMO whose major function during an emergency is the establishment, maintenance, and operational control of an emergency headquarters necessary to coordinate flood fighting operations. In addition, excellent cooperative relationships exist between Canadian and American authorities concerned with flood fighting. Daily reports were received at the flood control headquarters in Winnipeg from American officials concerning conditions on the Red River south of the international border.

Concluding Comments

Preparations for the 1969 flood threat in the Red River Valley appeared to be very adequate. In many instances, preparations for disasters tend to focus on the physical aspects while the social-organizational aspects are relatively neglected. For example, dykes are frequently constructed or reinforced and sandbags stockpiled in preparation for a flood threat, but little attention is devoted to maintaining adequate communication among responding organizations or for making arrangements for overall control and coordination of disaster activities such as organizing, transporting and feeding of volunteers.

This was not the case in southern Manitoba. The preparations were well-balanced between the physical and social organizational aspects. A central flood control headquarters was established and weekly meetings were held which facilitated direct communication among organizational representatives.

There were perhaps two areas of potential weakness in the planning inasmuch as most 1969 preparations were geared to handle an emergency of the same magnitude as the 1966 flood. The forecasts for 1969 indicated that the 1966 flood levels would probably be reached but not exceeded. Thus, the past 1966 disaster was often referred to, and plans tended to be limited to coping with conditions similar to those of 1966, and little attention seems to have been given to the 1969 threat surpassing this prior flood. One major exception to this is that the ring dykes around the rural towns in southern Manitoba were built two feet higher than the flood levels of 1950.

DRC has found a similar tendency in most other places that have undergone a recent disaster or a threat of one. Preparations at a later point in time become organized in terms of the earlier problems and circumstances. In a sense, the previous disaster is used as a benchmark. The potential weakness in this of course is that the new disaster may exceed the earlier one as some communities have discovered to their sorrow.

Another possible weakness centers around a lack of preparations for an unexpected event such as a dyke break. There was little evidence of consideration of evacuation procedures in case a ring dyke should fail around one of the smaller towns. In addition, the sub-headquarters in Emerson and Morris had only regular telephone service with central flood control headquarters. It is not know whether some form of alternative communications were available if the phones should become inoperative. Officials in the city of Winnipeg were perhaps least concerned about an unexpected emergency event. Preparations were not intensive in the city since it was anticipated with certainty that the floodway would handle the excess flood water, however the floodway had never been in use during any prior flooding. It was to have its "trial" run in 1969.

In 1950 the Canadian Red Cross became heavily involved in flood fighting activities in southern Manitoba. The situation varied in 1966 with the premier and provincial cabinet playing a rather dominant role in the flood emergency. In 1969 a further variation occurred with overall coordination of flood preparations being undertaken by the Manitoba Emergency Measures Organization. In so doing, Manitoba EMO was accomplishing the major role for which the organization exists and at the same time was conforming to legislation enacted by the government in The Civil Defence Act (chapter thirty-eight R.S.M. 1954) Province of Manitoba.

In summary, it was found that compared with similar situations studied by DRC in both the United States and in other countries, the flood preparations in southern Manitoba during the spring of 1969 generally surpassed those undertaken in other communities. In only a relatively few instances has an emergency operations center such as the Manitoba EMO flood control headquarters been established and become operationally functional prior to the actual disaster impact. Furthermore, it is also very infrequent that overall control and coordination is attained through the holding of meetings prior to impact of the representatives from key emergency organizations. These meetings generally have to be hurriedly arranged after the disaster has struck. In contrast, the preparations in southern Manitoba involved the weekly meeting of the Red River Valley Flood Committee, and long-range plans specified that this committee would meet daily once the flood threat became more imminent. Thus, it appeared that flood preparations in southern Manitoba had very adequately encompassed the social-organizational as well as the physical aspects of disaster planning. ▲

FOOTNOTES

Organizations Contacted

1. *Federal*
   Canada Emergency Measures Organization
   Provincial
   Manitoba Emergency Measures Organization
   Manitoba Department of Agriculture
   Manitoba Department of Mines and Natural Resources
   Manitoba Department of Health and Social Services
   Manitoba Telephone Company
   Red River Valley Flood Committee
   Metro Winnipeg
   Metro Emergency Measures Organization
   Municipal (City of Winnipeg)
   Mayor's Office
   Department of Engineering
   Fire Department
   Police Department

2. Representatives from the following organizations attended the April 9 meeting of the Red River Valley Flood Control Committee:
   Manitoba Department of Agriculture
   Manitoba Department of Finance
   Manitoba Department of Health and Social Services
   Manitoba Department of Mines and Natural Resources
   Manitoba Department of Highways
   Manitoba Hydro
   Manitoba Telephone System
   Canadian Armed Forces
   Information Services
   CNR and CPR Railroads
   Canada EMO
   Metro Winnipeg EMO
   Attorney General's Office

3. Interviews with city of Winnipeg officials revealed that no special preparations were being undertaken to cope with a flood emergency in the city. Given the high water levels being predicted for 1969 and the existence of the floodway, it was not felt that the city was facing a flood threat.

