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WARNING SYSTEMS RESEARCH SUPPORT:

FINAL REPORT

30 November 1966

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TECHNICAL MEMORANDUM

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WARNING SYSTEMS RESEARCH SUPPORT:

FINAL REPORT

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ABSTRACT

Final report on the Warning System Research Support Project undertaken for the Office of Civil Defense under subcontract to Stanford Research Institute. The report describes the current warning environment, accordingly updates the requirements for an integrated national warning system, and then specifies a system design that will meet these requirements. Additionally, it discusses in detail various aspects of the warning problem, including organizational warning, natural disaster warning, civil and military warning, and warning message credibility.

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INTRODUCTION

I. PURPOSE AND SCOPE

In October 1965, under Subcontract SRI B86985-4949A-56 to Stanford Research Institute, the System Development Corporation undertook the Warning System Research Support Project to provide the Office of Civil Defense with an updated statement of warning system requirements. This project consisted of the following tasks as quoted from the contract work statement:

- Revision and updating of prior work on national warning requirements for nuclear attack. This work will emphasize the requirements for providing warning information that is credible and is readily and satisfactorily accepted by the public.

- Examination of the extent to which military and civil warning systems should be combined, and the methods by which information should be exchanged and disseminated through the systems.

- The general capability of sensors associated with the United States defensive forces will be examined with respect to enemy capabilities.

- Investigation of the requirements for providing warning of a specialized nature to Civil Defense personnel and emergency personnel at all levels of Government.

- Summary identification and evaluation of systems and equipment either available or in development which could satisfy these requirements.

- The analysis of the siren false alarm that occurred in Concord, California in July 1965, published as a supplement to this report (TM2870/010/01).

In performance of the tasks outlined above, it was found necessary to organize the research effort into study areas described as follows:

NATIONAL WARNING REQUIREMENTS STUDY

The purpose of the National Warning Requirements Study was to reexamine, reformulate and restate a generalized set of national warning requirements that were formulated in 1962.[1] Specifically, the objective was to determine whether changes in the warning environment, and knowledge gained in subsequent studies (e.g., NEAR System,[2] Radio Warning System[3]), indicated that the existing requirements were invalid or needed modification.

The environmental factors to be considered were: 1) the general international situation and the types of attack that conceivably might occur, 2) current stated Department of Defense policy and plans for responding to various types of threats, 3) existing or planned active defense measures--specifically anti-missile missile systems, 4) natural disaster threats, and 5) the general national political and social context into which a civil defense warning system must fit.

The updating of requirements was to include a study of warning credibility, as well as of the factors that might encourage public acceptance of and response to alerting signals and warning messages.

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1. Civil Defense Warning Requirements Study, TM-L-900/001/01, System Development Corporation, 31 January 1963; Classified Supplement to Civil Defense Warning Requirements Study (U), TM-L-900/002/00, System Development Corporation, 31 January 1963 (SECRET).

2. Interim Report for the Office of Civil Defense, NEAR System Study, TM-L-1505/040/01, System Development Corporation, 31 March 1964.

3. Lamoureux, Robert L., Radio Warning System Interim Operational Requirements, TM-L-1960/021/02, System Development Corporation, 1 February 1965.

The final portion of the National Warning Requirements Study was to determine the requirements that would be placed on the system if it were used also for natural disaster warning.

The purpose of this study was twofold: to identify the warning needs unique to civil defense organizations, and to examine various ways of satisfying these needs. The specific aim was to systematically describe exactly what information the organizations would need, when the information would be most useful, and how the information should be supplied.

CIVIL AND MILITARY WARNING STUDY

The goal of this study was to isolate specific relationships between civilian and military warning functions, and to determine which if any of the functions could be combined. In addition, if initial investigation indicated that a combination was warranted, detailed information on the communications facilities of various military systems was to be gathered.

MESSAGE CREDIBILITY STUDY

This study consisted of an intensive investigation of those factors that appear to be relevant in determining the credibility of warning messages to the public.

INVESTIGATION OF PUBLIC RESPONSE TO SIREN SOUNDINGS

This task was defined as completion of the report on the investigation of public response to the false siren alarm sounding in Concord, California, 14 July 1965. This was done more or less independently of the other tasks, and the report has been published as a separate document.[1]

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1. Bosak, N. M., et al., Investigation of a Siren False Alarm in Concord, California, 14 July 1965, TM-L-2870/010/00, System Development Corporation, 30 June 1966.

II. APPROACH

The overall approach was to view all aspects of warning in the system context, and to identify the inputs, processes, and outputs, of the system--or rather of *a* system. The basic assumption was that in the event of attack there will be a need to transmit information to the public and to organizations that have emergency duties; and that, further, there will be someone, some group, some agency, or some combination of groups and agencies, who have critical information and know what should be transmitted to whom, and when.

This approach, limiting the study to events occurring after the decision to warn, was the only way to define any sort of manageable system whose inputs, procedures and outputs could be specified. Incorporating the decision to warn into the warning system results in an all-encompassing complex including as operators the President, the Joint Chiefs of Staff, the Unified and Specified Commanders and many others. The possible conditions under which a decision might be made to activate the warning system must be considered as part of the environment of the system, as must the organizational structure within which the system operates. These factors may influence the design of the system, but they are not part of the system itself. Therefore, although it is acknowledged as a part of the total warning process, the intricacies of the decision to warn were considered to be beyond the scope of this study.

III. ORGANIZATION OF REPORT

This report consists of an initial summary of major conclusions and recommendations, followed by the main body of the document composed of six chapters, and ending with two appendices that discuss in detail some specific topics referred to only generally in the main text.

SUMMARY

I. PURPOSE

The purpose of the Warning System Research Support Project (Stanford Research Institute Subcontract B86985-4949A-56) was to provide the Office of Civil Defense with an updated statement of warning system requirements.

II. CONCLUSIONS

TOTAL SYSTEM

The fundamental conclusion drawn from this study is that primary emphasis should be placed on requirements to ensure that the various essential components will be successfully integrated into the total warning system. Some hardware components may be very large, complex and expensive; but these characteristics should not be permitted to overshadow the fact that even the most elaborate components must be adapted to the procedures, personnel and environment that affect the operation of the entire system. Whether or not all the components of the system presently exist, the technology for creating them is available. Therefore, the warning system development task is primarily one of integrating components, in the correct proportions and with the proper rules for employment, into an operating entity.

WARNING SYSTEM MISSION

The mission of any warning system is to provide appropriate information on a timely basis so that the most adaptive actions can be selected from the set of actions available to the recipients. Recipients, for a civil defense warning system, include: the general public (both in single-family units and in larger groups), various organizations (with and without civil defense responsibilities), management of industry, and others; in sum, the total population of the United States.

The actions available to the recipients range from duck-and-cover, activate Emergency Operating Center, to shut down your plant. What are the most adaptive actions, and consequently what information is required for selection of actions and when this information is required, depend on who is being warned and on what is being warned against in a specific situation. All these aspects of the mission affect the system requirements.

SYSTEM ENVIRONMENT

The environment in which the warning system must operate can be characterized as dynamic. A wide range of attack threats and of defense strategies designed to counter them exists. At practically any point, it may be necessary to prepare organizations to perform emergency functions, and also it may be necessary, or at least desirable, to shelter the civilian population.

In addition to the wide range of threat/defense options, there are also the wide variations in state and local organizational structure, in the location and characteristics of the population that must be warned, and in the protective measures available to segments of the population. All of these factors are part of the warning system environment.

SYSTEM REQUIREMENTS

The fundamental requirements of the civil defense warning system--that is, those that follow directly from its mission and environment--are that it be flexible and have provisions for growth. The flexibility requirement is a direct result of the need to supply various types of information to diverse groups of people. The flexibility and growth provisions are necessary because the environment is not, and will not become, static. The types of attack possible, and the active defense measures designed to counter the attacks, are constantly being modified. The available actions--for example, shelter availability for the public and the existence and capability of Emergency Operating Centers for organizations--vary with time.

More specific requirements can be categorized in terms of: function, coverage, structure and operation, response time, reliability and survivability, security and sabotage.[1] Each of these categories are briefly discussed below.

Coverage Requirements

The coverage of the system must be total. That is, there must be some means of getting information to everyone, who in passing the information will be in a better position either to save his own life or to exercise his responsibility in saving other lives or property.

Structure and Operations

The warning system must be structured so as to take maximum advantage of all possible means of disseminating information. This implies a loose structure, in a sense, but also implies very stringent requirements for planning and coordination of operations. There must be capabilities for national control and local control, as well as procedures for coordination of control so that the system does not provide contradictory outputs.

An additional structural requirement is that there must be provision for feedback at various levels within the system. This is necessary for system control, both in a positive and a negative sense. Information that is intentionally transmitted but not received must be retransmitted. Information that was unintentionally transmitted, or that was erroneous, must be cancelled or corrected.

Response Time

Delays in the total warning system must be minimized. Of necessity there may be certain delays in some components of the system. As an extreme example, a community that has only one policeman in one police car, the siren of which is the

1. This categorization of requirements was suggested by R. L. Lamoureux in Emergency Operating System Development Project Warning Task, TM-L-2454/000/00, System Development Corporation, 14 June 1965.

only outdoor warning device available to that community, could not expect to have the service of an outdoor warning device on a 24-hour basis. The total system must be such that there are other means of warning the hypothetical community when that policeman is off duty, so that response time is not dependent on the response of the one man.

<u>Reliability</u>

The reliability of the total warning system is a function of the reliability of its individual components and of the way in which they are integrated. The reliability of each portion of the system must be the highest that is feasible within the state-of-the-art and economic limitations applicable to that portion. Redundancy must be added in the form of more of the same type of component, or of different types, so that the reliability of the total system approaches unity. The system must be so designed that failures (to the extent possible) do not result in dissemination of false warning.

<u>Survivability, Security and Sabotage</u>

The warning system must be survivable in the sense that destruction of a single portion would not render the rest of the system ineffective.

The warning system must be virtually immune to false-triggering due to spoofing or sabotage. It must include authenticating procedures to prevent attempts at such actions from having widespread effects.

ORGANIZATIONAL WARNING

Some requirements specific to organizational warning are identified in the report. The most important of these is the need to supply organizations that have emergency responsibilities, such as state and local civil defense organizations, with enough advance information to enable them to prepare for an emergency. This information should be supplied from the national level to the state, and from the state to the local, as necessary. The information required is simply a notification that increased readiness measures are in order, and some indication of what the measures are. A standardized way of indicating the required measures is essential.

CIVIL AND MILITARY WARNING

Two conclusions resulted from the analysis of the relationship between civilian and military warning. The first is that the objectives of warning civilians and warning military personnel are basically incompatible.

Military warning generally is in the form of sensor reports to a command headquarters where they are used in decision making, or of orders from a commander to a subordinate facility to assume an alert status. The sensor report is not comparable with any functions of civilian defense warning. The order to assume an alert status has some relationship to alerting organizations to increase their readiness conditions, but the fundamental differences between the responses required of civil and military organizations, as well as problems of security, prevent the analogy from being extended to any meaningful conclusion.

The second conclusion from the civil and military warning study concerns the sharing of facilities and operations. The trend evidenced in the military systems studied was toward the use of Defense Communication System facilities (AUTOVON and AUTODIN) whenever possible. These facilities also could be used in a civil defense warning system.

NATURAL DISASTER WARNING

The results of the Natural Disaster Warning Task indicate that the civil defense warning system could be used profitably for natural disaster warnings. The addition of natural disaster warning functions puts little extra burden on the system, since the basic requirement for natural disaster warning and the ability to issue localized warnings is also required for attack warning.

The two warning functions have essentially the same purposes: to activate the public to take protective action, and to mobilize organizations to protect resources. Using the civil defense warning system for natural disaster warning provides operational experience that would be valuable in an attack situation, and a better, more organized warning capability for both natural disasters and nuclear war.

MESSAGE CREDIBILITY

Analysis of the research related to message credibility revealed some message characteristics that could influence the response to a warning message. These factors include: meaningfulness of the words to the recipient, extent to which message content serves to motivate the recipients, medium by which the message is delivered, and quality of the voice that delivers the message.

III. RECOMMENDATIONS

The primary recommendation resulting from the study is that no further research into warning requirements per se is warranted. The actual requirements are simple; they have not changed a great deal since 1962, and do not seem likely to change very soon. A low level of effort in monitoring the environment for changes (e.g., implementation of NIKE X) and in evaluating any changes that occur should be sufficient for detecting any changes in warning requirements.

Areas that do need further research are the techniques for meeting warning requirements. Additional means of getting people's attention and giving them information need to be studied and evaluated from a cost-effective standpoint, and in the context of a total warning system.

Simultaneous with the research into techniques, effort should be applied toward integrating existing components into a total operating system, which can be improved as new information is added to the store of knowledge concerning warning techniques.

TECHNIQUES FOR WARNING

Present research into equipment for warning (telephone, radio, sirens, etc.) should be continued and carefully coordinated, and should be supplemented by some additional research into the responses of people to warning. This response research should include research into the meanings of words, vocal qualities, and the responses of recently-awakened people.

The Meanings of Words for Warning

Research should be undertaken to determine which words and phrases are most credible in a warning context. Specifically, semantic analyses of word meanings should be conducted, and to identify the most effective phraseology, studies using test messages in which the phrasing only is varied should be made.

Vocal Qualities for Warning Delivery

Research aimed at determining the vocal qualities most suited to credible warning should be performed. First, patterns of speech and phrasing that convey the warning message most effectively need to be determined, and then tonal qualities in the human voice that inspire confidence and reassure listeners should be identified.

Performance Levels of Recently-Awakened Warning Recipients

Research specifically designed to investigate the ability of people recently aroused from sleep to carry out complex survival instructions should be conducted. Until such data becomes available, it is suggested that warning messages be kept fairly simple and be repeated at frequent intervals over a period of at least one hour.

SYSTEM INTEGRATION

As noted above, the basic components from which a total, dynamic warning system can be built are in existence. The remaining task is to integrate these components, and others as they are developed, into a single system.

The task of integrating a diverse group of elements into a single system is best begun by establishing standards to be applied in the use of the elements. It is recommended therefore that a warning standards activity be set up and controlled at the national level, with active participation from regional, state and local levels.

The importance of standards that are agreed-upon by working groups who must use the standards cannot be overemphasized. In contrast with guidance supplied from above (which is subject to misinterpretation and is of necessity over-generalized) standards can be made specific and unambiguous.

CHAPTER ONE

MILITARY ATTACK WARNING SYSTEM ENVIRONMENT

I. INTRODUCTION

This chapter is limited to the consideration of warning against enemy military attack. Warning against physical hazards of a nonmilitary nature is treated in Chapter Five.

The environment in which a civil defense warning system must operate can be described by considering three subject areas:

- The threat spectrum,
- The response spectrum, including measures available to protect the population, and
- The social and psychological characteristics of the population that affect their receptivity to warning.

The threat spectrum includes the military attack capability that an enemy may possess and the attack strategies he may employ. The response spectrum includes our own defensive capabilities, active and passive, as well as a consideration of the ways in which these capabilities may be employed. The social and psychological characteristics of the population that affect their receptivity to warning determine those response patterns (disclosed by studies of human behavior in disaster) that must be considered and overcome in developing a warning system with an effective warning capability.

Because the determinants of the warning systems environment in these three categories all depend upon human decisions both as they affect policies and responses to those policies--there is an almost infinite number of possible environmental configurations at any particular time. Therefore, a study of the environment must consider as a fourth area the dynamic effect that factors in these three subject areas have upon each other.

II. THE THREAT SPECTRUM

The possibility of a nuclear attack upon the United States represents the gravest threat to national survival. Nuclear weapons threaten the population with three specific types of lethal effects: blast, thermal and radiation. Blast and thermal effects occur almost immediately after a burst, and directly affect the population and structures within a circumscribed target area. In contrast, radiation in the form of radioactive fallout is a delayed effect. The distributional pattern of the fallout is determined partly by the prevailing wind conditions. The earliest fallout in locations that are outside the range of direct surface burst effects does not arrive until almost a half-hour after the burst. Downwind from the target area, fallout may arrive many hours afterward, depending on the wind and other climatic factors. The vulnerability of the United States civilian population to the direct and delayed effects of a nuclear attack will depend upon the magnitude and character of these attacks, as well as on the relative effectiveness of the defense measures taken.

The threat of nuclear attack no longer can be considered as a single monolithic phenomenon, but rather as a spectrum of possibilities. For example, the Soviet Union currently has the nuclear military capability for launching a wide range of nuclear attacks upon the United States, such threats extending from full scale to limited attacks, and involving strategic options as to the mix of the delivery systems employed, as well as targeting and timing factors.

In reporting on Department of Defense (DOD) analyses that were confined to strategic exchanges between the United States and the Soviet Union, Secretary of Defense Robert S. McNamara indicated the scope of these attack possibilities when he stated that "Attacks might be directed against military targets only, against cities only, or against both types of targets, either simultaneously or with a delay. They might be selective in terms of specific targets or they might be general."[1] In addition, the circumstances under which a Soviet nuclear attack might occur include the possibility of a surprise attack, as well as one resulting from some previous crisis or lower-level conflict involving conventional weapons.

In fact, in discussing the nature of the general nuclear war problem, McNamara defined a general nuclear war as "One in which the United States or its allies had been attacked by an aggressor in such a manner as to require the use of United States strategic nuclear forces in retaliation."[2] This statement alludes to the fact that other potential aggressors than the Soviet Union exist, and that the nuclear threat includes the possibility of hostilities of a lesser degree than an all-out direct attack upon our nation.

From the above discussion, one may isolate three general attack variables that characterize the scope, or spectrum, of threat possibilities: 1) source, 2) magnitude, and 3) the relative degree of sophistication of the weapons and their delivery systems. Accordingly, these three classes of attacks can be delineated as in Table 1.

Each of the three classes of attacks are discussed separately below. The reader is cautioned, however, not to consider as exhaustive this general breakdown of the spectrum. It is used merely to point out that a variety of threat possibilities does indeed exist.

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1. Subcommittee on Independent Offices, Independent Offices Appropriations for 1966, Hearings Before a Subcommittee of the Committee on Appropriations, House of Representatives, Eight-Ninth Congress, First Session, Part 3, Washington, D.C., 1965, p. 33.

2. Ibid., p. 33.

Table 1. Classes of Attacks

Class	Source	Magnitude	Level of Sophistication
1	Soviet Union	Heavy	Sophisticated
2	Soviet Union	Limited	Sophisticated
3	Nth Country[1]	Light	Primitive

Class One Attack

In the 1970 period, a general nuclear war with the Soviet Union conceivably could result in 135 million United States fatalities. Even if the United States carried out a first strike, the nation would suffer about 90 million fatalities.[2]

The weapons systems that the Soviet Union could use in attacking the United States include, in order of the degree of threat posed, the following:

1. Intercontinental Ballistic Missiles (ICBMs)
2. Submarine-Launched Ballistic and Cruise Missiles (SLBMs and SLCMs)
3. Air-Launched Ballistic and Cruise Missiles (ALBMs and ALCMs)
4. Free-Fall Bombs

In addition to the above weapons there is the threat posed by future weapons, such as space-launched ballistic missiles.

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1. Nth Country is defined as any country other than the Soviet Union that conceivably can launch a nuclear attack against the United States. Usually, however, the Nth Country does not mean Great Britain or France, but refers rather to China or one of the lesser powers.

2. Committee on Armed Services, Hearings on Military Posture and H.R. 13456... Before the Committee on Armed Services, House of Representatives, Eighty-Ninth Congress, Second Session, Washington, D.C., 8 March 1966, p. 7339.

A substantial portion of the Soviet's dependable damage-inflicting potential is deliverable by some form of missile attack. As such, the major threat confronting the United States consists of "...ICBM and submarine-launched ballistic missile forces."[1] Although the Soviets also possess an extensive long-range bomber force, Secretary McNamara suggests that "...in any deliberate, determined attack upon the United States, we can assume that the enemy would strike first with his missiles and then with his aircraft."[2] Since the United States has "...no defense against the ICBM and only very limited defense against the submarine-launched ballistic missile..."[3], the vulnerability of our population to a Soviet attack is extremely high.

However, because of changes in the nuclear strike capability of both major powers, the prospects of a deliberately-initiated Soviet all-out attack, although not completely discounted, have lessened considerably. Previously, such an attack (Class One) was feasible because, if successful, it could have disabled the United States strategic retaliatory forces. During the past decade, however, the latter forces have grown to be so diffuse and protected that a segment at least would survive--a segment large and powerful enough to inflict unacceptable damage on the Soviet Union.

Also, the Soviet Union earlier could have launched a Class One attack to prevent a similar thrust by the United States. However, this contingency has also been negated by developments during the past decade. Symmetrically, this nation cannot hope to benefit from such a full-force first strike because the Soviet strategic nuclear force also has grown to the extent that a sufficiently large and powerful segment would survive to inflict unacceptable damage upon this country. Therefore, because both the United States and the Soviet Union have

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1. Subcommittee on Independent Offices, _op_. _cit_., p. 48.

2. _Ibid_., p. 48.

3. _Ibid_., p. 48.

developed an "assured destruction" capability, and also because the international climate currently indicates that both would indeed avoid a massive encounter, the Class One attack threat is no longer considered by authorities to be as critical as in the past.

Class Two Attack

At present, there exist no vital interests in dispute between the United States and the Soviet Union that are of sufficient magnitude to cause a deliberate nuclear war. Nevertheless—although the mutual destructiveness of such a war has become generally acknowledged on both sides—the threat still remains. A nuclear exchange between the two major powers could occur through miscalculation or through escalation of a limited conflict.

Assuming for the moment that the Soviet Union will take pains to avoid a massive nuclear strike, this section discusses the Class Two attack, launched by the Soviet Union, limited in scale, and sophisticated in delivery techniques. In this view, a potential range of limited threats exists. A limited strategic exchange between the United States and the Soviet Union (assuming that a Class Two attack will cause a similar response) poses two sets of dangers. The first involves the potential damage to both sides, and the second the escalation tendencies of such a conflict.

A limited exchange is one in which restraint is the keynote. Restraint would be reflected in the positive control of both forces, and in their capability for limited and selective responses in line with limited objectives. Under such circumstances both powers would attempt to avoid escalating the conflict into an all-out general nuclear war.

A limited Soviet attack "most likely" would not be a surprise attack, because this would jeopardize the limited goal as well as risk a massive United States response. A limited Soviet attack therefore would be likely under the following conditions: a crisis situation that got out of hand, a non-nuclear conflict that involved intercession by the major powers on the behalf of secondary powers, etc.

As an example, reverse the roles taken during the Cuban Missile Crisis. Suppose as a limited goal the Soviet Union wanted to persuade the United States to remove threatening missiles from, say, Turkey. In this crisis context, the United States conceivably could be directly threatened with a nuclear attack on a specific target unless the missiles were removed. Clearly, Class Two attacks are subject to wide variations in intensity and in the type of weapons used.

Class Three Attack

Over the next decade the United States faces, in addition to the Class One and Class Two attacks, the danger of a relatively light, primitive attack by an Nth country (Class Three attack). A reassessment of the Nth country threat has been made: Secretary McNamara stated to Congress that "During the past year (1965), the potential of an Nth country nuclear threat to the United States has become more real."[1]

Communist China poses the most immediate Nth country threat, for that nation already has detonated three nuclear devices. It is currently estimated that by the mid-1970s, the Chinese could deploy a small ICBM force capable of launching a light nuclear attack upon the United States. The weapons employed would be unsophisticated; that is, they would be equipped with minimal penetration aids.

The Nth country problem is a result of the spread of nuclear weapons among the secondary powers of the major power blocks, as well as among the nonaligned smaller powers. These threats extend beyond the dangers posed by Communist

1. Committee on Armed Services, op. cit., p. 7343.

China's rapid progress. Additional countries have the technological resources at hand for developing a limited nuclear military capability, and among the likely candidates are Israel, Indonesia, Japan, India, Canada, and West Germany.

As reported in Technology Week, "Japan will have all the ingredients for a ballistic missile nuclear warhead delivery system within the next five years."[1] In an analysis of the international environment, 1956-1975, D. Ivanoff and D. Harrison estimated that by 1975 two major powers would have full nuclear military capability, seven powers could have a significant nuclear military capability, and 18 others a partial nuclear military capability.[2] As reported in an article in the New York Times, "The Soviet Union recently has begun stressing the global dimensions of the proliferation problem, especially the danger that such countries as India and Japan will decide to 'go nuclear' if a treaty is not reached in the near future."[3]

A number of dangers are evident from the above discussion. For instance, further dissolution of the current bipolar strategic balance can be expected, resulting in a less-stable strategic environment. As each new nation gains a nuclear military capability, pressure will no doubt be exerted on its immediate neighbors to acquire an equal capability. Furthermore, rational and responsible behavior in the international environment of some of these potentially new nuclear candidates appears to be questionable. If additional smaller countries secure a nuclear attack capability over the next ten years, the possibility of nuclear conflicts occurring among these secondary powers increases the prospects of a general nuclear war. In addition, possibility of a limited attack upon the United States by one

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1. "Japan Has Nuclear Missile Capability," Technology Week, Vol. 18, No. 25, 20 June 1966, p. 16.

2. Ivanoff, D., and D. Harrison, International Environment: 1965-1975, SM-49226, Douglas Aircraft Company, Inc., October 1965.

3. Finney, John W. "A Nuclear Treaty Seems Closer," New York Times, 13 November 1966.

of these powers represents a distinct, though distant, threat contingency. At this point, however, the military capabilities for such an attack do not exist.

Finally, the proliferation of nuclear weapons among many other nations, and development by them of a submarine-launched missile capability, raises the spectre of an Nth country attack designed to provoke the United States into a general nuclear war with the Soviet Union or with Communist China. In a limited provocative attack, surprise and covertness are the essential factors involved.

The most significant feature of these potential Nth country threats is that the prospects for a surprise attack are reintroduced into the overall threat problem. For nations possessing a one-shot nuclear capability, the retention of the element of surprise represents a significant addition to their damage-inflicting capabilities.

III. THE RESPONSE SPECTRUM

The defense of the United States against nuclear attack must take into account the different classes of threats previously described. In each, the dangers of a general nuclear war occurring are evident. To confront these dangers, the United States has developed a balanced, general nuclear-war posture characterized by two basic strategic objectives: "assured destruction" and "damage limiting."

Assured destruction refers to the ability of the United States "to deter a deliberate nuclear attack upon the United States and its all... maintaining a clear and convincing capability to inflict unacceptable damage on an attacker, even were the attacker to strike first."[1] Damage limiting refers to the United States' ability "in the event such war should nevertheless occur, to limit damage to our population and industrial capacities."[2]

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1. Subcommittee on Department of Defense Appropriations, 1965, *op. cit.*, p. 34.
2. *Ibid.*, p. 34.

Maintaining our assured destruction capability is of the highest priority, for it is our primary means for ensuring that the United States is not subjected to attack. If deterrence fails, at any level of strategic conflict, the United States' strategic offensive and defensive forces face the task of limiting the damage by a combination of defense measures.

RANGE OF DEFENSES

The Department of Defense has conducted a series of studies designed to provide various orders of balanced defenses against these threats. As noted in Armed Forces Management, the damage-limiting programs as outlined by the Department of Defense "could range across the entire spectrum, from one designed against a threat of a minor nuclear power, for example, the Chinese Communists in the 1970s, to one designed against the threat of a carefully synchronized surprise first strike by the Soviet Union on our urban industrial areas."[1]

The Department of Defense has acknowledged that even with an all-out balanced defense effort, a determined Soviet attack in the 1970s would result in at least 50 million United States fatalities.[2] Beyond a certain level of defense, the advantage lies with the attacking forces. The exchange rates are such that the Soviet Union can offset any additional United States' defensive measures by increasing the size of its attacking forces or enhancing its penetration aids at a much lower cost.

Major Damage-Limiting Effort

Secretary McNamara, in assessing the character of a major damage-limiting effort against the Soviet threat, indicated that a mix of damage-limiting measures

1. Armed Forces Management, March 1966, p. 91.

2. Committee on Armed Services, op. cit., p. 7342, noted that "...against a massive and sophisticated Soviet surprise attack in civil targets, there would be little hope of reducing fatalities below 50 or more million."

would be required involving a "full civil defense fallout shelter program, ballistic missile defenses, antisubmarine defenses, and improved bomber defenses."[1] These include area defense forces composed of manned interceptors, long-range antiballistic missile missiles, and antisubmarine warfare forces. The antisubmarine warfare forces also have an offensive role, in that their primary means (at present) of limiting damage is by detecting and destroying the enemy submarines before the SLBMs are launched. Next in sequence are the terminal defense forces, bomber defense surface-to-air missiles, and ballistic missile defense missiles such as SPRINT. Finally, passive defense measures, such as fallout shelters and warning systems, attempt to reduce casualties from the weapons that reach their target areas.

The major damage-limiting effort against a heavy Soviet attack depends both upon a concentrated missile defense of major urban areas and full fallout shelter program. It is designed to counter a heavy Soviet attack that employs saturation techniques and sophisticated penetration aids. A deployment decision on the heavy attack version of NIKE X has been deferred annually for the past several years. Aside from the potential destabilizing effects upon the strategic balance of power, the deployment of NIKE X is contingent upon Congressional authorizations for a full fallout shelter program.

Secretary McNamara stated that "the effectiveness of an active ballistic missile defense system in saving lives depends in large part upon the existence of an adequate civil defense system. Indeed, in the absence of adequate fallout shelters, an active defense might not significantly increase the proportion of the population surviving an all-out nuclear attack. Offensive missiles could easily be targeted at points outside the defended area and thereby achieve by fallout what otherwise would have to be achieved by blast and heat effects."[2]

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1. Ibid., p. 7342

2. Committee on Armed Services, Hearings on Military Posture and H.R. 9637... Before the Committee on Armed Services, House of Representatives, Eighty-Eighth Congress, Second Session, Washington, D.C., 29 January 1964, p. 7017.

Minor Damage-Limiting Effort

"A light antiballistic missile system using exoatmospheric interceptors and terminal defenses at a small number of cities offers promise of a highly effective defense against small ballistic missile attacks of the sort the Chinese Communists might be capable of launching within the next decade."[1] A thin defense thus would be provided against a relatively small and sophisticated attack.

Recent developments reveal that a longer-range NIKE-Zeus missile, a new type of multifunction array radar and new long-range ICBM detection radar have made the deployment of a light-traffic area defense system technically feasible.[2] The limited threat, as estimated, could produce from six to 12 million fatalities. In one of the defense postures studied, these can be reduced to from zero to two million fatalities.[3]

Such a thin defense missile system would be capable of defending the entire nation, not merely selected cities, from limited attacks. A significant feature of an area defense system is that the role of a fallout shelter program in damage limiting is reduced. According to Secretary McNamara, a full fallout shelter program would not be appropriate.[4] The shelter program was essential to the heavy attack version of NIKE X, in that it denied to the Soviet Union the tactic of upwind targeting of dependent cities. In the light attack version, intercepts are made hundreds of miles from likely target areas.

In addition to its damage-limiting potential, the prospective deployment of a light attack missile defense system has been viewed as a possible deterrent to the Chinese efforts to develop a nuclear military capability. However, the

1. Ibid., p. 7345.
2. Getler, Michael "U.S. Opting for New Low-Cost ABM," Technology Week, Vol. 18, No. 25, 20 June 1966, pp. 14-16.
3. Committee on Armed Services, 1966, op. cit., p. 7344.
4. Ibid., p. 7344.

prospects do not seem encouraging along this line. More likely, the Chinese would be encouraged to develop more sophisticated ICBMs, or else to concentrate upon developing an SLBM capability. In either of these latter cases, the United States would be gaining additional time.

An area defense system may be partially effective against the limited Soviet attack threat. Although announced as designed to handle relatively unsophisticated penetration devices, it was also stated by Secretary McNamara that "even against a heavy sophisticated Soviet attack, an area defense would be a valuable supplement."[1]

An Overall Controlled-Response Strategy

Because of the multiplicity of possible threats and the escalation dangers associated with them, DOD has attempted to secure the capabilities for a controlled-response strategy. This strategy attempts to preserve options: a wide range of responses to any given enemy action is to be available. Thus, in response to a spectrum of enemy actions, including a direct attack on the United States, the President should be able to order an appropriate retaliation, ranging from a full scale attack upon the enemy's urban centers to the destruction of a single military target.

The controlled-response strategy gives the initial choice as to the size and character of a war to the enemy. By making the first strike, the enemy chooses not only the time and place at which the war will begin, but determines its intensity (i.e., full-scale or limited) and the attack targeting (i.e., whether the attacks will be restricted to military targets or extended to urban centers).

A major implication of the controlled-response strategy is that it carries with it the prospects of a limited nuclear war that might extend over a prolonged

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1. *Ibid.*, p. 7356.

period of time, with respite periods during which negotiations and/or damage assessment would take place.

Essential to the credibility of a controlled-response strategy is the development of an effective damage-limiting capability, especially in the area of civil defense. There is no point in preserving options for limited United States responses if a significant part of the population has been killed by fallout from a pure counterforce attack. Therefore, the civilian population of the United States must not be subjected to extensive losses due to fallout from an initial limited attack. This could be avoided if the total warning system were able to respond to such a level of attack by directing the public to take specific protective action determined to be appropriate for the threat.

IV. THE SOCIAL/PSYCHOLOGICAL WARNING ENVIRONMENT

The complete warning environment extends beyond consideration of the threat posed and the response capabilities available. Equally significant in the environment is the awareness that warning recipients have of danger, and the receptivity of warning recipients to survival instructions and other warning-related information. Assumptions made about the condition in which the recipients will be when warning is given vitally affect warning dissemination, warning information and warning credibility requirements. Extreme care must be exercised in introducing simplifying assumptions about the status of the public in a future warning environment. It is unwarranted to postulate that the general public, or a significant segment thereof, will be properly conditioned and educated to the purposes and relevant features of a warning system and related civil defense measures.

More realistic assumptions about the status of the public in the warning environment must be introduced. Such assumptions should not contradict the evidence that studies of human response to past disasters afford about the way people behave in response to warnings of threatening situations. One thing such studies demonstrate is that effective warning results from creating within the recipient's mind a convincing appreciation of his own personal danger, and providing him direction as to how to survive that danger. When the elements of the warning fail to dovetail into such an integrated and functionally complete process, the response may be far different from that which is desired or for which plans are made, as prior studies also demonstrate.

To determine the effect that warning should produce in the public, it is necessary to consider the public in relation to the specific threat.

NATURAL DISASTER EXPERIENCE

Disaster research literature contains many examples of the positive and negative effects of warning. For a direct comparison of effective and ineffective responses to the same threat, one of the most dramatic contrasts emerges from the study of the 1954 flood on the Rio Grande River as it affected the towns of Eagle Pass, Texas, and Piedras Negras, Mexico.[1]

The warning process in Piedras Negras was conducted by local officials at first, and as the threat grew more imminent, by radio broadcasts. For a variety of reasons, including a rumor that the local officials wanted the population evacuated so that they could rob their houses, the citizens did not take adequate protective action in response to official warning. Further, the warnings were disseminated in a disorganized fashion. Means of dissemination included personal contacts by officials, army personnel and people who had heard of the flood; as well as messages broadcast by loudspeaker trucks. One of these loudspeaker trucks alternated the warning with an advertisement for a local theater. It was not until the radio began broadcasting flood reports and more directive warnings that the population began to respond to the danger. By that time it was too late

1. Clifford, Roy A. The Rio Grande Flood: A Comparative Study of Border Communities in Disaster, National Academy of Sciences-National Research Council, Publication 458, Washington, D.C., 1956.

for many to save their personal belongings. Over 40 percent of those interviewed by the researchers reported losing everything they owned to the flood. Over 200 people lost their lives.

On the other side of the river, conditions were considerably different. The earliest warnings heard by the people in Eagle Pass tended to be from friends and neighbors, because local officials at first systematically concentrated their warnings in the most threatened areas. Those who heard the official warnings took them very seriously and made preparations to evacuate if evacuation were required. The result was that, of those with any loss due to the flood, only two percent lost most of their personal belongings. And, although over 200 were killed in Piedras Negras, none lost their lives in Eagle Pass.

A variety of influences were present in the two cities to create these strikingly-different responses to the same threat. The people of Eagle Pass were quicker to recognize the danger, while most of the Piedras Negras people felt that the levees which were built to withstand a flood the magnitude of the worst recorded to date (1952) would hold against all floods. Eagle Pass was more willing to believe the official warnings; one official had a line painted on shopwindows along the main street to indicate the level the crest would reach. In Piedras Negras there was a culturally-induced distrust of all local officials, and their warnings were not believed. These various factors illustrate a key point: effective warning is possible where the warning agencies let the environment help them.

Disaster research literature is replete with similar examples. More than 1800 Hollanders died on 31 January 1953 when the "impervious" dikes failed and allowed vast areas of the Dutch lowlands to be flooded. In some cases the warnings were laughed off, as in the case of "a retired sea captain (who) sprinted through the streets of Kortgene shouting warnings of the flood. The official Dutch report says that he was 'put down as a fool' and people slept on."[1] On 11 April 1965, the U.S. Weather Bureau was able to forecast and disseminate warnings for the Palm Sunday tornadoes. As the official report notes: "...the calibre of these forecasts provides a striking example of progress in severe weather forecasting since the Severe Weather Local Storms (SELS) Center was first established to carry out this most difficult task..."[2] The report goes on to say that a large number of people in the threatened areas were aware of the forecasts, but 271 died and a large number were injured. The reasons offered are similar to those found in other disasters: many just could not believe the warnings, it was a balmy Sunday, tornadoes happen in Kansas, not in Indiana, Michigan or Ohio, and nothing has ever come of previous tornado forecasts. As a result, the effects were catastrophic.

On the other hand, even the incredible can be made credible. Few living near Natchez, Mississippi, would have believed in early March 1962 that by the end of the month they would be faced with the threat of a chlorine gas attack comparable to the dangers in the World War I combat trenches; or that there were possibilities of between 10,000 and 25,000 being killed, and another 40,000 to 50,000 being injured, all because a barge carrying four tanks of liquid chlorine shipped too much water and sank 80 feet under water.[3] In September of that year, when recovery operations were initiated, people in the area not only believed that a disaster could strike, but were prepared for its occurrence. Alerting procedures were established and understood, children could clear a school house and be in evacuation trucks within minutes, over 34,000 people had been issued gas masks, the location and facilities available at evacuation

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1. Robinson, Donald The Face of Disaster, Doubleday & Company, Garden City, 1959, p. 53.

2. Weather Bureau Survey Team, P. H. Kutschenreuter, Chairman, Report on the Palm Sunday Tornadoes of 1965, Department of Commerce, Washington, D.C., 1965, p. 1.

3. The following discussion is based on Public Health Service, Report on Operation Chlorine, U.S. Department of Health, Education and Welfare, Washington, D.C., 1963.

centers were well known and most of the nonambulatory invalids in the area had been evacuated well in advance of the danger time.

This switch in public thinking was made possible by the smoothly-coordinated efforts of a number of agencies, both official and private. Realizing the extent of the threat, and the potential difficulty in convincing the population of this, officials without initiating panic decided on a policy of keeping the public constantly apprised of all significant developments in the recovery operations. "It was felt that people who are fully informed concerning a potential danger become a fully prepared people. There was no panic."[1] The public information function closely followed the development of the threat reduction efforts. Before the salvage operations began, news releases were widely disseminated explaining the procedures and attendant dangers. The nature of chlorine gas and techniques to circumvent its effects were also described to the public. Officials in charge of the operation made themselves available for interviews with personnel from newspapers, radio, television and magazines.

As the crisis period neared the public was ready. They listened to their radios and quickly grapped up available newspapers, eager to learn every detail of Operation Chlorine; and the news was made available to them. During the recovery the U.S. Army Corps of Engineers issued two bulletins daily, and, as each tank was lifted from the water, newsmen broadcast a description direct from the decks of an observation ship provided for that purpose by the Corps of Engineers.

The foregoing illustrations of the impact of the social and psychological environment upon effective warning also can be seen in other disasters that have been studies. Given the types of responses illustrated above, it is possible to conclude that if the public is to be effectively warned, the warning must be complete, consistent and credible. From disaster studies it is evident that such a warning:

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1. *Ibid.*, p. 26.

1. Secures the attention of the recipients,

2. Makes the recipients aware of an environmental change wherein a threatening situation has developed,

3. Conveys information about the threatening situation to the recipient. This information includes an identification of the threat, an indication of the imminence of the threat, and a personalization of the dangers involved. And,

4. Indicates a course of adaptive behavior to the recipient by supplying a directive for action.

Thus, it appears that an effective warning, in exhibiting the above functional characteristics, also provides assurance to the recipient as to the authenticity and validity of the warning. It is necessary to convince the recipient that the warning means what it says and is to be heeded.

A detailed study of factors in warning message credibility is presented in Appendix A of this report.

ATTACK WARNING ENVIRONMENT

Two models of the warning environment are required, because changes in the strategic environment no longer permit the worst-case threat to be identified with the more-likely threat contingencies. Accordingly, two warning environment models can be postulated:

1. Escalation model: Normal environment → Crisis environment → Attack environment.

2. Surprise attack model: Normal environment → Attack environment.

As the escalation model reflects the more likely threat contingency, it is necessary to consider the effects that a crisis buildup period would have upon the dissemination, warning information and warning credibility requirements of an attack warning system. Additionally, the national warning requirements for crisis warning in each of these requirements areas must be determined.

For attack warning, the condition of the public (i.e., their receptivity and responsiveness to warning) will not be the same for each of these warning environment models. As such, the warning information and warning credibility requirements will not be identical in each case. Similarly, the distribution of the national population at the time attack warning has to be issued will not be identical for each model. The issuance of crisis warning during a crisis period can be expected to perform a prealerting function, in that various segments of the national population would be more likely to be within the reception areas for attack warning. Thus, while the coverage requirements (total coverage of the nation) may be constant for both models, the prospects for achieving maximum warning reception will vary with the postulated warning environment model.

It must be noted that what is viewed as most critical and/or most problematic in the warning process, changes with the warning environment model being considered. Thus, within the surprise attack environment, the achievement of assured dissemination of warning, and the establishment of a credible warning, are equally critical for effective warning. Where there is no advanced preparation period for developing public receptivity and responsiveness to warning, the authenticity of the warning has to be established within a single warning experience. On the other hand, for the escalation model, the warning credibility issue is less problematic, since the public would have been conditioned over some time period to the possibility that attack warning might be issued. Even where the crisis period is characterized by a series of heightened and relaxed tension cycles, the difficulties associated with establishing belief in the warning, although increased, are not as severe as in the case of a surprise attack.

Although further study is required, the relationship between a crisis buildup and increased public responsiveness to warning is not as obvious as it may appear. For example, occurrences of given false alarms in times of international crisis have not disclosed any significant improvement in public responsiveness to warning. Those people who were not indifferent to the siren, merely sought further information on the meaning of the given signal. These experiences have tended to support the position that voice messages, immediately following an alert signal, to reenforce and confirm the signal, are essential to effective warning.

In order for the public to become fully cognizant of the impending dangers and to become more receptive to warning, it appears that they need to see overt changes taking place in the national and local environment, in addition to receiving official pronouncements about the mounting crisis. As a stimulus to action, changes in the status of the local environment have the most immediate and most pronounced effect upon the members of that community.

Less direct and less forceful in impact are changes in the national environment, since these are not readily observed by the general public. This being the case, local actions are required to increase the readiness and receptiveness of the general public in times of international crisis, to serve as reinforcements of reports on international changes, and to serve as indicators of the significance of these changes to the local community. It is also the case that reports on the international situation serve as the incentives for local actions. Without both events taking place, the overall effect of increased public receptivity to warning is difficult to achieve.

In order to be convincing, the issuance of warning about a mounting international crisis has to be coordinated with local civil defense readiness and emergency measures that are apparent to the public. As a consequence, warning about a crisis would by definition be disruptive to the normal activities of society. In effect, information about a crisis conveys to the public the fact that the survival values of society have an increasingly higher probability of being placed at risk.

V. IMPACT OF ENVIRONMENTAL FACTORS ON WARNING REQUIREMENTS

The range of possible attack and defense alternatives described above in Section II and III demand that any attack warning system be a flexible system. This flexibility must allow for a selective response to a particular attack/defense strategy. Thus, an all-out attack launched by the Soviet Union (a Class One attack in the structure developed in Table 1) requires prompt and general dissemination of warning to the entire population. A limited Soviet attack (Class Two attack) or an Nth country attack (Class Three attack) may require more selective warning. Both kinds of attack probably have high potential for escalation, and in any given situation a general warning may appear either as a signal that the United States is preparing to launch an all-out attack, or alternately may encourage an all-out attack upon the United States because of the centralization of significant portions of the population in fallout shelters. Flexibility also must allow for ongoing modification to the warning system to watch long-term changes in overall attack/defense postures. Thus, a warning system that supports a ballistic missile defense designed against an Nth country attack must allow for ready modifications if the ballistic missile defense is ecpanded to protect against more sophisticated and/or heavier attacks.

The range of social and psychological factors affecting the warning process (Section IV, above) also must be recognized in the requirements for a warning system. The requirements for an effective warning system must recognize the limiting possibility of a surprise attack, and must provide for developing the most positive public response to a warning as the limited warning time allows. The requirements also must allow for effective use of the time afforded by a crisis buildup, and for exploitation of the change in the perception of danger that such a buildup can occasion.

Even where the public is effectively warned, however, the warning will not be necessarily effective in saving lives. The life-saving potential of warning is only partially determined by the capabilities of a warning system. Thus, to be effective, the decision to warn must be made on a timely basis. System response time in disseminating the warning to the public, and the response time of the public in recognizing, interpreting and preparing to act upon the warning, represent delaying factors affecting the timeliness of warning. These delaying factors reduce the available time for the public to act. Of greater significance is the time spent in moving to available shelters. Similarly, even where the public has been effectively warned and where the warning is received in time, the effectiveness of warning in saving lives is dependent upon the adequacy of available protective measures against the hazards of the attack threat.