BROADCASTING *(Continued from page 15)*

tion with other Federal and Provincial officials in order to provide unified control of program material by regional emergency government Operations Control. Advice and instructions will be prepared by government officials with special emphasis on how to survive under wartime conditions. Information material will be prepared by the Emergency Public Information Service made up of government and news agency personnel. The emergency Broadcasting System will work in the interests of emergency government in time of war, with particular emphasis on warning and instructions for survival.

Future

In this field of planning for emergency broadcasting, current feasibility studies are in progress to provide organizational access to municipal radio stations by local government authorities. Municipal emergency governments have established a need to gain access to local radio stations for the purpose of issuing advice and instructions of a local nature. The studies have been completed to the point involving control procedures for radio stations which are automatically operated or unmanned. In the modern system of radio broadcasting the trend to unmanned or automatic operation of studios and transmitter facilities is creating a problem in this project for control under emergency municipal broadcasting. This problem does not arise in the system of provincial control by Regional Emergency Government Headquarters. Emergency Broadcasting System program lines can be

switched into an unmanned transmitter and carried on indefinitely until a power service failure or equipment breakdown causes the station to go off the air.

The Emergency Broadcasting System has been planned and organized to provide, in co-ordination with emergency government, a means of warning and instruction for survival of the public. The survivability of the E.B.S. is predicated on the arrangement of safe routing of microwave and landlines circuits as maintained by the Trans-Canada Telephone System, the "hardening" of safe-sited radio stations, protected to provide continuous essential radio coverage, and the professional capability of broadcasting personnel to perform duties under adverse conditions. Much has yet to be done to improve the survivability of the system as an essential part of civil emergency measures. ▲

NON-PROLIFERATION *(Continued from page 20)*

of nations owning fissile materials through the indiscriminate distribution of plutonium for commercial purposes. He has maintained that the more information and technical help which they receive in the so-called civil nuclear technologies the more likely it is, on technical grounds, that nations finding it within their means scientifically to make bombs would find the political and economic decision to do so that much easier as well; unless the materials, such as plutonium, in their nuclear industries were kept under international control. There is no adequate international machinery yet established to police the world-wide distribution of plutonium and creeping proliferation is thus taking place all the time.

In his article Mr. Beaton has now taken his argument a stage further, by raising doubts about the advisability of an arrangement between Britain, West Germany and Holland to co-operate in the development of gas centrifuges. Gas centrifuges are yet another means of making atomic bombs. Hitherto they have been largely ignored because the technology has proved inscrutable and the cost prohibitive. But their main significance is that they can produce the highly enriched uranium with which thermonuclear bombs are made; this has only been produced so far by enormously expensive diffusion plants belonging to the five military nuclear powers. While many countries with a reasonably advanced civil nuclear industry could even now manufacture primitive atom bombs from plutonium, the weapons themselves would require fairly specialized delivery systems to take account of their size. The additional importance of thermonuclear weapons is that they are smaller and can therefore be delivered with less trouble than their more primitive predecessors.

If the development of gas centrifuge continues to remain not only technically unfulfilling but also economically overwhelming, Mr. Beaton's fears may not be realized. Yet the question he asks deserves an answer from the Government before any work on the agreement goes too far. And although there may be economic arguments associated with civil nuclear programmes, it should require more than just an economic justification to make this arrangement seem politically advisable. The nuclear future of West Germany is, after all, one of the World's most important international questions. ▲

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may also get to read about themselves. "The Unfortunate Comrade Blinov", was cited in the journal Military Knowledge for his lackadaisical attitude toward his civil defence duties. He declined to make use of the special classroom set aside for a civil defence office; he failed to acquire sufficient training equipment and visual aids; and those he did get were not kept in order. Worst of all, the lessons conducted by Comrade Blinov both "in content and in method are not worthy of criticism." Poor Comrade Blinov!

Summary

On the whole, the Soviet civil defence program is comprehensive, well integrated, and substantial. This is not to say that it is above criticism. The Soviets themselves admit the discrepancy between the civil defence blueprint and the current edifice — the plans are well conceived but their implementation imperfect. There are pockets of apathy as well as inefficiency and, in some cases, poor quality of performance.

But Soviet civil defence is impressive. In the last year alone, civil defence planners have introduced:

1. Compulsory civil defence instruction for school children, youth, and factory workers;
2. Better training for those who teach them;
3. More detailed and concrete evacuation plans;
4. Greater realism and practicality in training scenarios;
5. An improved communication system; and
6. Extended radio, television, and newspaper coverage.

A sheltered population, having high morale and well trained in how to make the best use of the warning time at its disposal — be it two minutes, two hours, or two days — is not likely to give way to panic or to give up in resignation. The high state of discipline and morale of survivors would be an extremely important factor in enabling the Soviet Union to withstand the severe hardships of nuclear war and to work toward victory and recovery.

Even more convincing than the assurance of survival to the Russian people is the attractive proposition held out by Kremlin leaders that hard-core civil defence strength on the home front means much more than realistic survival insurance: it means making nuclear attack on the Soviet Union unattractive, without requisite gain and full of unacceptable risk. It means giving Red diplomats a particularly effective weapon at the conference table. ▲

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