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CHAPTER TWO

ORGANIZATIONAL ASPECTS OF THE WARNING SYSTEM

I. INTRODUCTION

All federal, state and local governmental agencies, and all citizens, will be affected during a civil defense emergency, and they will be engaged in some form of emergency preparation. To achieve effective mobilization, civil defense organizations will be required to coordinate their activities, and to provide their skills to other organizations unskilled in emergency operations. In addition, depending on the preparedness of specific organizations at the onset of a developing emergency, an interval of time is required for placing in effect measures that should result in an optimum defensive posture. Therefore, these organizational requirements must be adequately met by the warning system.

In this chapter the specific organizations vital to carrying out established civil defense programs and charged with the responsibility of coping with emergency situations are described. An analysis is made of the warning needs of organizations with civil defense responsibilities. This analysis includes the actions required by organizations to accomplish mobilization, the information required to initiate mobilization, the time required to accomplish mobilization, and the types of equipment needed to disseminate the information.

Civil defense organizational warning can be described as the issuance of warning of impending public danger by an official source to organizations with civil defense responsibilities. This warning is for the purpose of mobilizing organizations and increasing their civil defense readiness posture.

Analysis of the requirements for organizational warning is based on the federal organizational structure (including the regional structure) as it relates to a realistic model of a state organizations. From this analysis, the study endeavors to identify major organizational warning problems, and suggests alternative measures that would lead to the solution of the problems. A description of the overall organizational structure for civil defense and of the various agency functions is presented in Appendix B of this report.

II. PRESENT ORGANIZATIONAL WARNING STRUCTURE

The warning sources and procedures that currently are used to notify civil defense organizations of pending military crisis or disaster are described in this section.

NORTH AMERICAN AIR DEFENSE COMMAND

The North American Air Defense Command (NORAD) is charged with the mission of the military air defense of the North American continent. To accomplish its mission, NORAD maintains a system of detection radars to warn of the approach of enemy aircraft or missiles threatening to the North American continent.

In addition to its surveillance radar system, NORAD maintains a complete intelligence assessment capability with inputs from its own intelligence facilities and the National Military Command Center. The threat analysis function is a continuous process of evaluating the international situation to determine crisis conditions that could lead to the requirement for increased military readiness. If the NORAD commander decides to increase the defense posture, increased Defense Readiness Conditions (DEFCONs) and Air Defense Warnings are issued as appropriate. These warnings are passed to designated military command and Federal governmental agencies, including the State Adjutant General, through military command channels. OCO maintains an office at NORAD headquarters with direct access to current threat information and DEFCON status. It is from this office that Civil Defense attack warning would originate.

CIVIL DEFENSE WARNING SYSTEM

The Civil Defense Warning System (CDWS) is the means established for disseminating attack warning and other emergency information throughout the continental United States. The CDWS consists of federal, state and local systems combined, and is called the National Warning System (NAWAS). NAWAS consists of full-period, private-line voice circuits to key points throughout the country that are available 24 hours a day. The state portion of the CDWS is the communications utilized by the states and their political subdivisions for disseminating warnings from NAWAS warning points to local communities. The local portion of the CDWS is the means used by each community to give warning to the public.

National Warning System

The United States Army Strategic Communications Command (USASCC) is responsible for the functions, personnel, property resources and operational responsibilities of NAWAS. However, USASCC is responsive to the civil defense warning and communications requirements established by OCD.

There are three OCD Warning Centers interconnected with eight OCD Regions, 761 Warning Points and the OCD National Headquarters. The OCD Warning Centers are: National Warning Center (NWC) located in the NORAD Cheyenne Mountain Complex (NCMC) near Colorado Springs, Colorado; National TWO Warning Center (N2WC) at OCD Region Five Headquarters at Denton, Texas; and National THREE Warning Center (N3WC) near Washington, D.C.

There are two separate NAWAS circuits: the control circuit and the warning circuit. The control circuit interconnects Warning Centers, OCD Regions and OCD Headquarters, and is used primarily for exchange of tactical information. The warning circuit is composed of three area warning circuits that can be operated from any Warning Center as a nationwide system, or separated to give area-specific emergency information to states and their political subdivisions. The NAWAS Warning Circuit interconnects the Warning Centers to federal and civilian warning points located in the states within the Warning Center area. Warning points are located at federal installations, state and local police stations, sheriffs' offices and fire departments.

Warning points that are the normal terminal points for the NAWAS warning circuit manually relay the warning messages on to local authorities for dissemination within their areas of responsibility via available radio and telephone facilities.

The NAWAS Extensions program provides for warning information to be automatically disseminated, without relay, past the NAWAS terminal points to selected emergency operating centers and to other authorized locations in counties and cities.

State and Local Systems

The state portion of the CDWS is established by the particular state, and the facilities used vary from state to state. The purpose is to relay emergency information within the state from NAWAS warning points to political subdivisions and local warning points. The local warning systems are generally comprised of indoor and outdoor warning devices (sirens, horns, bells, lights, etc.) used by communities to warn the public and alert key personnel of impending danger. These systems are not tied directly to NORAD or NAWAS.

THE EMERGENCY BROADCAST SYSTEM

The system utilized by the President to disseminate news and information to the public is the Emergency Broadcast System (EBS).

The EBS has no direct tie either to NORAD or NAWAS, but is designed to provide the President, the Federal government, and state and local governments a means of communicating with the general public through nongovernment broadcast stations during the period preceding, during and following an enemy attack or other disaster.

The EBS plan provides for using facilities and personnel of the entire non-government communications industry on a voluntary basis. However, only those broadcast stations holding National Defense Emergency Authorization (NDEA) will be allowed to remain on the air during a declared national emergency.

Activation of the EBS system is only on the authority of the President. When the decision is made to activate the EBS, U.S. Army personnel at the classified location near Washington, D.C., who have been given operational responsibility for the EBS, transmit an Emergency Action Notification (EAN) message via Teletype over AP and UPI radio wire circuits to all radio stations. Stations participating in the EBS by NDEA "transmit the Emergency Action Notification Signal ...followed by a message indicating that the EBS is going into operation, that listeners should tune to a station that is participating in the EBS in their area, and that the transmitting station is covering a particular area. The participating EBS station announces several times the name of the locality to enable listeners to find the proper station for information applicable to them. Stations that do not have NDEAs follow a similar procedure except that they announce that they are going off the air, instruct their listeners to tune to a local EBS station, and turn off their transmitters."[1] At the same time that EBS is activated an announcement will be made over NAWAS to the effect that EBS has been activated.

NDEA stations have a common program priority system as follows:

1. Presidential messages
2. State messages
3. EBS operational area programming and news
4. National programming and news (including regional)

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1. Lamoureux, Robert L., et al., Emergency Operating System Development Project Warning Task, TM-L-2454/001/00 (Draft), 22 October 1965, p. 6-32.

Under all conditions, top priority will go to the Presidential messages that all NDEA stations must carry at time of transmission.

PRESIDENTIAL WARNING PROCEDURES

The President, as cited under the EBS description, has the final decision of officially informing the public regarding developing crisis situations. Retention of this prerogative allows the President more effectively to manage a crisis situation in the best interests of the country. When the decision to warn the public has been made, the EBS system is the means for mass communications to the public. Prior to a national emergency during peacetime conditions, Presidential broadcasts to the public are handled entirely by existing nongovernment radio and television broadcast facilities without activation of the EBS.

OCD WARNING PROCEDURES

The National Warning Center is located in the NORAD Cheyenne Mountain Complex, and provides OCD federal organizations, through the warning centers, access to North American Air Defense tactical information, including the threat warning, nuclear detonation (NUDET) reports, sabotage reports, damage assessments and operational intelligence. The NCMC decisions and actions affecting continental air security, as they relate to civil defense, are the ultimate value in OCD access to the NCMC information.

As noted, if the NORAD commander in the process of evaluating the international situation determines that crisis conditions are developing to the point where the military defensive posture should be increased, he issues increased Defense Readiness Conditions and Air Defense Warnings commensurate with the crisis. The military forces and appropriate federal governmental agencies effect those measures that will increase their defensive posture in accordance with the particular DEFCON requirement. The federal OCD organizations are given increased DEFCONs when the international situation has deteriorated to the point where a high probability of a crisis exists. If the NCMC determines that an attack against the North American continent is imminent, Attack Warning Officers manning the NWC, N2WC and N3WC are required, in accordance with OCD policy, to issue voice "Attack Warning" messages over NAWAS. Following an Attack Warning, warning centers disseminate supplemental warning information to warning points in their areas of responsibility.

STATE WARNING PROCEDURES

Prior to the Presidential announcement of a developing crisis, the states are responsible for assembling and analyzing their own information from the commercial news media. This information is made available by the President and the Federal Government to the general public through White House press releases.

After the declaration of a civil defense emergency, the President will give warning to the general public in the form of a Presidential message over EBS. EBS also is programmed for issuance by state and local government officials of civil defense instructions and special news releases to keep the public informed on specific area information.

The NAWAS, through the civil defense warning centers, passes attack warning and other emergency information to warning points, which further disseminate this information to state civil defense organizations according to approved state and local plans.

III. WARNING FOR INCREASED CIVIL DEFENSE READINESS

Since the development of an operational nuclear ICBM capability by the Soviet Union, it is possible that an attack could be launched against the North American continent without prior warning. In case of an ICBM attack, and even with NORAD's eleaborate surveillance systems, the warning time from detection to detonation would be from 15 to 30 minutes, depending on the launch point and area of impact.

The Civil Defense Warning System is capable of disseminating warning information to civil defense organizations within the 15-minute missile warning time. Survival, however, is unfortunately related to how fast the public can be warned, to the time required to take protective measures, and to the facilities available for protection.

Many military and civilian experts in international politics believe that any all-out nuclear attack would be preceded by a period of rising international tension.[1] Information about a developing crisis could give some measure of time for the initiation of civil defense actions that are primarily the responsibility of the state and local governments.

During an escalating crisis, there should be specific indicators that would point toward the desirability for taking previously-determined actions to increase civil defense readiness. These indicators may also be used to estimate the probable time remaining to prepare for an attack were one to occur. Determination of these indicators is the most important factor in the decision to warn, and one of the most difficult tasks associated with warning.

The present procedures for providing warning to civil defense organizations during a period of increased tension appear to be inadequate at all levels of the civil defense structure, with the possible exception of those of the National Warning Center. (The National Warning Center has access to NORAD precrisis information, but it has no authority to disseminate this information to civil defense organizations.) The only procedures established for such warnings are those of the Emergency Broadcast System, which is primarily for use by the President in giving the public general information about a crisis and in making the Presidential press and news media releases available to the public on a daily basis. During a developing crisis, the EBS and news media sources of information do not

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1. Civil Defense 1965, MP-30, Office of Civil Defense, April 1965, p. 23.

provide for warning in advance of a general public awareness of a crisis. This is a critical shortcoming of civil defense warning, since there are numerous actions that should be taken by civil defense organizations prior to escalation of a crisis to a national emergency.

Crisis analysis specialists at the federal level are continually making estimates as to the severity of crisis conditions, and are in the best position to know the probability of crisis escalation and to estimate the time remaining prior to attack. With proper emphasis on the civil defense aspect of crisis management by the Presidential advisors, and by close coordination with the Office of Civil Defense, an effective system could be developed that would result in an effective warning for civil defense organizations.

Even though the requirements to effect additional protective measures during a developing crisis are well recognized, the problem remains at all organizational levels of civil defense of determining the status of the crisis and the measures to be taken in relation to the crisis. During an emergency, the state and local governments and civil defense organizations have primary responsibility for taking protective measures that will assure maximum survival. Therefore, this is the level requiring the most reliable and timely crisis information. However, the prime source of precrisis information at state and local levels is the commercial news media that communicates to the public official federal positions as revealed by the President.

In addition, AP or UPI often print the first news of a developing crisis, and it is then necessary for state and local governments to perform their own analyses and decide what preparatory actions are necessary. In an attempt to compensate for the lack of federal guidance, certain states have developed their own systems of determining civil defense readiness conditions. These defense conditions provide state and local officials with appraisals of the international situation and of actions considered necessary to place the particular state in a readiness condition commensurate with the crisis. These defense conditions are arrived at in different ways by each state and local agency, therefore the responses are not the same and lead to varying degrees of actions at all levels.

IV. RECOMMENDATIONS

There is an urgent requirement to regulate and formalize crisis information passing from the Federal Government to the state-level civil defense organization. It is not intended that highly sensitive government policy information be released. As a minimum, however, it is recommended that news releases indicating a potential crisis situation be consolidated and passed from the appropriate federal crisis management facility to the states as an analysis of the crisis situation. This analysis then could be related to the civil defense readiness condition that would indicate required actions. These actions would not be the same for all levels of federal, state and local government. The actions required would differ among most organizations depending on the degree of preparedness of each at the time of the warning, the time remaining, and the constraints placed on civil defense by federal crisis management decisions.

In order to determine the civil defense readiness actions required during a particular increase in international tension, analysis has to be made as to the severity of the crisis, from the time of detection, through increases in severity, to possible attack. A continuous updating process must be available for determining readiness status for all levels of civil defense. Each civil defense organization has specific program planning goals, and should have target dates for accomplishing each goal. The time-phasing of these goals will give individual organizations guidance on those actions to be accelerated and completed prior to a crisis developing into an attack.

Any system devised to achieve adequate warning to civil defense organizations should be a flexible system capable of 1) being controlled from the federal crisis management level, 2) giving specific area warning as appropriate, and 3) providing sufficient analyzed crisis information to civil defense organizational personnel so they can determine the imminence of the crisis.

Those crisis management personnel making the decisions to give warning to civil defense organizations must be knowledgeable in the functions of civil defense. They must know the requirements of civil defense, and the effect their decisions would have on the overall civil defense preparedness program. This familiarity with civil defense must include a working knowledge of the detailed categories of civil defense activity and of the actions expected under each activity. Further, crisis management personnel must be informed on the current status of civil defense preparedness by the Office of Civil Defense, and must be aware of what that status means in relation to the national survival.

The recommended warning system would not include classified information, even though the analysis could have a sensitive connotation giving official recognition to a crisis area. However, the sensitive nature of the information could be controlled, and the analysis of the information could be given the degree of urgency desired. The releases could provide a system for recommending specific types of actions to be taken, or curtailment of actions not considered appropriate.

An alternative and preferred recommendation to the news media consolidation procedure is a combination of analyzed news and a code name-associated system. This system, in addition to giving an analysis of the news, would also associate a readiness condition code name (REDCON) with the crisis condition. This code name would indicate the degree of seriousness of the crisis, but would not necessarily relate to the time remaining for preparation. The code name association could be used by civil defense organizations below the state level as a common reference to the degree of danger related to news distributed to the general public.

A suggested series of Civil Defense Readiness Conditions have been developed, numbered inversely from Four through One.

Each REDCON would indicate degrees of international tension, ranging from normal condition REDCON-4 to extreme emergency or "Civil Defense Emergency" REDCON-1. These conditions should mean the same to all civil defense organizations and should indicate uniform degrees of danger. They should emanate from the national level and be passed to the state level, and as appropriate, through the civil defense organizational structure.

Development of the above procedures would provide civil defense officials some official measure of the crisis condition, and a means of estimating the actions required to carry out increased readiness. Since releases of REDCONs and international news releases would emanage from the Federal Government, control of crisis information and desired readiness actions could be more effectively accomplished.

REDCON-4 would indicate a normal international situation and that all actions required during day-to-day development of the civil defense program should continue in a normal manner.

REDCON-3 would warn civil defense organizations to review all civil defense plans and procedures, brief appropriate civil defense personnel, conduct run-through exercises on procedures, accelerate training and plans for personnel augmentation, and take any additional actions specified by higher governmental authority.

REDCON-2 would indicate that all of the actions recommended by lesser-degrees of REDCONs should be accomplished, and in addition, to arrange shift schedules, consider leave cancellation, check supplies and replenish as appropriate, review interagency procedures at all levels including the military, update increased readiness status reports to higher levels of government, accelerate those plans that could be completed without creating public concern, consider minimum manning of Emergency Operating Centers, verify shelter facilities, check communications, review RADEF monitoring and reporting procedures, and check warning facilities.

REDCON-1 would indicate the requirement to complete all of the above actions, and in addition, that all leaves of absence should be cancelled, Emergency Operating Centers manned 100 percent, all emergency communications activated, warning procedures checked, shelters activated and supplied, coordination made with industry and public information services, noncivil defense personnel augmentation arranged, and any other actions taken that would result in a better defensive posture for survival.

Prior to the implementation of this system, a complete indoctrination program for regularly-assigned civil defense personnel and the federal-level crisis analysts and decision makers should be conducted. This indoctrination would explain the system, stress the potential sensitivity of information that could be received, and the unfavorable consequences of unauthorized release of this information to the general public.

The REDCONs and associated analysis should as a minimum be passed in hard-copy format to the state-level civil defense agency, where the decision to inform below that level could be controlled by the governor and his special analysts. They would further evaluate the information and determine appropriate further distribution for their particular state.

The communications system recommended for passing REDCONs and news media analysis to organizations is the established National Communications System No. 1 (NACOM-1). The NACOM-1 is a leased teletypewriter system with alternate secondary-use telephone facilities. It connects the OCD National Headquarters, Regional Headquarters, the special facility, and state civil defense offices. The system also has interconnection facilities with other government, military, and commercial systems. In addition, it serves to connect with the emergency relocation sites of selected federal government agencies.[1]

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1. Kutchenreuter, Paul H. (Chairman, Natural Disaster Warning Survey Group), A Proposed Natural Disaster Warning System, Department of Commerce, October 1965, p. 66.

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CHAPTER THREE

RELATIONSHIPS BETWEEN CIVIL AND MILITARY WARNING

I. INTRODUCTION

As a result of one delegation[1] and two redelegations,[2] the Director of Civil Defense has the responsibility for "all steps necessary to alert and warn the Federal military and civilian authorities, state officials and the civilian population." The existence of this responsibility, and the fact that there are many military systems that perform various warning functions, prompted the study reported in this chapter. As discussed below, only military facilities whose primary mission is combat-oriented were considered in detail.

PURPOSE OF STUDY

The purpose was to:

- determine if any combinations of civilian and military warning systems were feasible, and
- identify the areas where such combinations could be effected.

Two types of combinations were considered. The first is a functional combination, using one set of actions to accomplish two purposes. (A hypothetical example of such a functional combination would involve modifying the current

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1. Assigning Civil Defense Responsibilities to the Secretary of Defense and Others, Executive Order 10952, as amended, 20 July 1961, amended 27 September 1962.

2. Department of Defense Directive 5160.50, Subject: Civil Defense Functions, 31 March 1964, was a redelegation to the Secretary of the Army. The Secretary of the Army redelegated his authority to the Director of Civil Defense, 1 April 1964, according to the Federal Register, (29 F.R. 5017), 10 April 1964.

DEFCON procedures so that DEFCON changes could be distributed to both military and civilian agencies.) The second type is a combined use of facilities. (A hypothetical example of this combination of facilities would involve modifying the National Warning System (NAWAS) to service all, or a substantial number of military facilities, in addition to its current and primarily civilian users.)

APPROACH

The two types of combinations were considered more or less independently. The functions (missions) of various combat-oriented military systems were examined to identify similarities to civil defense warning functions, and to determine the feasibility of combining functions. The facilities used to perform the functions were not ignored completely in the initial analysis. (For example, the Ryukyu Air Defense system, 418L, was not analyzed functionally because of location of facilities.) But the assumption was made that if a functional combination were feasible, equipment modification would be relatively minor--a matter of adding additional terminal equipment and connecting it. Joint use of facilities for separate purposes, however, depends on the characteristics of the facilities themselves, and is relatively independent of the individual purposes. Capacity of the facilities, of course, had to be considered in both steps of the analysis.

LIMITATIONS OF THE STUDY

Because the initial scope of the study, as defined above, was too broad for the limited time and funding available, the study of the relationship between civil and military warning was arbitrarily restricted to the warning process for military facilities whose primary missions are combat-oriented. It is evident that the military warning process also serves military facilities whose primary missions are not combat-oriented, as well as civilian dependents and employees associated with many military facilities. This aspect of the military warning process was not specifically studied; however, limited information collected as a result of the study of warning to combat-oriented facilities indicates that further study of warning to facilities whose missions are not combat-oriented, and to civilian dependents and employees, has a high potential for payoff in terms of more effective warning to a significant number of people, reduced costs, or both.

II. FUNCTIONAL ANALYSIS

The many complexities and levels of operations involved, and the fact that terms themselves are used differently in different contexts, precludes any general analysis, or even discussion, of military warning systems and civilian warning systems. For this reason, the analysis was based on specific military systems and the functions of those systems that could be compared with civil defense warning functions, rather than on a comparison of the systems themselves. In order to make the study as complete as possible, and at the same time to avoid complex semantic discussions, no definition of terms, or categorizations of systems, was imposed on the study in advance. Military systems of various types (warning, alerting, communications, command, control, etc.) were examined, and their functions were analyzed before any attempt was made at generalization.

Early in the study effort it was determined that, because of the military command structure, no combat-oriented action could be taken on the basis of a civilian warning. In addition, any information that could serve as warning for combat purposes would of necessity originate at military sources, and the addition of a civilian middleman in the distribution of such combat-related information to the military could only hamper military actions. The emphasis of the remainder of the study was therefore concentrated on the possible use of military information for the civilian warning purposes. Because of this limitation imposed by the military command structure, it appears that the use of civil defense systems for warning military facilities with combat missions is not feasible. However, as noted in Section I above, the possibility of payoff exists from further study of use of civil defense facilities to warn military facilities without primary combat missions, as well as civilian employees and dependents on military bases.

MILITARY SYSTEMS FUNCTIONS

The number of military systems in existence, or under development, is so vast that examining all of them would be virtually impossible. Armed Forces Management (AFM) magazine has catalogued over 3,000 military systems,[1] and over 3,000 military electronic systems[2] (mutually-exclusive categories). These systems range from single weapons systems to elaborate, computer-based command and control systems. Many of these, of course, could be eliminated just by examining the brief description included in such a catalog. It is reasonably obvious that ADDPEP, a "missile for testing deceleration and stabilization,"[3] and AN/BQR-3, a "submarine passive sonar system,"[4] do not perform any functions that might be useful for civil defense warning. There are, however, many other military systems, including some that AFM does not describe, that do perform functions analogous to civil defense warning functions.

Although the aim was for an exhaustive study, it was not possible for all of these systems to be investigated. In addition, not all the systems that were studied are described here. This section is limited to information available from unclassified sources on systems, or groups of systems, whose functions were considered to be closely related to civil defense warning functions. The descriptions, and the systems, are arbitrarily ordered for ease of functional comparison with civil defense warning, and not by any characteristics of the systems themselves. Thus, since NORAD is the obvious starting place for comparing civil and military warning functions, systems that respond to, report to, or are controlled by the Commander-in-Chief of NORAD (CINCNORAD) are described

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1. AFM Editors, AFM Fourth Annual Military Systems Catalog, Armed Forces Management, March 1966.
2. AFM Editors, AFM Fourth Annual Military Electronics Systems Catalog, Armed Forces Management, July 1966.
3. AFM Military Systems Catalog, p. S-3.
4. AFM Military Electronics Systems Catalog, p. S-9.

first. Because the Strategic Air Command (SAC) must be able to respond rapidly to a warning signal, the system (465L) that supports SAC is described second. The other systems described are included because each uses widespread communications links that conceivably could be used for warning.

NORAD Systems

Since CINCNORAD is responsible for the air defense of the North American continent, and since there is already a close relationship between NORAD and civil defense, NORAD systems were given the most attention in the civil and military warning study. Much of the information obtained was classified and cannot be included here. It is believed, however, that enough general information extracted from unclassified sources can be presented to permit functional comparisons to be made.

The basic functions of the totality of the NORAD systems can be simply stated as: detect and destroy any weapon that threatens to destroy or damage any portion of the continent. Many complex interacting systems perform this function. The main system is 425L, the NORAD Combat Operations Center system, which collects, processes, and displays the data required for CINCNORAD to command and control his forces. The focal point for 425L and related systems is the NORAD Cheyenne Mountain Complex (NCMC), a hardened facility.

The detection function for NORAD's operation is performed by 474L, the Ballistic Missile Early Warning System (BMEWS); 416N, the Sea-Launched Ballistic Missile (SLBM) Detection and Warning System; and the Space Detection and Tracking System (SPADATS). BMEWS provides not only detection but also threat evaluation and impact pattern prediction functions. The modified SAGE radars used in 416N are designed to detect SLBMs launched toward U.S. targets. SPADATS provides CINCNORAD with a capability for the detection and tracking of all satellites. All of these systems, together with other data-gathering systems, provide input information to the NCMC to assist in decision making. The inputs from these systems do not directly result in action, except action by the command staff. After a decision is made on the basis of these inputs, CINCNORAD may command his forces to take action to destroy the detected weapon, or to assume a specified defense posture so as to be ready to destroy an as yet undetected weapon.

The Semi-Automatic Ground Environment (SAGE) System, 416L, and the Backup Interceptor Control (BUIC) System, 416M, under the command of CINCNORAD, combine the missions of detection, identification, interception and destruction of air-breathing threats. Surveillance information is provided from radar sites, displays are presented at the SAGE/BUIC facility, weapons are assigned by the officers in charge of the facility, and guidance commands are given to the weapons by the officers or by the computer a the facility. Information is exchanged among the facilities and between each facility and NORAD headquarters. The purposes of the information exchanges with other facilities are: 1) coordination and 2) advance notice of approaching weapons. Information transmitted to NORAD concerns status of forces, positions of detected threats, and the general air picture. Information coming from NORAD is in the nature of request for information or instruction for action.

Strategic Air Command

The SAC Control System, 465L, is designed to provide the Commander-in-Chief of SAC with the information required for decision making and the means of disseminating commands to his forces. The basic functions supported by 465L are maintaining operational readiness of SAC forces in this country and at overseas bases, and responding immediately to orders to attack. This support is provided in the form of data gathering, processing and display capability, and communications capability for transmitting operational instructions to airbases and missile sites.

Tactical Support Systems

The Tactical Command and Control System of the Tactical Air Command (TAC), System 492L that supports the United States Strike Command (USSTRICOM), and systems that support the Military Airlift Command (MAC), all provide to some degree the capabilities required for fast, flexible response and rapid movement of forces to specific battlefield areas.

The Tactical Air Control System, of which 407L is the ground-based portion, serves the Air Force Component Commanders in their functions of planning, directing, controlling and coordinating resources. It operates as an adjunct to the basic air combat missions of counter air, interdiction, and close air support of ground forces. The main system components are mobile, ground-based installations for air operations in a limited area, transportable to various locations.

System 492 provides semiautomated support to the USSTRICOM and to subordinate Joint Task Force Command elements. The basic mission supported is that of providing forces, ranging in size from a few troops to a division, at locations throughout the world. The first phase of 492L is the Joint Airborne Command Center and Command Post, nicknamed JACKPOT. It is built into small air-transportable wheel-mounted shelters, and can maintain communications links while in transit.

The MAC Command Post System is a tactical organization with a wartime mission requiring positive control over all MAC crews and the Airlift Force. The functions necessary to support this mission include gathering of data on force disposition and aircraft status, and transmitting commands.

Headquarters Systems

Although there are headquarters functions of every major military system (every command has a headquarters), there are some systems that serve headquarters with overall management as opposed to direct operational control functions. The U.S. Air Force Headquarters System, 473L, is the most highly developed of these. A semiautomated system, 473L is a resource management system serving the Air Force Chief-of-Staff. The system provides information to be used in resource monitoring, situation monitoring, plans evaluation, and plans generation and modification.

National Military Command System

The National Military Command System is a composite system that can best be described in terms of some individual functions performed by its users, rather than an entity in itself. The Joint Chiefs of Staff (JCS) are the principal users, and the system can be defined as the set of procedures, techniques and equipment that enable the JCS to perform their functions. These functions include: 1) monitoring of actions being taken by world-wide military forces and the status of these forces, 2) planning and directing the use of these forces, and 3) assisting and advising the National Command Authority in decisions involving use of forces.

Categories of Functions

It can be seen from the brief descriptions above that the functions of military systems generally fall into three basic categories: 1) resource management and the supporting status reporting, 2) surveillance, or sensing, to provide inputs for decision making, 3) transmission of commands, either to subordinate facilities or directly to manned or unmanned weapons.

COMPARISON OF FUNCTIONS

Assuming that the basic function of civil defense warning is to initiate action both by organizations that have emergency duties and by the general population whose duty is to protect themselves, some comparisons can be made with military functions. The resource management and allied status reporting functions of the combat-oriented systems examined in this study do correspond to functions required in the overall civil defense activity. The Integrated Management Information System (IMIS) and the Increased Readiness Information System (IRIS) would serve such functions. Although the warning system must fit into the overall civil defense program, it should not be directly involved in resource management-type activities.

Surveillance, or sensor, functions also are required in the total civil defense program. Infrared fire monitoring, for example, is a surveillance function, but it also is related to warning only as all elements of civil defense are related to each other.

The final category of military function, that of transmitting commands to subordinate facilities (or to weapons) is the one category bearing the closest resemblance to civil defense warning functions. The resemblance however is not close enough to make a combination of the two functions; or more specifically, to make any use of the military function for civil defense purposes either feasible or desirable.

The fundamental differences in the actions required in response to transmitted commands, and the fact that what is transmitted are commands, preclude combination. The military action required is destruction of an enemy in all the combat-oriented cases examined. For NORAD, it is to destroy the attacking weapon itself, for SAC it is to destroy the war-making capability of the attacker; for TAC and others it is a mixture of both. The civilian actions required are protection, either of self or others, from the effects of weapons that penetrate defenses. There is no action to be taken against the weapon itself.

There may of course be times when it is desirable to have SAC bombers in the air and the civilian population in shelter at the same time. There will almost certainly be (and there have been) times when it is desirable to have SAC in the air and the civilian population oblivious to any danger. It is not therefore reasonable to consider using one action or signal to achieve the two purposes. The vast difference in the economic and political effects of getting some or all SAC pilots awake and on duty, and of getting the nation's civilian population into shelter, precludes any combination of these functions.

Similarly, though perhaps not as obvious, it is not desirable to tie NORAD alerting activity to civilian alerting activity and more closely than they presently are tied. There is no need for state and local civil defense officials to receive information about DEFCONS, as these conditions relate to the military task and have no direct relationship to protection of civilian population and resources. Problems concerning the readiness of SAC bombers and NORAD interceptors are greatly different from those of getting the population into shelter.

The final point to be considered in any attempt to compare civilian warning functions with warning for military facilities with combat missions is the relation of the organizations and people involved. As pointed out above, the fact that military functions exist in a command structure is extremely significant. Warnings that are issued to combat facilities are not primarily issued for information or to convince any person that he should protect himself. The information gathered from surveillance systems provide a headquarters with a decision situation, but when information is transmitted out of a headquarters it is in the form of a command to action. This sort of relationship does not exist in the realm of civil defense; there is no tightly-controlled chain of command. Civil defense warnings therefore, whether public or organizational, must be far more informative about actions required than military warnings are or need be.

III. JOINT USE OF FACILITIES

The initial investigation of military systems indicated that, in considering joint use of facilities, detailed examination of specific circuits was not only unnecessary, it was unmeaningful. Except for some very limited and very special-purpose applications, all strategic military communications requirements are being (or will be at some scheduled time in the future) satisfied by the Defense Communications System (DCS). The DCS consists of an Automatic Voice Network (AUTOVON) and an Automatic Digital Network (AUTODIN).

The system management and implementation responsibilities for AUTOVON and AUTO DIN are assigned to the Defense Communications Agency (DCA). Both AUTOVON and AUTODIN are switched communications networks. These systems are being developed separately with an objective of integrating the two systems during the 1970's.[1]

The unfeasibility of combining military and civilian warning functions does not preclude the joint use of facilities. Such joint use--the use of the same equipment and operating procedures to perform two separate functions--is standard in the military, and is the only type of merging of civilian warning and warning to military facilities with active combat missions that should be considered.

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1. Bourcy, Lt. Col. Robert A., USAF, "AUTODIN Worldwide Automatic Digital Network," Signal, March 1966; Col. Lee M. Paschall, USAF, "AUTODIN and AUTOVON Management and Implementation," Signal, March 1966; Defense Communication Agency, AUTOVON Implementation Manual, Vol. I, November 1964, pp. 1-7.

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CHAPTER FOUR

NATURAL DISASTER WARNING CONSIDERATIONS

I. INTRODUCTION

The purpose of this chapter is to describe the natural disaster warning functions that can be performed by a civil defense warning system. To accomplish this task, the following areas were investigated.

1. Natural hazards for which warning is required
2. Organizational responsibilities of agencies providing natural disaster warning
3. Warning systems developed for specific natural hazards
4. Facilities used in communicating natural disaster warning

II. NATURAL HAZARDS

"A natural disaster is an event which is caused by the uncontrolled forces of nature and is sufficiently severe to result in death and destruction of property."[1] Since the inception of the Federal disaster program, the President has declared an average of 15 major disasters each year in the United States. The economic loss averages between $11 billion and $15 billion per year. The annual loss of life averages between 500 and 600.[2]

To fully appreciate the task of natural disaster warning, it is necessary first to understand the phenomena that create the conditions under which disasters

1. Kutchenreuter, Paul H. (Chairman, Natural Disaster Warning Survey Group), A Proposed Natural Disaster Warning System, (NADWARN), Department of Commerce, October 1965, p. 23.

2. Ibid, p. 3.

occur. The purpose of this part is to describe the natural hazards that lead to disasters in terms of their causes, consequences, the nature of advance information that can be obtained, and (when applicable) efforts aimed at controlling their occurrence. This section treats natural hazards as members of three major categories: hydrological (caused by water), meteorological (caused by atmospheric phenomena), and geophysical (caused by forces of the earth).

Certain other hazards are not discussed in this part. Dust storms, avalanches and icebergs are not covered because of their limited effects or infrequency. Hazards such as clear-air turbulence, and drought and weather conducive to forest fires, are bypassed because the warning against these hazards is not systematically or consistently disseminated to the public, but only to organizations that act for the public's safety. For example, warnings of weather that result in high fire hazards are distributed to forestry and range management groups for use in fire-fighting efforts and in determining when to open and close public forests and recreation areas.

HYDROLOGICAL HAZARDS

Floods

Although only 2-1/2 percent of the area in the United States is vulnerable to the effects of floods, almost 25 percent of the population lives in such proximity that they can be either directly or indirectly affected by these events.[1] Neither season nor river size provide assured safety against this hazard. In the southeastern United States, damaging floods have occurred in each month of the year, and flash floods that accompany the summer hurricanes and the spring runoff of winter snow are almost inevitable in various parts of the nation. And, just as the Mississippi can spill over its banks to inundate large portions of the countryside, small creeks and streams can inflict severe damage to lesser areas.

1. Ibid., p. 32

Floods can, and are, being predicted with adequate lead time to allow protective measures and evacuation of imperiled populations. Weather Bureau Water Supply Forecasts, predicting the amount of water upon the melting of winter snow that will enter the drainage basins via networks of streams and rivers, give the first estimate, sometimes months in advance, of spring floods. Private citizens, local officials, and Weather Bureau facilities make observations during times of peak danger and pass the alert as conditions require.

Tsunamis

Erroneously called tidal waves, the powerful, seismically-generated sea waves that intermittently strike areas bounding the Pacific Ocean, combine the destructive energies of an earthquake with the hydraulic force of the ocean. The origin of tsunamis is usually associated with seismic and/or volcanic disturbances. In the absence of earthquakes or volcanic action, it has been hypothesized that such phenomena as submarine avalanches or vertical displacements of the sea floor could cause these waves. Tsunami waves were reportedly responsible for as many as 36,000 deaths in 1883 in the East Indies.[1] In Japan, deaths in the 1896 tsunami numbered 27,000, and another 1000 died in the wave of 1933.[2] In the United States the toll has never achieved such numbers, but on March 28, 1964, a tsunami generated by an Alaskan earthquake killed 132 people and caused 124 million dollars worth of damage along the Alaskan Gulf and the Oregon and Northern California coasts.[3]

Tsunamis are not predictable in the long-range sense, but can usually be detected early enough to give adequate warning to those who might be in danger. The Pacific area is dotted with seismograph stations that automatically report

1. Tsunami, The Story of the Seismic Sea-Wave Warning System, Department of Commerce, undated, p. 3.

2. Ibid., p. 3

3. Kutchenreuter, Paul H. op. cit., p. 34

seismic waves strong enough to generate a tsunami. Based on these reports, the Coast & Geodetic Survey's Honolulu Observatory may issue advisory bulletins notifying participants in the Seismic Sea-Wave Warning System that an earthquake has occurred. The advisory will include the earthquake's epicenter, and an estimated time of arrival for any tsunami that it may have generated.

Storm Surges

Although a problem only on larger lakes and in coastal areas, storm surges cause a great deal of damage. On large lakes, surges are caused by winds blowing at moderate speeds for long periods in one direction. This causes water to build up at one end of the lake and remain there, as though under tension, until its ultimate release when the water rushes to the far side to inflict its damage. The most dangerous surges are those accompanying hurricanes in coastal areas. Here the surge of water is actually pushed against the shore. Seiches are storm surges occurring on the Great Lakes. They are formed by a line of thunderstorms moving over a lake at a critical speed and direction, pushing the water to the far end of the lake, where the waves are reflected back to the other shore. The seiche can do double the damage of a typical lake storm surge, particularly if there are people living on both sides of the lake.

METEOROLOGICAL HAZARDS

Hurricanes

A fully-formed hurricane is a rotating mass of air containing many arranged in lines, often hundreds of miles long, convoluting inward toward the eye of the storm. While this mass is rotating (in the center at speeds of 64 mph and greater) air close to the sea is being pulled into the low-pressure area in the center, where, because of the cooling air at the top of the vortex, it absorbs heat from the sea and starts its own rise. The danger from a hurricane stems from the extremely high winds and heavy rains.

Although not enough is known of the factors that cause hurricanes to allow accurate prediction, there is a well-established season running from early June through November, and in the United States there is an excellent detection system that provides ample warning time for those who might be endangered.

It may be that some day in the future the need for the elaborate warning system will be obviated by techniques to stop, or at least dissipate, these storms. The Navy-Weather Bureau Project Stormfury, which has been in operation since 1956, is aimed at testing the efficacy of at least one proposed technique: massive bombardment, with silver iodide, of the supercooled portion of the core cloud that drives the storm.[1] Experiments have been conducted as recently as Hurricane Faith (late August 1966), but have not proved the effectiveness of this technique.[2]

Additional research on the conditions surrounding the formation of hurricanes is being accomplished with the aid of sophisticated mathematical models and digital computers.

Tornadoes

The tornado is fashioned in about the same way hurricanes are. In both cases moist warm air rises, condenses into rain, and other air rushes in to replace it. The movement of air into a low pressure area begins with the rotation of winds around a focal point. To retain cohesion with the eye, a low pressure center is required. The warm air in the shower cloud provides the "low" for a tornado which, as the rate of rotation increases, is balanced by the centrifugal forces of the winds to produce a funnel between 100 and 200 yards in diameter.

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1. Weather Modification, Seventh Annual Report for Fiscal Year Ended 30 June 1965, NSF-66-4, National Science Foundation, January 1966, pp. 23, 42.

2. Los Angeles Times, August 25, 1966.

The season for tornadoes will vary with the geographical area considered. For the United States as a whole, however, there is no single month in which no tornadoes are reported. The period of greatest frequency is usually between March and September.

Over the past 20 years, tornadoes have done an average of $40 million in damage each year.[1] From 1916 to 1964, deaths per year have averaged 194 in this country.[2]

GEOPHYSICAL HAZARDS

Earthquakes

As many as a million earthquakes occur every year. All but 700 or so may be classes as minor--mostly they are tremors that are barely noticed by people in the area. The more sizeable ones have been known to kill thousands and cause damage upwards of a billion dollars.[3]

Most earthquakes result from shifts in the earth's crust at focal depths of five to 50 miles, resulting in vertical or horizontal movements at the earth's surface. The depth at which the movement focuses affects the surface intensity greatly. The deeper the focal depth, the more earth there is to absorb the shock, and therefore the less damage that will occur at the surface.

There are few areas in the United States that have not experienced a fairly-sizeable earthquake at some time in their history. The greatest shock on the eastern seaboard was centered around Charleston, South Carolina, in 1886.[4]

1. Kutchenreuter, Paul H., *op. cit.* p. 26.
2. *Ibid*, Table I/2, p. 26.
3. Neumann, Frank *Earthquake Investigation in the United States*, Special Publication No. 382, Department of Commerce, Revised (1964) edition, 1965, p. 3. Present day value of the property lost in the San Francisco, California, quake of 1906 approaches that figure. However, much of the damage was a result of the fires that broke out.
4. *Ibid*, pp. 6-7.

A total of 60 people were reported killed, and many buildings were destroyed or damaged. The shock was felt as far away as Boston and Chicago. The largest earthquake ever experienced in this country occurred in the Mississippi Valley region, around New Madrid, Missouri, in 1811.[1] Although this area is usually regarded as safe from earthquakes, the movement at that time created a vast depression now known in Missouri and Arkansas as the "sunken country." In 1963 alone, all but six of the 50 states experienced an earthquake classified as destructive, or nearly destructive.[2] However, two-thirds of all the seismic activity in the United States is confined to the Pacific Coast region, including Alaska and Hawaii.[3] These areas are the scene of the most devastating United States earthquakes because of the extensive faulting along the coast, the volcanic activity occurring in the Pacific Basin, and the submarine fractures and troughs in the Pacific.

Seismologists in many countries are working on earthquake prediction. The Japanese have some evidence that certain phenomena occur as early as two days before a quake. They believe that there may be minute tilting of the ground, changes in gravity, a series of nearly imperceptible tremors called "microseisms" and magnetic changes in underground rocks in advance of large-scale seismic action. American efforts appear to be centered on measuring earth stress along known faults. Another indicator being considered is the water levels of wells, which is extremely sensitive to dilational changes caused by earth stress.

It has been estimated that prediction should be possible within ten years.[4] At that time, earthquake warning will become far more certain than the current method of providing information on what to do while experiencing an earthquake.

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1. Ibid, p. 7.
2. VonHake, Carl A., and William K. Cloud, United States Earthquakes-1963, Coast and Geodetic Survey, 1965, Figure 1, p. IV
3. Ibid, p. 10.
4. Press, Frank and W. F. Brace, "Earthquake Prediction," Science, Vol. 152, No. 3729, 17 June 1966, pp. 1575-1584.

Volcanic Action

The only active volcano that is a direct threat to inhabitants of the United States is the Mauna Loa volcano in the State of Hawaii. Although there appears to be no way of predicting eruptions, volcanoes provide sufficient signs to allow plenty of time for short-term warning. The Weather Bureau has a research and observation unit on Mauna Loa to provide this warning.

III. NATURAL DISASTER WARNING

The responsibility at federal level for natural disaster warning is divided among several different agencies. The Environmental Science Services Administration (ESSA) in the Department of Commerce has the bulk of the responsibility for detecting natural hazards and for communicating a warning to affected organizations. Other departments and agencies, including the Navy, Air Force, Army Corps of Engineers and the Office of Civil Defense, participate in various ways to detect and warn for natural disasters. Warning functions at the state level are performed by the state police, governor's office and the militia. At the local level, local officials, agencies and the mass media all contribute to natural disaster warning.

This section describes the organizations with active roles in natural disaster warnings, their responsibilities, and the communication facilities they use. Also covered are the special-purpose warning systems developed for hurricane, tsunami and tornado warning. Interrelationships are diagrammed in Figures 1 and 2.

ORGANIZATIONAL RESPONSIBILITIES

Environmental Science Services Administration, Department of Commerce

The Weather Bureau and Coast and Geodetic Survey (C&GS) are the primary branches of ESSA with natural disaster warning responsibilities. Both agencies maintain large professional staffs and extensive facilities to perform their warning tasks.

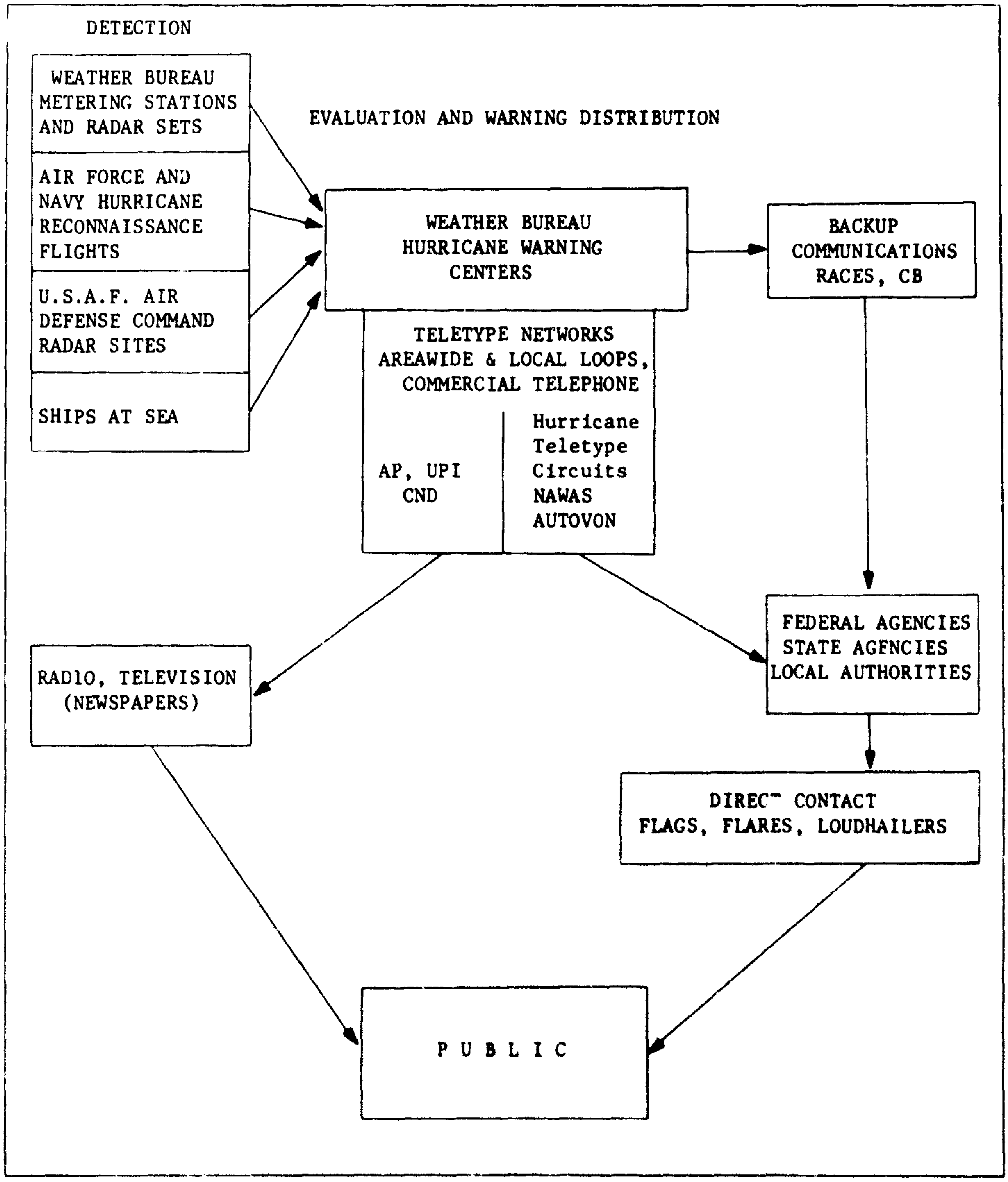

Figure 1. Hurricane Warning Functions

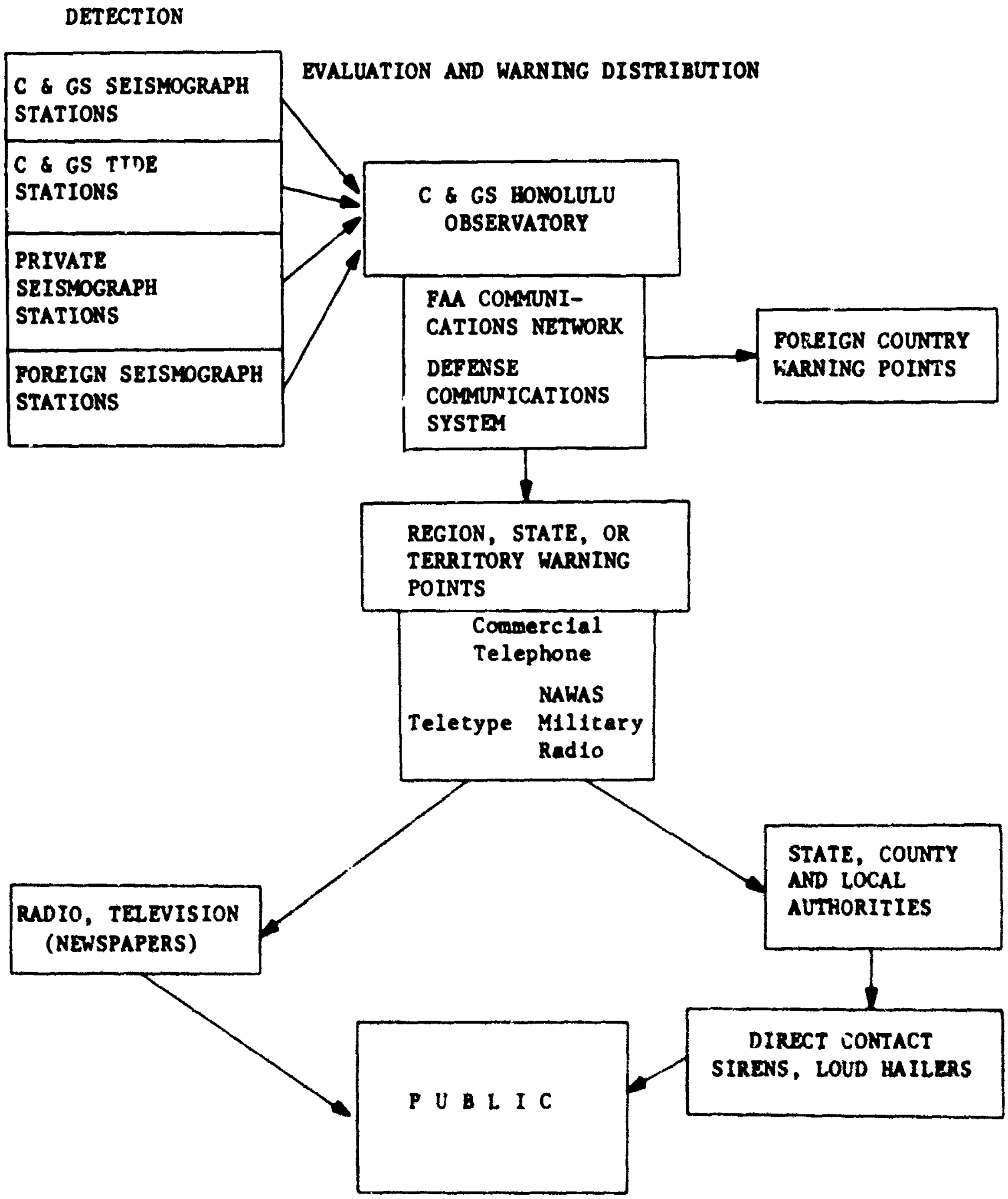

Figure 2. Seismic Sea-Wave Warning Functions

The Weather Bureau Region Office coordinates the activities of subordinate offices and disseminates information to adjacent and higher level agencies. The Region Office is responsible for ensuring that all affected areas are working in concert. There are six regional offices located at New York, New York; Forth Worth, Texas; Kansas City, Missouri; Salt Lake City, Utah; Anchorage, Alaska; and Honolulu, Hawaii.

The forecast centers constitute the heart of the operational system. They are usually equipped with meteorological detection instruments such as radar, TIROS photo receivers, instruments for measuring pressure, temperature, wind velocity, etc., and with direct communication lines to special-purpose sensors such as the citizens' volunteer tornado watch. It is the function of the meteorologists and hydrologists at these centers to examine all input data and evaluate it for its applicability to the public or to any special interest group that might be affected (e.g., commercial aviation, the military, or the maritime industry). On a day-to-day basis the evaluations will result in routine weather forecasts. When conditions are seen as threatening, or are known to be in the process of inflicting damage, the centers disseminate advisory and warning messages through every available channel.[1]

A multitude of lower-level weather observation stations are also incorporated into the system. The weather stations make observations of relevant phenomena and relay this information to the forecast centers for inclusion in the predictions. Included in this network are meteorological stations that make three- and six-hourly measurements of barometric pressure, wind speed and temperature. There are also special aviation stations that record hourly conditions pertaining to aircraft takeoff and landing. The hydrologic stations observe tide movements for storm surge forecasts, and make rainfall and river state measurements to assist in flood prediction. Some of these installations record and transmit their observations automatically by radio or telephone line.

1. Weather warning communications are discussed in detail in "Communication Facilities," p. 88.

The warning functions of Coast and Geodetic Survey (C&GS) are largely limited to tsunamis and earthquakes. To accomplish this task the C&GS has about 250 permanently-assigned personnel at field locations in the United States, its territories and possessions.[1] These men, plus those assigned to vessels and in mobile field parties, use seismographs, magnetometers, visual recorders, tide gauges and other specialized instruments to detect both the normal changes in tide and earth as well as unusual phenomena such as the strong motion associated with earthquakes or the special frequencies of seismic sea waves.

These operations are conducted by the Operations Division, Marine Data Division, Geomagnetic Division and Seismology Division under the direction of the regional field offices of the C&GS. When a seismic threat is detected by one of the specialized units, the warning is called in to the central observatory at Honolulu. From here it is relayed through facilities of the Federal Aviation Agency, Defense Communications Agency, National Aeronautics and Space Administration and the Weather Bureau to all Pacific nations and territories that might be affected.[2]

Corps of Engineers, Department of the Army

The major civil involvement in natural disaster warning of the Army Corps of Engineers centers on their flood-control activities. Public Law 99, 84th Congress, provides authority to the Corps for emergency flood preparations, rescue and flood-fighting during the flood, and reconstruction efforts after the emergency. In compliance with this Law and other applicable legislation, the Corps carries on a variety of studies and disseminates information to the public and to other agencies at federal, state and local levels.

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1. The Coast and Geodetic Survey, Its Products and Services, Publication 10-2, Department of Commerce, 1965, p. 13.

2. A more complete rendering of the tsunami warning system will be found in "Tsunami Warning System," p. 84.

Although each engineer division has a communications network employing high frequency, very high frequency, single sideband and continuous wave (CW) equipment, there are no direct provisions made for public warning. Most often these facilities will be used to relay warning information at the request of the Weather Bureau. As such, the Corps network is best considered as a backup system to the regular warning channels.

U.S. Coast Guard, Department of the Navy

As might be expected, the Coast Guard's warning activities are primarily oriented toward the natural hazards at sea. They provide to marine vessels warning information on icebergs and floes, heavy seas in coastal areas, hurricanes and other storms.

Civil Defense

The Federal Office of Civil Defense (OCD) participates in natural disaster warning mainly by making the National Warning System (NAWAS) and National Communication System (NACOM) available for that purpose. There are 100 weather stations on the NAWAS network, with 49 more scheduled for later inclusion. The State Civil Defense warning role generally consists of relaying warning information received over NAWAS to any affected political subdivision not included in that network. To accomplish this task the State Director may choose to use fan-out phone lists, Teletype, bell and lights systems, County Sheriff radio network and/or existing public service radio systems where they are available. In large-scale disasters such as hurricanes, the state civil defense Emergency Operating Center may be used as the coordinating unit for the activities of local CD units, and the variety of state agencies involved in relief and rescue work also may be used.

Local civil defense organizations warn for natural disasters according to the facilities and personnel available. In many cases the local Civil Defense Director initiates plans to sound the CD sirens, and with the concurrence of other officials, activities the Emergency Operating Center (EOC). It is also common to set the RACES network into operation and to supplement the warning activities of other agencies with CD volunteers.

Law Enforcement

The part played by state, county and local law enforcement agencies in natural disaster warning varies considerably with different jurisdictions, and is not subject to the control of the Weather Bureau. In some cases the agencies have well-established procedures for carrying out their warning roles and for co-ordinating their activities with the Weather Bureau. In other cases there may be almost no interaction between the Weather Bureau and the law enforcement agency.

At the state level, the State Highway Patrol Headquarters often serves as one of the official NAWAS Warning Points. When a natural disaster warning is passed over NAWAS, the highway patrol further disseminates the information to all mobile units and stations in or near the affected area with instructions to these units on what additional steps to take. In rural areas the mobile units are often used to contact the public directly with the warning.

This use of highway patrol units has been especially helpful during hurricanes and tsunamis where large and sparsely-populated areas are threatened. In some cases the highway patrol has doubled as a supplementary detection source and warning unit. Officers in patrol cars have sighted and maintained constant surveillance of tornadoes, and have reported their movements to the Weather Bureau and to radio stations broadcasting public warning.[1] County and city police play a substantial part in the process of warning for natural disasters.

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1. Robinson, Donald The Face of Disaster, Doubleday and Company, Inc., Garden City, 1959, p. 65.

The county sheriff's office and local police headquarters are frequently tied into the NAWAS network, as well as serving as the control point for CD siren activation. Further, because of the communication network interconnecting the main office and mobile police units, they are able to achieve a high degree of coordination in ensuring warning coverage. Some mobile units are equipped with loud hailers in addition to the sirens that are installed on all squad cars and motorcycles. Both devices have been effectively used to inform citizens of an impending threat. Police also are usually well distributed throughout the area while still in contact with the main office, and this allows for more immediate and timely contact with the population than is possible to agencies that must send people into the threatened area.

Mass Media

The mass communications media serve as a critical link between the Weather Bureau and the public in the dissemination of natural disaster warnings. To take full advantage of the mass media consumption patterns of the public,[1] the Weather Bureau maintains a variety of Teletype services at each warning office.[2] In this way, every radio station, television station and newspaper office subscribing to a commercial news service, or to one of the Weather Bureau areawide Teletype networks, will receive hard copy of the warning.

Commercial radio and television stations are licensed by the Federal Communications Commission (FCC) and participate in natural disaster warning on a voluntary basis. These media normally broadcast directly to the public the weather bulletins, advisories and warnings as they are received from the Weather Bureau. Some stations have made arrangements to transmit the warnings direct from the Weather Bureau office; in other cases these media have established their own "weather watches," and provide on-the-spot observations to their audiences.

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1. For a full discussion of public utilization of news media, see the Message Credibility Appendix, Part IV.
2. "Communication Facilities," p. 88.

The mass media must pay out-of-pocket for the Teletype facilities carrying warning information and for the remote transmitters used for weather reporting. This accounts in part for the wide range in the quality of natural disaster warning provided by the mass media across the country. In some places the cooperation and participation of the media in warning has drawn wide public recognition and acclaim.[1] In other places radio and television stations have inadvertently added to the confusion by broadcasting unqualified "all clear" notifications intended for one locality, but which reached people in still-threatened areas. There are also instances where stations continued a normal broadcast schedule of entertainment, pausing only to issue Weather Bureau bulletins.

Newspapers are somewhat limited in the warning role they play. Generally, newspapers warn of hazards such as floods, hurricanes and tsunamis. The most significant service newspapers perform in these situations is to give the public detailed information of the cues associated with the hazard and of effective protective actions.

State and Local Officials and Other Agencies

The state governor, local officials and other political figures are usually involved in coordinating various disaster control activities. These officials may also use the mass media to communicate warnings, crisis information, or special instructions to the public.

Most agencies employed in relief, rescue and/or recovery operations have no specific public warning task assigned as part of their responsibility. However, as these units begin operations, their actions will probably serve some warning function.

1. An example of such a case is reported in: "An Outstanding Job," The Topeka Daily Capital, Wednesday, 15 June 1966, wherein the staff of WIBW-TV and its affiliated radio stations are commended for operating for 23 hours without commercial interruption while covering the Topeka tornado of 8 June 1966.

SPECIAL PURPOSE WARNING SYSTEMS

This section describes three systems developed for the specific purposes of detecting and warning for hurricanes, tsunamis and tornadoes.

Hurricane Warning

Hurricanes, as noted above, constitute a major recurring threat to large parts of the Atlantic seaboard, to all of the Gulf Coast states and occasionally to the Pacific area. The Weather Bureau is charged with the coordination of a multi-agency detection and warning system for the continental United States. It maintains Hurricane Warning Centers at Miami, Florida, and Los Angeles, California, with alternates respectively, at Washington, D.C., National Airport, and San Francisco, California. The major functions are depicted in Figure 1.

Detection and surveillance needs are met by the use of Weather Bureau radar installations and those of the U.S. Air Force Air Weather Service. Weather observation can also be obtained by the Weather Bureau from the USAF Air Defense Command sites on the Atlantic and Gulf Coasts. Additionally, the Air Force Hurricane Liaison Office can request the Air Weather Service to provide reconnaissance flights. The United States Navy provides a similar service. Supplementary information is obtained from ships in the critical area and from various manned and remote metering stations.

Numerous agencies other than the Weather Bureau provide personnel and facilities for dissemination of warning to the endangered population. The Coast Guard receives Weather Bureau warnings and passes them on to small boats in coastal areas and ships at sea. On at least one occasion low-flying Coast Guard planes warned the inhabitants of isolated houses by dropping messages with the latest information.[1] The Air Force acts on Weather Bureau forecasts to warn Air Force

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1. Treadwell, Mattie E. Hurricane Carla, September 3-14, 1961, Office of Civil Defense, Region 5, Denton, Texas, 1962, p. 5.

and Army bases, aircraft in flight, and other Department of Defense facilities as required.[1]

Agencies such as the Civil Air Patrol (CAP) have also been used to issue public hurricane warning. In 1961 the CAP mounted public address systems and loud speakers in their aircraft and broadcast the warning to St. Mary Parish, Louisiana.[2]

The final components of the hurricane warning system are radio, television and the newspapers, and the state, county and local agencies that participate in the overall natural disaster warning system.

Tsunami Warning System

A number of governmental, civilian and military organizations based both on the United States continent and in the Pacific basin participate in detection and warning for tsunamis. The major functions are depicted in Figure 2. The primary responsibility for detecting a potential wave rests with the Coast and Geodetic Surveys (C&GS) Seismic Sea Wave Warning System (SSWWS). Reports of earthquakes of sufficient magnitude to generate a tsunami are sent by government seismograph stations, and those of private institutions and universities, to the C&GS Honolulu Observatory where they are processed to determine the source of the shock. If the earthquake occurs in or near the ocean, or is strong enough to cause submarine avalanches or convolution of the sea floor, the Observatory sends out bulletins advising all points in the system of the earthquake and the estimated time of arrival (ETA) for any wave that it might have generated.

The advisory message usually allows the responsible warning agencies time to begin advance preparations without alarming the public. (If the tsunami ETA

1. USAF Severe Weather Service, Air Weather Service Manual, AWSM-105-41, United States Air Force, p. 7.

2. Treadwell, Mattie E., op. cit., p. 10.

is very short, public warning begins immediately.) In most cases there is sufficient time to allow the second line of detection devices to come into play and provide more accurate information on the effects of the quake. The positive detection source consists of a network of tide stations equipped with water pressure sensors for accurately recording the tidal variations.

Passing tsunamis are easily spotted on the tide record as "discontinuities," and when the SSWWS headquarters requests tide observers near the source of the earthquake to check their recordings, it is a simple matter to confirm or deny the generation of a wave. If a tsunami has been generated, the SSWWS issues an actual warning message to all points. Hawaii, with as many as 159 killed in one tsuanami,[1] activates the state and county EOC's and the district OCD headquarters nearest the coast upon receiving an advisory. As the decision to warn, the Honolulu area utilizes its civil defense sirens, police and fire units with sirens and loud speakers, and similarly-equipped Civil Air Patrol and Air National Guard aircraft. People are warned to stay away from beach areas, and are instructed in the characteristics of tsunamis. As evacuation of the low-lying zones is carried out, the CD sirens are sounded hoursly, and for the last half hour before the ETA. Civ-Alert, a Civil Defense-funded telephone system that allows the state EOC to simultaneously contact all radio stations, is used to instruct the stations to broadcast the warning. Television stations and movie theaters also are notified, and they flash the warning on their screens. The background music systems (MUSAK) used in stores also carry the warning.

The reaction on the West Coast is neither as well-organized or as extensive. In general, the authorities are somewhat reluctant to issue warnings and evacuation orders, and do so only under extreme circumstances. When the actual warning confirmation is received at the state warning centers, it is retransmitted over NAWAS and by commercial phone lines to all bayside, coastal and river delta communities. Upon receiving the alert, these communities make the same preparations they would for floods or other water surges. This includes using local or

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1. Tsunami, The Story of the Seismic Sea-Wave Warning System, op. cit., p. 7

state police to alert the public and prepare for evacuation, for setting-up fire watches and traffic controls, and for taking antilooting precautions.

Tornado Warning Systems

The primary source of tornado warning is the Forecast Center at Kansas City. This Severe Local Storms (SELS) center functions for tornadoes in approximately the same way the Honolulu Observatory does for the SSWWS; that is, as a central data collection and threat evaluation agency. Figure 3 shows the major functions of the tornado warning system.

SELS receives meteorological data from all Weather Bureau stations and issues a daily "outlook" alerting local weather stations to the possibility of tornadoes. This allows the local units in threatened areas to increase their manning, set up communication links with direct warning agencies, and intensify their surveillance activities.

Radar is the most valuable instrument for detecting the actual tornado; the scope idsplays a characteristic "hook-like" return from the funnel as it hangs down from the thunder cloud. However, the limitations of radar for detecting the funnels at short ranges, or in shadow areas caused by high buildings, mountains, or the earth's curvature, make some of the other detection sources doubly valuable. The organized network of citizen volunteers provide a good deal of useful tornado information. These volunteers, including local and state police, firemen and private citizens, make collect calls to the Weather Bureau office in their area to report their observations.

These data are used by the local office and are passed back to the SELS Forecast Center. As conditions develop, the center will issue severe weather forecasts which usually state that severe storms should be expected in an area 60 miles either side of a line between two familiar locations. This area will range in size from 10,000 to 30,000 square miles. At the Center hourly reports

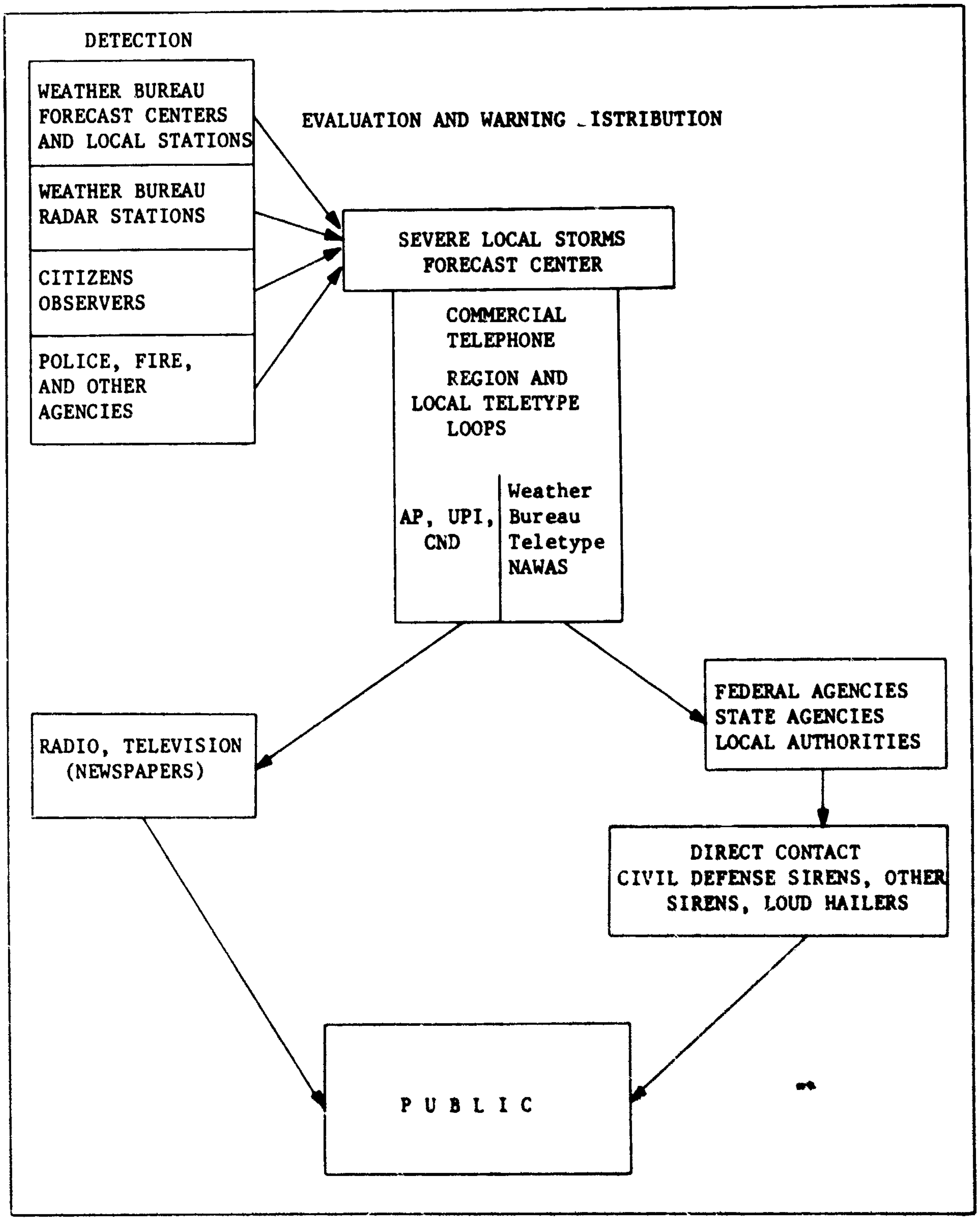

Figure 3. Tornado Warning Functions

of surface pressure and air stability are processed by an IBM 1620 computer to calculate changes that may indicate the development of severe storms. If it appears that conditions are ripe for tornadoes, the forecast will point this out and advise people to take preliminary action to protect their property and themselves, and to keep their radios tuned to a local station for further information. Only when a tornado has been sighted by radar or by an observer will the Weather Bureau issue a severe storm warning.

When a tornado sighting has been confirmed, the Weather Bureau office immediately sends the warning over its Teletype lines to all local news media, and in the few cases where arrangements have been made, orders the CD sirens activated. Offices on the NAWAS network notify all other warning points of the storm and its movements. Where NAWAS is not available, the Bureau office will contact Civil Defense, police, or any other agency that could be used to pass the warning. As the tornado moves it is plotted by weather personnel, and progress reports are issued as required.

Tornado surveillance is also a function of radio and television stations. Very often they send reporters into the area to monitor the storm and provide the audience with direct reports of the damage. Some stations encourage listeners to call in and report their observations as they occur.

COMMUNICATION FACILITIES

Although a large variety of equipment and facilities are used in natural disaster warning, it is useful to identify only two functionally-different categories: 1) the communication facilities used to distribute warning information within and between organizations, and 2) the facilities used by the organizations to disseminate the warning to the affected public. This section provides a brief description of the equipment, facilities and (where applicable) the networks used for natural disaster warnings.

Organizational Warning Facilities

A number of agencies maintain extensive teletypewriter networks that carry routine information and natural disaster warnings to stations on the network. A, C, and O Networks are the nationwide Teletype services operated jointly by the Weather Bureau and Federal Aviation Agency (FAA). Service A has a transcontinental, 857 word-per-minute express circuit with circuit extensions leading to over 600 stations that in turn are able to disseminate information to more than 3,000 users. Service C is used to collect basic weather data and to distribute weather forecasts to over 200 send-receive stations in the United States. Service O, is the United States' part of the International Northern Hemisphere Exchange Network. It has single-channel circuits connecting the mainland with Hawaii and stations in the Carribean, and a dual-channel circuit to Alaska.

Area-wide Teletype networks provide weather information and natural disaster warning to subscribers within a state or parts of several states. There are ten such networks, consisting of the Weather Bureau offices in the area as message senders, and police, public utilities, the mass media and others as receivers. There are also 90 metropolitan areas served by local Teletype loops that provide the same service on a smaller scale as the area-wide networks. A local loop consists of the Weather Bureau office as a sender, and local agencies, newspapers, radio and television stations as receivers. The NADWAS group recommended that these statewide networks and local loops "...be extended to cover the conterminous states, together with automatic switching and relay facilities to interconnect them."[1] This would allow for natural disaster warning and other information to be disseminated at the national, regional, state or local levels while maintaining the specialized nature of the local loops.

The Radar Report and Warning Coordination (RAWARC) Teletype network extends from Kansas City to more than 130 Weather Bureau offices in tornado-prone areas.

1. Kutchenreuter, Paul H., op. cit., p. 84.

RAWARC is the primary communication facility of the Severe Local Storms Center, but it serves only points east of the Rocky Mountains. The NADWAS group proposed the "extension of the RAWARC System to all ESSA service outlets in the conterminous United States... (to) provide essential nationwide teletypewriter communications between warning offices."[1] Some agencies with specialized needs also maintain Teletype communications networks. The Coast Guard Teletype networks are used to distribute natural disaster warning to Coast Guard units, and connect Coast Guard stations along the East and West coasts. The Weather Bureau uses commercial lines to establish a "Hurricane Circuit" every year, in June. This network remains in operation until the end of the hurricane season, and is used to disseminate hurricane advisories and to collect and exchange information. It covers those areas along the East and Gulf coasts most likely to be affected by hurricanes.

Commercial News Teletype Networks, such as UPI (United Press International), AP (Associated Press) and, in some large metropolitan centers, area-wide wire services, carry weather forecasts to the mass media. It is through the wire services that weather information is eventually disseminated to every community in America. Major forecast centers and Weather Bureau Region Offices provide the wire services with the forecasts and warning messages. The Teletype facilities of Western Union (TELEX) and Bell System (TWX) are used for natural disaster warning where no federal facility is available. The Western Union Commercial News Department (CND) provides weather news in addition to sports results, market quotations, etc., to its subscribers. Warning messages are communicated to a standard list of agencies by CND. Agencies of foreign governments are passed weather warning by the marine cable facilities of commercial companies.

Agencies participating in natural disaster warning make extensive use of telephone facilities in their work. Direct telephone lines, operating on the

1. Ibid., p. 13.

pick-up-to-ring-and-talk (without dialing) principle, connect Weather Bureau facilities where communication needs are regular and urgent. For example, direct lines interconnect many of the hurricane and tornado forecasting offices to facilitate the distribution of warnings and to coordinate emergency actions. The Weather Bureau also passes advisories and warnings over the National Warning System (NAWAS) to local police, civil defense and sheriffs' offices in return for participating in the Civil Defense Warning System (CDWS). NAWAS is a full period (24-hour) system of leased telephone lines connecting NORAD Headquarters to the 761 warning points throughout the country. One hundred Weather Bureau stations are connected to this network.[1] The commercial lines of the licensed common carriers are commonly used where no leased facilities are available. This includes the Weather Bureau's procedure of accepting collect calls from weather observers.

Natural disaster warnings are also distributed to organizations over a variety of radio transmission facilities. Weather Bureau Forecast Offices in New York, Chicago, and Kansas City operate continuous transmission very high frequency (VHF) equipment for distributing weather information and warnings. Pretuned VHF receivers are loaned to interested groups and users essential to the warning process. The NADWAS Group recommended that "VHF radio transmission facilities... be extended to all cities of 100,000 population or greater where there is an ESSA office. The Group also propose(d) that pretuned VHF receivers be provided by the Federal Government to agencies, establishments, and officials essential to the warning process."[2]

Weather forecasts are also disseminated by any other federal or state agencies that have internal requirements for such information. The United States

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1. It was anticipated that an addition of 23 weather staions would have been added by 1 September 1966 but this is presently unconfirmed. A total of 149 Weather Bureau stations will eventually be on the NAWAS network.

2. Ibid., p. 9.

Forestry Service, Corps of Engineers, Navy, Air Force, and numerous state agencies maintain radio systems used for this purpose. Smaller, local networks, such as those operated by police, utility companies and fire departments, play a critical part in natural disaster warning. Amateur radio facilities used in natural disaster warning include the Radio Amateur Civil Emergency Service (RACES), Amateur Radio Operators, and Citizens Band Operators. Some Weather Bureau offices have regularly-assigned operators they dispatch for severe weather observations.

Public Warning Facilities

Most public warning of natural hazards is accomplished by the mass media: radio, television and newspapers. The public however is sometimes warned by direct contact from an agency with warning responsibility. The most common devices are listed below:

- Flags, used in coastal areas to indicate forecasted hurricanes, gales, and other severe weather conditions;

- Signs, supplied by the Weather Bureau to warn of seasonal hazards, and by other agencies as the Forestry Service, highway department, etc.;

- Sirens, both the fixed civil defense, and mobile units on police, fire and other emergency vehicles, are frequently used in natural disaster warning;

- Loud hailers and public address systems; and,

- Commercial MUSAK systems.

An automatic service is provided by the telephone companies in 14 metropolitan areas to allow phone users to dial in for recorded forecasts and warnings. The

Weather Bureau provides the information, and the telephone company supplies the equipment and makes the recordings. Other agencies warn a limited segment of the public over radio and continuous wave (CW) equipment. FAA-ATS is the Federal Aviation Agency's Air Traffic Service radio system used to transmit weather and flight conditions to aircraft in flight and on the ground. The Coast Guard broadcasting system uses middle and high frequency voice transmissions and continuous-wave radio to communicate marine weather information to ships at sea and other users.

IV. CIVIL DEFENSE AND NATURAL DISASTER WARNING SYSTEM INTERFACES

The number of similarities existing between the conditions surrounding a natural disaster and those surrounding a nuclear attack make the possibility of joint utilization of warning facilities desirable. In some respects, an earthquake can be viewed as comparable to a surprise nuclear attack. There is no certain detection system for an earthquake, and warning is largely limited to the secondary effects (i.e., weakened structures, residual shocks, possible seismic sea-waves, fires, etc.). A tornado, however, can be predicted in a general sense, but exact time or location cannot be achieved at present. Thus, tornadoes are akin to attack situations in which the crisis build-up is rapid and culminates in a limited-scale, sporadic attack. The hurricane best reflects the conditions present during a large-scale crisis build-up that allows adequate time for disseminating advance information and warnings, with, as is the case in most warfare, the possibility of the storm being deflected away until almost the last minute. Other natural hazards present their own analogs to the nuclear attack situation.

Because there are many similarities between natural disasters and nuclear attack, it is clear that a system for warning of one should be prepared to warn of the other. There are three broad areas in which a civil defense warning system can perform (or does perform) natural disaster warning functions. The first of these is in the actual conduct of warning operations, the second is in providing for the dissemination of natural disaster warning, and the third is in the area of public information and education.

The purpose of this section is to describe in detail the natural disaster warning functions that can be included in the capabilities of a civil defense warning system.

NATURAL DISASTER WARNING OPERATIONS

The operational warning functions that can be performed by a civil defense warning system effectively are the same functions being performed by only a few civil defense organizations at the present time.

The entire warning system would be responsible for disseminating Weather Bureau natural disaster warnings to civil defense organizations in the path of the hazard. This would allow the local civil defense units to authorize the use of alerting devices and to implement procedures to warn the public. This would include the use of CD sirens and of volunteer groups to make phone calls to theaters, schools, stores, etc., and to conduct door-to-door warning if necessary. Also, it would include issuing voice warnings over MUSAK systems, commercial radio and television, and sound equipment mounted on CD vehicles. Last, the local civil defense organization can function to coordinate the warning activities of civil agencies and volunteer groups during the warning period.

Performance of these functions imposes additional requirements on the civil defense warning system. Each function presupposes a comprehensive natural disaster warning plan which is fully understood by all agencies and groups that are to participate in its implementation. Also, the civil defense organizations that are to be responsible for natural disaster warning must be either manned 24 hours a day, or key personnel must be prepared for recall on short notice at all times. A final requirement is that civil defense personnel be familiarized with the characteristics of the natural hazards they are to warn against.

CIVIL DEFENSE DISSEMINATION OF NATURAL DISASTER WARNING

One important fact should be kept in mind when considering the natural disaster warning functions of a civil defense warning system. This is that natural disasters occur only in a limited geographical area--never to the entire nation at the same time. Thus, as discussed in Chapter Five, a civil defense warning system must be able to selectively disseminate a natural disaster warning to the endangered area, and not to the whole country. Presently the combination of Weather Bureau stations tied in to NAWAS and the local control over sirens and other alerting and warning devices provides the required selectivity. Future civil defense warning systems should maintain the flexibility inherent in the present system. This flexibility and selectivity can be ensured in two ways. First, by allowing local CD activation of alert and warning devices, contingent upon clearly specified natural disaster conditions. Second, by fostering the development of natural disaster warning plans that take full advantage of all local warning capabilities. This would include cooperative agreements with civil agencies (police, fire, etc.), the mass media, and volunteer groups such as Civil Air Patrol, Radio Amateurs Civil Emergency Service and CD volunteers.

NATURAL DISASTER INFORMATION AND PUBLIC EDUCATION

Educating the public to the signals, consequences and protective actions associated with the various hazards that surround them is generally considered a peripheral aspect of the warning process. However, because an informed population is better prepared to respond adaptively to danger, an ef[illegible] public education program can significantly enhance the outcome of the warning process. The Office of Civil Defense is aware of the potential benefit of an informed public, and actively engages in a program designed to acquaint people with nuclear hazards. It is suggested that by employing analogies between natural and nuclear hazards in its educational materials the civil defense education effort can be expanded to perform an additional function in natural disaster warning.

There are three points at which proper employment of a natural/nuclear disaster analogy is both appropriate and effective. First, by describing the warning signal used to the public in a hazard. A statement such as "...the siren your community uses to warn of tornadoes could save your life if the country is faced with nuclear attack" illustrates the similarities in the alerting aspects of the two hazards. Second, where parallels between the effects of a nuclear attack and natural disaster exist, they can be brought out to clarify the nature of either phenomena. Third, by showing how preparations useful for defending against one disaster are applicable to the protective actions effective against the other. For example, a family fallout shelter is equally useful as protection from a tornado and nuclear radiation.

The civil defense public education effort affords several specific programs where inclusion of natural disaster information could be easily accomplished. Many civil defense brochures and pamphlets could be modified to provide the public with the information. Equally suitable are such activities as the OCD-sponsored University Extension program, the public information display vans and trailers, and the Army film services.

CHAPTER FIVE

WARNING REQUIREMENTS

I. INTRODUCTION

The requirements set forth herein are directly responsive to the dynamic and widely-varying factors described in the previous chapters. They apply to an integrated and selective warning system capable of meeting the spectrum of warning needs characteristic of our present society. From the previous environmental description in Chapter One, it is clear that warning requirements vary according to the nature of the threat posed and the response that is desired. The threat to be warned against may first be distinguished with regard to its scope (whether it threatens the entire nation or a particular region or locality); second, with regard to its nature (whether it is of natural origin or man-caused); and third, with regard to its imminence (whether it is due to strike in two days, two hours, or two minutes).

The warning system missions, which are delineated before setting forth the requirements, are based on four categories of warning: attack warning, crisis warning, natural disaster warning and localized disaster warning. Having defined the system missions on this basis, the remainder of the chapter is devoted to specifying and discussing the operational requirements for the system in terms of a distinction between a national warning transmission function and a local warning dissemination function.

According to the above purpose and scope, the chapter is organized into six major parts, as follows:

- Warning System Missions
- Warning Transmission and Dissemination: A Distinction
- National and Local-Level Operational Differences

- National Warning System Requirements
- Local Warning Dissemination System Requirements
- Overall System Reliability Requirement

II. WARNING SYSTEM MISSIONS

The development of operational requirements for an integrated warning system must be based on a concise and comprehensive statement of the purpose or mission of the system. The previous chapter has set the foundation for this mission statement by describing the environment within which the warning system must operate. Thus, we may distinguish four categories of threats that establish four distinct missions that the warning system must fulfill. These are attack warning, crisis warning, natural disaster warning and localized disaster warning. Each is discussed below.

ATTACK AND CRISIS WARNING

One objective of any effort to develop an integrated warning system must be to achieve a balanced and controlled warning capability, so that all forms of warning related to an attack threat may be conveyed to responsible organizational elements and, when necessary, directly to all or selected segments of the general public. The threat of nuclear attack, developing international crises, and the effects of a nuclear attack represent threat conditions in which the survival values of all or a significant segment of the population are placed at risk. In the first two cases, the Federal Government, or a specific agency thereof, is responsible for determining the imminence of these threats and for deciding when and whom to warn. Such warnings are "national," in the sense that federal control is required to initiate their dissemination. Of greater significance, however, is the necessity for the actual nationwide distribution of such warnings. For attack threats and crisis developments, taken as singular events, dissemination of warning to all segments of the population is required.

An integrated warning system must possess balanced attack warning and crisis warning capabilities because multiple warning missions must be performed, each of which are accorded proper weight in the design of the system. Within the attack threat there is a spectrum of attack contingencies, each of which must be separately considered, and for which a single set of warning dissemination procedures is not appropriate. Additionally, the warning system must be integrated within a balanced passive defense posture, which in turn must be integrated into the total defense posture of the nation comprised of all active and passive offensive and defensive elements.

Furthermore, the warning system must be controlled both with respect to the initiation and the dissemination of warning. The existence of a spectrum of attack contingencies demands that a number of warning response options be available to national decision makers. Therefore, the desired capability for the controlled initiation and dissemination of warning must be viewed in conjunction with parallel developments aimed at achieving a controlled response in the strategic offensive and active defensive areas. Most critically, based upon escalation dangers during crisis periods, a need exists for the controlled dissemination of crisis information to various government organization elements.

NATURAL DISASTER WARNING

The threat of natural disaster also may imperil the lives and property of significant numbers of the population. Warning of such disasters, or their effects, is dependent upon the ability to predict their incidence. Where this is possible, as in the case of tornadoes, hurricanes and tsunamis, forecast warnings about the high threat probability can be disseminated to the public within the areas affected. After forecast warnings have been given, there is also a need to follow them up with action warnings when it has been determined that the threat is actually going to strike a particular local area. Where forecast warnings are not possible, as in the case of earthquakes, the ability to disseminate warning to the public (of possible after-effects) is essential to prevent confusion, to give direction, and thereby to minimize loss of life.

A forecast warning is analogous to the crisis warning, in that it alerts authorities and the public to an imminent danger. An action warning, similarly, is analogous to the attack warning that sends the public into a protective posture. However, the level at which these warnings originate is not directly analogous. Both crisis and attack warnings originate at the national level, because it is here that pertinent national information is available. Natural disaster forecast warnings may originate at the national or at a regional level. The natural disaster action warning originates locally in most instances, but may also originate regionally. Thus, there are different implications for the warning transmission and dissemination system when a natural disaster warning function is added to its repertory.

LOCALIZED DISASTER WARNING

Another type of warning may be categorized as localized disaster warning. Here, the threats include industrial hazards, civil disorders and limited attack effects. Their scope is restricted geographically, and warning of them can be carried out without recourse to governmental authorities above those of the locality. The process is similar to that in natural disaster action warning. The warning system we are describing must also include in its operational design the capability to carry out this local warning function.

SUMMARY OF SPECIFIC WARNING MISSIONS

- Attack Warning: The national warning system should be capable of providing for the controlled initiation and assured timely dissemination of a national warning concerning an actual or impending enemy attack. Attack warning must be disseminated to the general public, and to federal, state and local organizational elements.

- <u>Crisis Warning</u>: The national warning system should be capable of providing for the controlled initiation and controlled, timely dissemination of crisis warning to responsible and relevant organizational elements, and when necessary, to selected segments of/or the whole of the general public.

- <u>Natural Disaster Warning</u>: The national warning system should be capable of providing, on a selective basis, timely warnings concerning actual or impending natural disasters to the relevant organizational elements and to the threatened segments of the population.

- <u>Localized Disaster Warning</u>: The national warning system should provide responsible local governmental elements with the ability to warn, on a timely basis, the population within their jurisdictions of any threatening situation that imperils life or property. Such threats include, among other industrial hazards, civil disorder, and the delayed effects of an enemy attack.

III. <u>WARNING TRANSMISSION AND DISSEMINATION: A DISTINCTION</u>

A distinction between warning transmission and warning dissemination must be made in order that system requirements related to each of these two categories of operation can be separately specified. Transmission refers to the process whereby a message flows between two terminals of a point-to-point communications channel. Dissemination, on the other hand, refers to the process whereby a message flows between an originating point and an audience in a broadcast communications system. A transmission system is used to transfer information from an originating terminal to a receiving terminal, where either action may be taken or where the message may then be switched to a third receiving terminal or disseminated by broadcast means to a general audience.

The distinction between the two operations is valuable when related to the system design process, because transmission and dissemination systems require the use of different principles in their design. Hence, requirements for the two kinds of systems must be stated somewhat differently. Insofar as the terms are used in warning systems, it is clear that the transmission process is used to fulfill a different function from the dissemination process. Warning transmission is used essentially for two functions: 1) transferring the warning from decision making points to dissemination points, and 2) warning civil defense organizations and other agencies that require specific notification in time of an emergency. Warning dissemination on the other hand is used to broadcast the warning to the general public.

Warning transmission is essentially a national or regional function when used to transfer a warning from a decision making point to a terminal from which dissemination is initiated. However, it is a local function when, as part of an organizational, institutional or industrial warning program, specifically-addressed telephone calls or radio broadcasts are made to activate personnel and/or agencies in their emergency functions. Dissemination of warnings, whatever the level of government at which they originate, is entirely a local function, and is carried out by local facilities serving a local audience.

IV. NATIONAL AND LOCAL OPERATIONAL DIFFERENCES

As conceived, a national warning system must be established to carry out all warning functions for the nation, and must therefore serve agencies at all levels of government that have a warning responsibility. Such a system is described in Chapter Three. The local warning elements of that system duplicate in microcosm all of the features of the national warning transmission system, and in addition are equipped to disseminate all public alert signals and warning messages. The national system is equipped primarily to make warning decisions and to transmit warning messages to local areas. Because the two systems operate in a different manner, the requirements for each are presented in separate sections below. The first section presents those requirements that are national in scope and relate primarily to decision making and warning transmission in emergencies that threaten the entire nation or major parts of it. The second section presents those requirements that are local in scope and relate to the dissemination of national warning to the public, as well as to the decision making, warning transmission and warning dissemination in emergencies where the threat is restricted to a local area.

OPERATIONAL FACTORS

In the process of completing other system studies, SDC has developed a set of generalized categories for system requirements. Using these categories, the national and local warning transmission and warning dissemination system requirements are divided as follows:

- Function: What does the system do?
- Coverage: Whom does it reach?
- Structure and Operation: How is it set up and how does it operate?
- Response Time: How long does it take to do the job?
- Reliability: How well does it do the job?
- Survivability, Security and Sabotage: How difficult is it to put the system out of action?

V. NATIONAL WARNING SYSTEM REQUIREMENTS*

NATIONAL WARNING REQUIREMENTS: FUNCTION

> The national warning transmission system should provide to all agencies and persons within its jurisdiction, on a total or a selective basis as appropriate, warning of an actual or impending enemy attack or of a forecasted natural disaster that constitutes a threat to life or property. National warning should be transmitted in a hard-copy format. Voice warning may also be transmitted on a supplemental basis.

*All requirements are boxed for convenient reference.

The agencies and individuals constituting the jurisdiction of the national warning system include all federal agencies that require warning from a federal source, all state and local governments, all privately-owned facilities that are expected to participate in the warning process, and any other agencies or facilities that the Federal Government has decided to include within the juris-diction of the system. The jurisdiction of the national system includes all facilities that will be used for disseminating warning to the public, whether privately or publicly owned. It is essential and dissemination facilities receive warning directly without involving any intervening agencies because: 1) speed is essential if warning dissemination is to be timely, 2) accuracy and uniformity in message content are necessary to avoid confusion among the recipients of the warning, and 3) authentication is required to avoid delays resulting from attempts to validate the message.

As shown in Chapter One, a selective geographic transmission capability is necessary to provide decision makers with strategic options in the area of passive defense. The breakdown of the national population into subsets must be based on a principle that is operationally realistic. As a first estimate for the size of the smallest-addressable subset of the population, the operational area consisting of those local governments that have joined together to carry out common planning for emergency operations within their jurisdictions appears to be realistic. In this way, the number of terminals necessary in the system will be balanced against the possible need to deliver different warning messages to different segments of the population.[1]

The requirement for a hard-copy transmission capability is a minimal one in the national warning transmission system, and is based on three factors. First, hard copy is required in many instances to provide legal justification for both

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1. The operational area defined in this way is analogous to but not necessarily the same as the operational area used in the OCD document. A Provisional Concept of Emergency Operations Under Nuclear Attack, 15 September 1966.

public and private agencies entering into an emergency mode of operation. This is particularly true where such a mode of operation means that new jurisdictional responsibilities are assumed, or situations involving potential liability are entered. Hard copy provides not only positive evidence at the time of the event for entering the emergency mode, but in itself serves as a record to be retained for future protection

Second, hard copy increases the amount of information that can be accurately transmitted, because the problems associated with manual copying of lengthy messages are avoided. Although this is not so important with messages warning of already-detected attacks (which must be short to cut down on system response time), it is important in crisis warning and in natural disaster warning. In crisis warning, not only must detailed instructions on increased-readiness actions be transmitted, but, in certain situations, background information necessary to understand the reasons for, and to condition the implementation of such instructions, may also be required. In natural disaster-forecasted warnings, lengthy messages are required to specify areas that are threatened and the expected times that threats will be pending.

The final reason for hard copy arises out of the need for controlled transmission of warning. Clearly, if wide circulation of crisis warning in certain conditions carries with it the likelihood of escalating the crisis, then some means of controlling access to the warning is required. Selective transmission provides a means of limiting the number of terminals that receive the message, but it does not limit the number of people at the terminals who know about the warning. Nor does it prevent clandestine interception of the message enroute to its destination.

NATIONAL WARNING REQUIREMENTS: COVERAGE

> The national warning transmission system should be capable of activation at any time it is necessary to transmit a national or regional warning. The national warning system should have receiving terminals at all governmental and private agencies in the 50 states as well as in the territories and possessions of the United States where federal crisis, attack or natural disaster warning is required for official purposes. Such terminals should be located at all agencies and/or facilities responsible for disseminating warning to the public.

Since there is no way of foretelling at what time the government may decide that an enemy threat is sufficiently grave to require warning the public, the warning system must be continuously available for crisis warning. Similarly, since there is no way of determining how or when an enemy might attack, continuous system readiness is also required for attack warning.

The warning message transmitted over the national warning system is used primarily to activate warning dissemination at the local level. At any delay in activating the national warning transmission system only decreases the time available to the local warning system for disseminating the alert signal and warning message, and directly decreases the potential of the passive defense system to save lives.

If the national warning system is to carry out its function, it must be designed to interface with those agencies that require warning. The designation of which governmental agencies will have terminals in the system should be the responsibility of the Office of Civil Defense, since OCD is responsible for operational planning to meet the nation's warning requirements.

Operationally, it appears necessary to include in the system for crisis warning all the state governments and all local governments of sufficient size. The problem of defining "sufficient size" for local governments can again be answered by appealing to the operational area concept. For attack warning, all governmental and private agencies having responsibility for public warning dissemination must be included in the system.

If commercial broadcast media are included in the local warning structure, they must receive their authority to broadcast attack warning from the national warning system, not from the state or local governments. <u>Only the designated federal agency can make the decision to warn</u>. While it is understandable that state and local officials would be concerned with ensuring the validity of the warning, the only source for such validation is the agency that originally transmitted it. To the extent that validating the warning takes time, the ability of the public to take protective action is degraded. In view of the reliability requirements specified below, there is little reason to doubt the validity of a warning once received over the national warning system. Therefore, local initiation of warning dissemination must be automatic once a national warning is received.

NATIONAL WARNING REQUIREMENTS: STRUCTURE AND OPERATION

The national warning transmission system should have one decision point for crisis warning and one decision point for attack warning. The President of the United States will normally function as the decision point for crisis warning, and may function as the decision point for attack warning, if he has sufficient threat information upon which to base a decision to warn. If this is the case, there will be a single decision point for both crisis warning and attack warning in the system. If, on the other hand, the President chooses to delegate the decision to warn of an actual attack, there will be two (or more) decision points in the system. Priority should be given to attack warning in a system with two decision points. The inclusion of alternate decision points in the national warning system for crisis and attack warning will be dependent upon such alternate points having access to the same threat information as the primary decision points. (Requirements for other types of decision points are defined in a corrollary requirement below.)

The national warning process includes the detection and evaluation of the threat, the decision to warn, and the transmission of the warning to the local area. In order that the decision to warn will be timely, it is desirable that the decision point(s) be collocated with the official source for the information upon which the warning is based. Crisis warning will be based upon information developed by the diplomatic, military and intelligence communities, as interpreted by the President and his advisors. Because of the sensitivity of such information, as well as the criticality of the crisis warning process, as it may feed back into the management of the crisis, it is not likely that decision making in this area (at least decisions regarding initiating increased readiness actions) will be delegated by the President. Nor is such warning likely to be based upon predesignated decision rules (SOPs). Therefore, the initiation of crisis warning will almost certainly remain a Presidential function.

Warning of a detected enemy attack is currently delegated by the President to the Office of Civil Defense. Any decision to return this responsibility to the President would have to be based on his being provided threat information of the same type available at the NORAD COC in Colorado Springs. Until such information is made available to the President, it is reasonable to expect that warning of a detected attack will remain the responsibility of the Office of Civil Defense because of its close association with NORAD.

If such a dual decision point configuration is retained, the possibility will exist that problems may arise in determining the delivery priority between a crisis warning and an attack warning. Since warning of a detected attack imposes more severe time constraints on the passive defense system of the United States than does a crisis warning, priority in such a situation must go to the attack warning. This requirement means therefore, that some form of preemptive capability must be given to the NORAD decision point.

NATIONAL WARNING REQUIREMENTS: DECISION POINTS

The national warning system should have a sufficient number of decision points included within it to provide an adequate natural disaster forecast warning capability. Priority in the national system for natural disaster forecast warning would normally be lower than that given to crisis warning or attack warning.

Forecasting severe natural disasters is currently done primarily on a regional basis. Examples are the Hurricane Warning Centers located along the Gulf and Atlantic coasts of the country, the Severe Local Storm (SELS) Center in Kansas City (which has a national responsibility but is located in the region of the United States most affected by such storms), the Honolulu Magnetic and Seismological Observatory in Hawaii (which provides tsunami or seismic seawave warning to those parts of the United States and other nations bordering the Pacific Ocean and threatened by such waves), and various flood-warning centers scattered throughout the country. Forecast warnings of the type that these centers provide are closely akin to crisis warning in the attack threat spectrum. The forecast is a probabilistic warning and serves only to activate an increased alertness to the threat in the area affected. Like crisis warning, the forecast warning will presumably be followed up by an action warning in areas about to be struck by a disaster. In the case of tsunamis, however, the forecast warning may be followed only by reports of the arrival of the wave at other locations; these follow-up reports do not provide any indication of the intensity with which the wave will strike succeeding areas.

Because forecast warnings are essentially probabilistic and usually serve to alert large areas of the country to a threat that is not expected for at least several hours, the priority given them would normally be less than that given to a crisis or attack warning. However, provision should be made in the system to enable urgent forecast warnings of threats expected to occur in the very near future to preempt the system from a crisis warning in progress. An example of such an urgent forecast warning would be one of a tsunami arising out of a detected earthquake whose epicenter was within several hundred miles offshore the Pacific Coast. Such preemption would probably be exercised on a regional basis only, because the forecast center's coverage would be restricted only to its jurisdiction.

NATIONAL WARNING REQUIREMENTS: OPERATOR CAPABILITIES

The system operator at the appropriate national warning decision point should have the following operational capabilities:

1. Alert or activate receiving terminals at the local level. This capability is required for all types of warning.

2. Transmit preformatted warning messages. This capability is required in crisis warning and attack warning.

3. Transmit nonpreformatted warning messages as required. This capability is required in crisis warning and natural disaster forecast warning. It is assumed that attack warning will be by means of short unambiguous messages that can be drawn up in advance, and with the possible exception of a date-time group, can be stored on punched paper tape or some similar medium.

4. Cancel a warning message during transmission. This capability is required for all types of warning.

5. Test the system in any of its operational modes. This capability is required at all decision points. In a configuration where some of these have access to regional circuits only, the testing capability will be limited to their area of coverage.

6. Address alert or activation signals and warning messages to subsets of the total set of system terminals. This capability is required for crisis warning and attack warning, and may be desirable for natural disaster warning. The number of subsets capable of being addressed must be determined on an operational basis.

7. Determine the operational status of the system. This capability is required for all types of warning.

These capabilities represent minimal requirements. The alerting capability implies an adequate alert signaling procedure to notify the operator at the receiving terminal that a warning is about to come through. In a system where selective switching functions are performed on command from the decision point, the activation capability implies that the operator at the decision point can automatically turn the equipment on. The various modes of warning transmission are all derived from previous discussion of function and coverage requirements.

The cancellation capability may cause problems if there are terminals where automatic switching functions only are performed on command. Such operations as automatically turning on radio broadcast transmitters and selecting and broadcasting pretaped messages may require considerable hardware sophistication if a cancellation capability is to be provided.

The capability of cancelling a false alarm (from seconds to minutes, and perhaps even hours). This range of false alarm detection times give rise to the possibility that the false message: 1) may not have been broadcast to some terminals (the shortest false alarm detection times), 2) may have been partially broadcast but not completed (intermediate times), or 3) that it may have been completed, perhaps for some period of time (longest false alarm detection times). The terminal must therefore respond to the particular situation with the appropriate cancellation message; or it must present a very generalized cancellation message which because of its generality will have to be supported extensively by the commercial radio, TV and press. Except in the case detailed above, cancellation should prove no more difficult than in normal Teletype communications. The need for a system-testing capability is obvious. The subset addressing capability has been discussed in the previous section dealing with system coverage. The system operator needs an indication of the operational status of the system at the time warning is transmitted if he is to know whether the system fulfilled its mission. The required capability here means that feedback must be provided from a sufficient number of terminals to determine that the system circuitry was operating properly. A total roll call of all terminals in the system is not necessarily required.

NATIONAL WARNING REQUIREMENTS: RESPONSE TIME

> The maximum response time of the national warning system in warning of a detected enemy attack should be no more than one minute. The system should be capable of achieving the same response time for other warning messages. Response time is defined as the time between the initiation of a message transmission at a decision point and the start of message reception at all receiving terminals. Response time includes the time required for transmitting any signals necessary to control the system.

Inasmuch as the speed with which the public can be moved into shelter and the available time for doing this are both unknowns, we can only propose that the warning system response time be made as short as possible consistent with the practical limitations involved.

OCD has requested that the Decision Information Distribution System (DIDS) currently under development, have, as a design goal, a response time of 30 seconds.[1] Some difficulty has been experienced in developing system configurations that meet this requirement,[2] therefore, the longer one-minute response time is recommended as being more realistic.

The one-minute maximum value for system response time need only be met by the system in warning of an actual attack. Crisis warning and natural disaster forecast warning are not as time-critical. To arrive at the total system

1. Wellisch, J., and C. Schemmerling, Decision Information Distribution System (DIDS), System Development Corporation, TM-L-2550/012/01, 18 November 1966, p. 15

2. Wellisch, J., and J. K. Maloy, Decision Information Distribution System: Cost-Benefits Analysis, System Development Corporation, TM-L-2550/016/00, 8 February 1967, pp. 25-26.

response time, the time required for actual dissemination of the warning to the public at the local level must be added to the national response time. In the present environment, one minute may represent too stringent a requirement, if we consider it in terms of a balanced passive defense capability. Although it is almost a truism that the shorter the response time the better, this principle cannot be applied without considering the cost-effective implications to the entire passive defense system. If the cost of achieving a one-minute response time requires the expenditure of funds that would be better spent on a shelter system, then the sacrifice should be made in the warning system, not in the shelters. We believe a one-minute response time is feasible on a cost-effectiveness basis.

What the response time requirement will be in a future warning environment is difficult to specify. We can however postulate several cases. If the sheltering capability improves to the point where the time to shelter the public matches very closely the time required to detect and evaluate a threat, then a shorter response time than in the present environment becomes even more valuable in terms of lives saved, and the one-minute requirement may even have to be made more stringent. If, on the other hand, such improvements go hand-in-hand with significant improvements in our threat-detection capabilities, or with an increased willingness among our authorities to run the risk of crisis escalation by predetection-sheltering of the public, then response time requirements may not change, and may even be relaxed.

NATIONAL WARNING REQUIREMENTS: RELIABILITY

In the present set of requirements, the entire warning system is considered in terms of its two levels or components: the national warning transmission system and the local warning dissemination system. Since both systems must operate together to fulfill the national warning mission, a figure of merit for reliability can only be established for both systems operating together. Therefore, the required minimum measure of reliability is considered later in this chapter after all other requirements have been presented. There are however several requirements for the national warning transmission system that fall into the second category mentioned above.

TESTING REQUIREMENTS

> The national warning transmission system should include a testing program sufficient to ensure the continued readiness of both equipment and operators.

Although the expected maintenance time for system components will enter into the computation of the figure of merit that measures the system reliability, the requirement for system reliability can only be stated as a minimum, and all steps possible must be taken to keep the system's performance level above that stated in the requirement. The testing program provides a means of detecting failed equipment and at initiating maintenance procedures prior to an actual need to use the system. Even a system configuration incorporating automatic indication of failed equipment may benefit from such a program, since it is unlikely that all system components can be equipped with automatic indicators.

FAIL-SAFE REQUIREMENTS

> All equipment used in the national warning transmission systems should be designed to maximize the probability that a component failure will result in a silent or safe system condition, not in a condition that simulates system operation.

This requirement is included to minimize the likelihood that a "cry wolf" attitude will develop in the public with respect to the warning system. The danger of a false alarm is more critical in the transmission system because of the great likelihood that it would be widespread, and perhaps difficult to detect, if there is any degree of automation in the various interfaces between the national transmission and local dissemination systems.

NATIONAL WARNING REQUIREMENTS: SURVIVABILITY, SECURITY AND SABOTAGE SURVIVAL UNDER ATTACK

> The national warning transmission system should be designed for survival in the following sense: facilities in the system, with the exception of crisis and attack warning decision points, are not considered to be potential targets. System facilities should be designed and located to survive the bonus damage that results from a national attack, and should be capable of carrying on warning system functions as long as the decision points remain in operation.

If the warning system operates in either of the two attack conditions that we have postulated as likely to occur (attack following crisis and surprise attack), then the survivability requirement stated above will be adequate. In an attack following a crisis period, there is: 1) high probability that the local agencies and the national population will be in a state of alert, and 2) high probability of detecting an attack in sufficient time to transmit the national warning before the decision point is put out of action. In the surprise attack case, we can postulate a light or a heavy attack. In the light attack case, involving SLMBs or an Nth country, it is unlikely that all the attack warning decision points will be targeted, since they are either hardened or have minimal value to an enemy trying to inflict the heaviest-possible damage with a limited attack. Therefore, the national warning has high probability of being transmitted. In the heavy attack case, there is a higher probability of detection prior to the decision point being put out of action; in this case, the warning also should be transmitted satisfactorily.

The level of survivability called for in the above requirements provides that the facilities constituting the national warning transmission system be designed and located so as not to be subject to bonus damage in an attack. This requirement is designed to provide for dissemination of a national warning in the event that:

- The decision to warn is erroneously delayed, or
- An attacker initiates hostilities with internal sabotage, or by firing weapons with inherently-short detection times (e.g., submarine-launched ballistic missiles).

In either of these cases, bonus damage will not eliminate the possibility of distributing a national warning.

It does not appear appropriate to require the warning system to be hardened against a direct attack. Hardening adds significantly to the cost of the system. At the present time (and for the duration of the time for which these requirements are proposed), civil defense in the United States lacks the capability of providing full protection to the general public against attack. Until such full protection exists (e.g., and a large-scale system of blast shelters is implemented), then the functioning of the warning system is not the limiting factor in the operation of the civil defense system. Since the successful protection of the population does not hinge on whether the national warning transmission system operates successfully, the transmission system itself is not likely to be subject to attack; an enemy can inflict heavier damage by attacks directly on population centers. Furthermore, the responsibility of the national warning transmission systems ends when warning of a detected attack is passed in the local level. Once the enemy weapons begin to detonate, the problem is no longer one of attack warning, but one of attack effects warning, which is most appropriately a state or local responsibility. It is at the local level that the threat data are available, not at the national level. Therefore, given sufficient detection time at the national level, the national warning transmission should be completed even if national warning is not timely for people in those cities that are among the first targets in the attack.

PROTECTION AGAINST SABOTAGE

> The facilities of the national warning transmission system should be provided with physical security adequate to prevent disruption or false-alarming as a result of entry by vandals or enemy agents.

It may be appropriate to provide a variable level of physical security for unique elements of the national warning transmission system against undesired intruders. Thus, during periods of normal international relations, fences and intrusion alarms may provide adequate security. During crisis periods it may be necessary to augment these normal physical security measures by the addition of armed guards. This requirement will generally be automatically satisfied if the facilities of the national warning transmission system are located on military bases.

Where the facilities of the national warning transmission systems correspond to commercial facilities (e.g., telephone company long-lines facilities), the level of physical security provided at any specific facility may be inadequate to protect against vandalism or enemy action. In such cases it may be necessary to provide redundant facilities to minimize the possibility of incapacitating the system through sabotage.

ANTIJAMMING REQUIREMENTS

> The national warning transmission system should be provided with antijamming capability.

Jamming may take either of two forms in this system. An enemy may attempt to jam the control signals (either those used in the control network or those that are transmitted to activate the home receivers and thereby prevent the transmission of the warning), or he may attempt to jam the audio signals transmitted to the home receivers (thereby preventing the public from receiving an intelligible message). The degree of antijamming capability to build into the national warning transmission system (frequency diversity, multiple paths, etc.) will have to be based on an analysis of the tradeoff involved in the cost of such features versus the likelihood of an enemy attempting to jam the system. Here, as with survivability, the likelihood of enemy jamming appears relatively remote due to the low payoff and the great risk, for detection of an attempt to jam the system would certainly be considered a hostile act.

ANTISPOOFING REQUIREMENTS

> The national warning transmission system should be sufficiently secure to prevent its being spoofed. The system should be designed to enable the rapid detection by system operators of any attempt, whether belligerent or mischievious, to spoof the system. The system operators should be provided with the ability to inform the public of the situation as soon as possible, using the system itself as well as other means of communicating with the public.

The voice-warning capability of the national warning system transmission provides an effective means of spoofing by an enemy. In the event an enemy succeeds in activating a portion of the system and transmitting a false message, the system operator can at the very least transmit a message immediately to the public nullifying the enemy's message. In order to overcome enemy spoofing, however, the system operator must be able to detect any spoofing attempts. This requires that the system be monitored in all the local areas. Police stations, fire stations, full-time EOCs and similar facilities can carry out this function. Reports of spoofing attempts can be made over the civil defense communications system that is available to the monitoring agency.

The transmission of voice messages can also be used to overcome the effects of a false alarm in a major portion of the system. One of the greatest contributing factors to the degradation of the siren-alerting systems has been the inability of the public to determine whether or not accidental triggerings of the sirens have been false. This need not be a problem with the national warning transmission system if feedback on false alarms that affect entire areas can be provided.

VI. LOCAL WARNING DISSEMINATION SYSTEM REQUIREMENTS

The requirements in this section apply to the local warning dissemination system. This system, in addition to providing the public outlet for national threat warnings, also provides a complete warning capability for natural disaster action warning and localized disaster warning. These functions are essential in an integrated warning system. Any configuration that does not allow for the dissemination of local warnings to threatened populations cannot therefore be considered adequate to meeting the total warning needs of our society.

LOCAL WARNING REQUIREMENTS: FUNCTION

> The local warning dissemination system should be capable of responding to national warnings by disseminating alerting signals and voice warning messages to the general public and/or governmental agencies within its jurisdictional area, as appropriate. It should also be capable of initiating the dissemination of similar alerting signals and warning messages in the event of an imminent or incipient natural disaster, or any other disaster that is restricted in its scope to the local jurisdiction.

The local warning dissemination system functions are twofold as discussed previously: 1) to complete the warning process in national warning, and 2) to carry out a complete but independent warning function in the case of localized disasters, natural or otherwise. The local warning audience can be subdivided into many categories, all of which overlap to a certain extent. Initially, we can speak of public and organizational warning, but members of organizations that have operational roles in an emergency cannot be wholly treated as separate from the public. It is unrealistic, for instance, to plan on warning each member of such organizations individually, as many local civil defense plans do. The demands that such procedures will place on the local telephone system may be unreasonable in a time of emergency. Therefore, there is a certain level within each organization below which members should expect to receive warning in the same way the nonmembers receive it: through the public warning system.

Moreover, there are certain agencies or entities that cannot properly be called civil defense organizations, but which should be given higher priority in the warning scheme than some of the organizations usually classified as civil defense. Among these are schools, hospitals, radio stations (whether part of the warning system or not), industries, commercial locations and parks. Such entities represent various categories of population concentrators that must be specially treated, either because they have special warning problems (hospitals, schools), or because they provide a more specific channel over which to contact the public (industries, commercial locations).

The use of the term "public" with respect to warning is deceptive, because it implies that the principal means of contacting people is by addressing them on a broad and generalized basis. Actually, people are more properly subdivided for warning purposes according to their roles as workers, shoppers, students, patients, attendees at public events, or residents of particular neighborhoods. If the public is subdivided in this way, then providing warning to the people becomes a somewhat more systematic process, because the warning system planner can think in terms of channels that are provided by the particular institution serving as the focus for the public in each of its roles.

An effective warning program is then seen to be dependent upon planning the means by which warning can be directed into each channel. It is dependent upon comprehensive programs in the areas of industrial and institutional warning, upon using background music and paging systems in business establishments, and upon organizing neighborhood warning watches in time of crisis, if necessary. A neighborhood radio watch organizes a group of volunteers in a particular area to monitor their radios on a 24-hour basis.[1] In this perspective, the installation of outdoor alerting devices becomes only one, and perhaps not the most effective one, of many resources to be exploited if the warning system is to fulfill its mission.

In carrying out its independent local warning function, the local warning system must have its own analogue of the threat sensor and evaluator system and decision point that is provided for each of the national warning functions. It must also have an analogue of the national transmission system to convey warning from the decision point to the dissemination point(s). These aspects of the local system are considered below in the section on structural and operational requirements.

LOCAL WARNING REQUIREMENTS: ALERT SIGNAL

> The local warning system should, when required, provide all persons within its area of coverage an alert signal. This alert signal should accompany any warning of a threat--whether of attack or natural disaster--that requires prompt protective actions. The alert signal should signify only that such a time-critical warning message is being or is about to be disseminated.

In Chapter One the nature of the public response to the alerting and warning process was reviewed. The evidence indicates that an alert signal can only direct the public to another source for explicit authentication of the threat, and for direction on an appropriate course of action. Therefore, an alert signal can be nothing more than an attention-getter. Furthermore, there can be only one signal with a single meaning if the public is to respond effectively.

1. Daley, W. E., Listing, Appendix, and Annex to Federal Civil Defense Guide (Part G, Chapter 5), TM-L-2454/007/01 (Draft), System Development Corporation, 15 July 1966, pp. 11-12.

The desired public response is to seek out, listen to and take the protective actions specified in the warning message. A detailed discussion of factors involved in warning message credibility is presented in Appendix A.

LOCAL WARNING REQUIREMENTS: SIGNAL CHARACTERISTICS

> The alert signal should possess attention-demanding characteristics that are extremely difficult to ignore, and that either should carry an inherent unequivocal meaning to the recipient or should motivate the recipient to seek out the specific warning message immediately following the alert signal.

An appropriate alert signal is any signal that the public recognizes as such. Experience with siren false alarms indicates that the current civil defense sirens are not providing effective alert signals because of poor coverage characteristics and lack of credibility by the general public.[1] Although considerable investment has been made in siren installations since 1952 when the matching funds program began, the coverage achieved to date is very low. System Development Corporation has previously estimated that only about 15 percent of the urban area of the United States is adequately covered by sirens.[2] Since coverage requirements involve procuring many additional devices, it is therefore appropriate to establish a requirement potentially calling for development of a more effective outdoor alerting device, even though such development may necessitate the replacement of some devices currently deployed. While the goal of any future deployment of improved outdoor alerting devices should be national uniformity, it must be recognized that at present such uniformity might not be achievable.

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1. Lamoureux, Robert L., et al., Emergency Operating System Development Project, Warning Task, TM-L-2454/001/00 (Draft), System Development Corporation, 22 October 1965, pp. 3-14 through 3-18.

2. Ibid., p. 6-19.

It must also be emphasized that public response is not entirely a function of warning signal characteristics, but depends also upon public attitudes and readiness to respond. In this connection, frequency of exposure to the warning signals, as during system testing, creates a problem. The false alarm studies indicate that even in areas where coverage is good, presently-used civil defense sirens evoke little response--presumably because they have been sounded so often during tests. Also, people may tend not to distinguish them from fire and police sirens. For an alerting system to be effective, some optimum balance must be struck between exposure sufficient to make the public familiar with its distinctive characteristics and meaning, and a too-frequent exposure that would tend to mitigate its impact should a real emergency arise.

Indoor alerting and planning devices have not been deployed, and therefore no such problems of alert signal uniformity and effectiveness exist. Any deployment of indoor devices that may be made in the future should guarantee that the alert signal be both effective and uniform.

LOCAL WARNING REQUIREMENTS: WARNING MESSAGES

> The warning system should provide all the inhabitants within its jurisdiction a local warning message simultaneously (or nearly so) with the local alert signal.

It has been shown in Chapter One that, in a warning situation, a concurrent warning message is required to lend credence to the alert signal. There has been no attempt to recommend message format or message content in these requirements. However, such messages, if they are to be delivered in a timely fashion, must be prepared in advance and must be ready to be delivered at the necessary time. To be effective, any warning message must provide the recipient with information about: 1) the existence, nature and imminence of danger, and 2) the steps that can be taken to prevent, avoid or minimize the danger. In the case of an enemy threat, the information must clearly identify the imminence of a nuclear attack and get the recipients to shelter on a timely basis.

An effective warning message should have the following attributes:

1. Official: The message should represent to the recipient the official policy of the warning agency. In the case of attack warning, this warning agency is the Federal Government, with the implied concurrence of the local government.

2. Impressive: The warning should not be easily ignored. The danger inherent in the impending situation should be explicit. In part, the effectiveness of the message itself can be favorably augmented by the prior presentation of a suitable alert signal. The import of the warning can also be increased by effective delivery. Repetition, even *verbatim* repetition, can further increase the impressiveness of the warning.

3. Unequivocal: The message should be simple, clear and direct. It furthermore should allow no possibility of inconsistent interpretation; any instruction given should be completely consistent and noncontradictory.

4. Personal: The message should convince the recipient that he personally is in danger, and that the protective action prescribed applies directly to him.

5. Balanced: In order to produce effective action, the message must balance the danger of attack with the protection afforded by taking the appropriate action. Failure to do this may produce ineffective and maladaptive action, or may result in an apathetic rejection of any action.

Insofar as the public's response to warning is raised as an issue, it must be recognized that the public's principal interaction with a national warning system occurs at the terminal phase of the warning process. The moment at which a national alert and warning is issued to the public is the moment at which the public either will rise to the occasion or will fail to do so. As a consequence, assumptions about large segments of the general public's likely receptivity and responsiveness to warning, independent of the warning environment model that is postulated, tends to represent an idealization of future warning environments. Only in the escalation model of the warning environment does an assumption of public responsiveness to warning appear warranted. (This model is discussed in Chapter One, Section IV.) However, even this responsiveness may have to be paid for dearly. In the surprise attack warning environment model, a more cautionary approach has to be taken. At best, one can postulate no more than the possibility of favorable public responses to attack warning, with the caveat that the warning dissemination system be required to exercise prime responsibility for convincing the public of the authenticity of the warning.

Thus, it is necessary to spell out the distinctive features of warning credibility problems for different warning missions, and within different warning environment models. As such, it is essential to deal with the credibility issues associated with crisis warning, attack warning (with and without a preceding crisis buildup period) and nonwar disaster warning (with and without advanced forecasts).

The major point associated with all these credibility issues is that credibility relates to warning credibility, and not merely to warning message credibility. Studies of natural disaster occurrences and false alarms indicate that the public tends to seek confirmation upon receipt of the initial warning stimulus by turning to other warning sources. The crucial problem however in attack warning is that the public must be made to believe the warning within the time constraints imposed by the threat. Mutual reinforcement of all warning stimuli is one of the primary basis for achieving timely credibility.

Accordingly, complementary alert signals must be given immediately prior to the dissemination of a national warning message. The synchronization of these complementary alerting signals for indoor/outdoor warning is necessary so that at least for the indoor population the sounding of outdoor sirens represents a background signal that simultaneously supplies additional confirmation of the indoor warning's authenticity. In addition, locally-initiated supplementary warning information may be forthcoming. This too serves to authenticate the warning. In effect, the recipient of warning has to experience the situation as one in which his total environment has dramatically changed. Recipients must believe that all of these warning events, taken in conjunction, signify that the warning is real, and is not merely a test or a false alarm. The techniques selected for producing the functional characteristics of a complete warning vary with the threat--especially the time available for issuance of warning, the prior conditioning and experience of the recipients, and the distribution patterns of the population to be warned.

LOCAL WARNING REQUIREMENTS: COVERAGE

> The local warning dissemination system should be a full period system capable of being activated at any time it is required. It should provide an adequate alerting signal at an effective loudness capabl of attracting the attention of all persons that are within the system's area of coverage, whether they are indoors or outdoors, asleep or awake.

The local warning system must be in a constant state of readiness, just as the national system. In the local system, the local warning decision points likewise must be ready at all times to initiate a local warning.

Ultimately, area coverage must be total. No local warning system in the United States meets the area coverage requirement today, if only because of the lack of indoor coverage. The major problem today is to find some way of making up this lack in full-period indoor coverage. Indoor and outdoor coverage need not be achieved by the same equipment. Sirens of the variety in use today may continue as the primary outdoor alerting devices; they have limited utility indoors. If currently-available sirens do remain in use, then the total coverage requirement must be met by an indoor system such as radio or telephone warnings. Changes however need not be limited to hardware, but may include procedural changes. Therefore, some improvement in the number of lives saved by warning could be achieved in attack warning, if the government were able and willing to consider crisis warning and predetection attack warning to alert the public early in the crisis and start them to shelter in sufficient time to make up for the coverage deficiencies of the present warning system.

LOCAL WARNING REQUIREMENTS: STRUCTURE AND OPERATION

> The local warning dissemination system should be so structured as to be capable of responding immediately upon the receipt of a national warning.

An immediate, unequivocal and unhesitant response to a national warning is required from the local dissemination system to ensure a timely warning to the public and to the emergency operating organizations. No decisions are appropriate at this level if the national system meets the requirements contained in the previous section of this chapter. These requirements establish the national warning transmission system as the only source for crisis, attack and natural disaster forecast warnings, and are so structured as to ensure that such warnings will be valid. Nevertheless, it is recognized that situations will arise in which some degree of local autonomy is necessary, or at least thought to be necessary, by local authorities. This problem needs to be resolved.

The present requirement has planning, personnel and equipment implications for the local system. Plans must be ready and current so that all who must respond to a warning can do so with a minimum of confusion. Operators of the local system will not only have to be on duty at all times, but will have to be sufficiently familiar with their responsibilities under the warning plans so that they can react automatically. Equipment reliability will have to be such as to ensure that an immediate response is possible.

LOCAL WARNING REQUIREMENTS: DECISION POINTS

> A central decision point should be established in the local warning dissemination system for the initiation and control of all local warnings. This local warning decision point should be responsible for evaluating all requests for the issuance of local warning by local governmental and private agencies (natural disaster action warnings excepted) and determining which of these will be disseminated to the public. In the case of natural disaster action warnings, the local office of the Weather Bureau should determine which warnings must be disseminated to the public and, in accordance with local plans, may be equipped to disseminate such warnings itself. The decision point(s) should be equipped, and should have the sole authority, to activate public alerting signals and to broadcast voice warning messages directly to the public in the event of a local emergency.

Centralized decision making in local disasters is necessary: 1) to provide a single point where agencies of the government and the public can direct all messages relating the existence of emergencies, and 2) to provide for the uniform evaluation of such messages, and the dissemination of those only that are sufficiently critical to warrant the use of the warning system.

The only exception to this unitary configuration that can be allowed is with respect to natural disaster action warnings. Two factors must be considered here. First of all, there is an implied conflict between the Weather Bureau, which is responsible for warning the public of natural disasters under Federal statute,[1] and the local decision point, which will operate under local statute.

1. 15 U.S.C. 313-Duties of Chief of (Weather) Bureau; Flood Control Act of 1938 (33 U.S.C. 706); Public Law 71, 1955; 14 U.S.C. 147; all contain various aspects of the Weather Bureau's warning responsibilities.

This conflict can be -- edied by plans governing access to the system and priorities to be used in issuing warning. But more important than this jurisdictional problem is the need for accuracy in the warning information. With respect to natural disasters such as hurricanes and tornadoes, the Weather Bureau is more capable of ensuring that the facts are presented accurately, since it has the equipment for acquiring such information. Of course, a smooth operation in the interface between the two decision points depends upon comprehensive planning and periodic exercising to ensure that personnel know the plans and that the plans are up to date.

Centralized control of local warning dissemination hardware is necessary to ensure uniform operation of the system throughout the locality. The simultaneous activation of all alerting devices will have a mutually reinforcing effect in spurring the public's response. In a crisis situation it is not wise to depend on the availability of sufficient intracommunity communications channels to coordinate the activation of alert devices unless this capability is specifically manned. Telephone systems, for instance, have overloaded almost immediately in past disaster and siren false alarm experiences. Direct programming of voice warning messages to the broadcast media ensures both an immediate dissemination of the warning to the public and accurate information content in the warning message.

LOCAL WARNING REQUIREMENTS: MESSAGE PREPARATION

National attack warning messages for dissemination to the public should, whenever possible, be pretaped and stored in such a manner as to enable immediate broadcast to the public when needed.

Nuclear attack represents the most awesome threat to the public. Because of the magnitude of the threat, it is essential that a careful choice of words be made in composing warning messages, and that the presentation of messages be carefully controlled. Controlled presentation will more likely result if the message is prepared in advance rather than if delivered in the face of the emergency by a person who also is periled by the threat.

LOCAL WARNING REQUIREMENTS: BROADCAST CAPABILITIES

> The broadcast capabilities of the warning system should be so structured that their control can be turned over to those responsible for directing and controlling the protective actions that the public will take in response to the warning. Plans for such transfer of programming capability should recognize the need to balance continued broadcasting of the warning and ensurance that everyone is warned, against the timely broadcasting of direction and control messages, to prevent confusion and enable an effective response to the warning.

This requirement has both planning and hardware implications for the local system. Its overall intent is to enable the warned population to respond effectively by taking protective action. The interface between the warning process and the direction and control process has been recognized as being poorly defined. The most satisfactory solution to the problem of properly intermixing warning and direction and control information is to have the same agency responsible for both.

LOCAL WARNING REQUIREMENTS: RESPONSE TIME

> In an attack warning situation the local warning dissemination system should be capable of responding to the national warning message so that the total response time of the entire warning system, from the initiation of the warning transmission at the national attack warning decision point to the activation of the local alerting devices and of the voice warning message dissemination, should be no longer than 90 seconds. In other warning situations, the local system should be capable of responding so that the local alert signal and warning message will be disseminated in sufficient time to allow predetermined local levels of protection to be achieved.

As in the national warning transmission system response time, the value chosen for the attack warning situation is an arbitrary one, because no analytical derivation of a plausible response time is possible. While the 90-second figure appears to allow 30 seconds for the local system to be activated, the actual time available to the local system may be longer if the national system can better its 60-second response time requirement. The 30-second response time can be easily realized if automatic switching is used to activate the local system on command of the national system. It may be impossible if manual activation is required. The response time requirement for other warning situations recognizes that time criticality in system response varies with the nature of each threat and the protective actions that must be carried out to meet it. For example, amount of warning needed may be minutes for tornadoes and hours for hurricanes.

LOCAL WARNING REQUIREMENTS: RELIABILITY

The requirement for a figure of merit for system reliability is contained in the next section. Only a requirement related to system testing has been included here. This requirement treats system testing as a means of ensuring adequate reliability in the operation of the system hardware and increasing the reliability of the public response.

> The local warning dissemination system should be capable of being tested and exercised in order that the system is assured of being in a constant state of readiness. The frequency and design of these tests should be such as to maximize the degree of public support for the warning program and minimize the likelihood that the public would respond ineffectively in the event of a real warning.

The ability to test the system is required not only to check on the operational status of the system, but to enable the exercising of the system as a part of an overall emergency operations educational and training program. In order to check on the status of the local system hardware, the decision point must be able to test the system. Local testing of the system must include the sounding of the alert devices and the accompanying dissemination of a voice message explaining the test. Ideally, testing and exercising of the system should be done concurrently. However, it may not be possible to determine a frequency median that would be meaningful for both testing and exercising. System exercising is required to make the public aware of the local warning system mission. The public must be integrated to the degree possible in these exercises. Effective public involvement will result only from an educational program designed to convince people of the need for warning.

LOCAL WARNING REQUIREMENTS: SURVIVABILITY, SECURITY AND SABOTAGE

As with the national warning transmission system, the need for survivability in the local warning dissemination system must be evaluated in terms of the effects of nonsurvivability. At the local level there is little need to give special consideration to survivability in the design of the system. If a nuclear detonation takes out even part of the local system, those in the locality who survive will have been alerted by the weapons effects themselves. This is particularly true if such a detonation follows a crisis buildup.

The need to protect against jamming and spoofing, as well as sabotage, must be evaluated in terms of the potential payoff to an enemy. Such action is highly dangerous to an enemy if such action is discovered. Again, the need for such provision in a local system appears minimal until that system is able to cope effectively with the threat to the population. However, the local elements must be secure from damage by vandalism.

VII. OVERALL SYSTEM RELIABILITY REQUIREMENT

> the system effectiveness of the national warning transmission system and of the local warning dissemination system in the event of an attack warning should be such that there will be at least a 90 percent probability that at least 99 percent of the local warning dissemination systems will operate satisfactorily. The mission time for calculating system effectiveness will be the maximum response time for each system.

System effectiveness is defined as the probability that the system can successfully meet an operational demand within a given time when operated under specified conditions.[1] Two more definitions help clarify the concept of system effectiveness. Mission reliability is the probability that under stated conditions the system will operate in the mode for which it was designed (i.e., with no malfunctions), and for the duration of the mission (given that it was operating in this mode at the beginning of the mission). Operational readiness is the probability that at any point in time the system is either operating satisfactorily or ready to be placed in operation on demand, when used under stated conditions. Total calendar time is the basis for calculating operational readiness.

With these terms defined, we can see that the system effectiveness of each of the two component systems in the overall warning system is merely the product of the operational readiness and the mission reliability of each. These quantities can be calculated for any given component system configuration. The result will be a number p, lying between zero and one that represents the probability that the particular component system will operate satisfactorily, upon demand, under the conditions described in the system requirements. Then, given a number p_1 that represents the worst value of system effectiveness among the many local

1. ARINC Research Corporation, Reliability Engineering, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1964, pp. 6-15.

warning dissemination systems throughout the country, and a number p_2 that represents the system effectiveness of the national warning dissemination system, we want to calculate the lower bound for the system effectiveness of the overall warning system. We are interested in the lower bound established by the worst case local system, because the requirement is written in terms of at least a 90 percent probability that at least 99 percent of the local systems will operate. The values 99 and 90 percent were chosen because they are the same as those which the Research Directorate of OCD has established as requirements for the Decision Information Distribution System (DIDS).[1]

1. Wellisch, J., and C. Schemmerling, Decision Information Distribution System: Operational Requirements, TM-L-2550/012/01, System Development Corporation, 18 November 1966, p. 15.

CHAPTER SIX

WARNING SYSTEM DESCRIPTION

I. INTRODUCTION

The purpose of this chapter is to describe the functions that would have to be performed in an integrated warning system in order to fulfill the Requirements stated in the preceding chapter. Where the means for accomplishing a given function are indicated it is only for the purpose of illustration, and not to suggest that implementation should necessarily be done in the manner described.

The integrated national warning system to be described is designed to warn government agencies and the public of those threats that are capable of endangering lives and property. Clearly, the warning system must include the capability for input of warning decision information at several levels of government. Such a hierarchy of decision making elements, combined with the diversity of threats that might necessitate use of the warning system, lead to problems of warning priority, as well as to problems in defining the extent of coverage (both geographic and functional) that each type of warning should have. Notwithstanding the complexity of interrelationships, the total warning system may be divided into three basic functional elements as follows:

> Decision Components: Individual or agencies in whom responsibility for initiating warning is vested,
>
> Recipients or Audience: The individuals, organizations, and ultimately the public to whom warning information is communicated, and
>
> Transmission and Dissemination Components: The means for communicating warning information.

Accordingly, the first part of this system description discusses some of the decision making elements involved, the second section discusses the problems of defining the audience for the warning, and the last section defines the system in terms of its elements and the connections between them.

II. DECISION COMPONENTS

The decision components are the points at which the system receives its inputs. They vary with the type of warning required, and in some cases, with the amount of time available for disseminating the warning. There are three basic categories of decision components that the system must accommodate. These categories can be described simply as: 1) agencies that have information about the international situation and are in a position to determine whether there is reason to prepare the nation for an attack, 2) agencies that have information about an impending natural disaster and the measures required to prepare for it, and 3) agencies that have information about purely local threatening situations and can supply instructions for protecting against such situations.

The first category includes the President and the National Security Council, the Joint Chiefs of Staff, and to some extent, the Commander-in-Chief, North American Air Defense Command (NORAD). The second consists mainly of the several levels of the Environmental Science Services Administration (ESSA).[1] The third category includes a multitude of diverse agencies, such as civil defense, police and fire services.

III. WARNING RECIPIENTS

The audience to whom the warning must be given establishes specific functional requirements on the output end. Because there are several types of audience with different warning needs, they will be referred to generally as recipients. Functionally, there are two types: 1) the organizational recipients, consisting

1. Refer to Chapter Three for a complete description.

of those governmental agencies having an operational role in coping with the disaster, and 2) the public recipients, consisting of those in the population who are threatened by the disaster and whose primary role is to take self-protective action. Each of these types is discussed below.

ORGANIZATIONAL RECIPIENTS

Planning for and operating in emergencies is a necessary part of all governmental activity. Quite obviously, an operational agency involved in coping with an emergency will require special information that is not needed by the general public. Moreover, to the extent that the operational agency maintains a high level of emergency operating proficiency as well as a ready status, the credibility of warning can be more readily established and the amount of warning information required by the agency held to a minimum. Consequently, the organizational response to warning can be quick and efficient.

Organizational warning is best provided in a hard copy form for retention as records. Upon examining the threat spectrum and individual areas of responsibility, one can see that not all governmental agencies will require warning about all types of threats. Furthermore, certain agencies will not have operational roles in particular threat situations and can therefore be treated as part of the public recipient category.

There are many governmental hierarchies in our society, and consequently many overlapping functional jurisdictions. Considering only the federal, state and local interrelationships, there is a high probability that personnel and facilities belonging to each of these hierarchies will exist side-by-side in any given community. In the integrated warning system described herein, separate warning procedures for each will be possible, but these must be coordinated by OCD within the total operation of all participants in the warning process.

Another problem area of organizational warning relates to increased readiness buildup in preparation for an emergency. Quite obviously, such actions have within them the potential for escalating a crisis; their initiation must therefore be carefully controlled. Federal management of the increased readiness program (i.e., federal direction as to which actions must be taken, which must not be taken, and which are optional) is necessary if a controlled national response is to be achieved. A means of communication from the federal to the state and local levels must be available, over which to transmit warning information related to increased readiness buildup.[1] Such messages must be provided in hard copy form in order to avoid the confusion that comes from manually copying voice messages, and to provide permanent copies of the messages for the record.

PUBLIC RECIPIENTS

System coverage must be such as to reach the public wherever they may be found in significant numbers. Clearly, this means that indoor warning is required in households, commercial and industrial establishments, and institutions. It also means that the vast number of people in automobiles must be reached by the warning system, and that the outdoor population must be at least alerted to the fact that a threat situation exists, and, wherever possible, they also should be warned.

IV. SYSTEM DESCRIPTION

DEFINITIONS

In the following system description, two modes of communications flow are specified--<u>transmission</u>, which implies sending information along point-to-point channels between specific system nodes, and <u>dissemination</u>, which implies the broadcasting of information to the public at large. In general, a transmission

1. See Chapter Two for a suggested means of accomplishing this.

component is used within the warning system to distribute the warning to the dissemination component. The transmission component also serves as the primary warning channel to the organizational recipients.

A decision component of the warning system consists of those organizations, plans, procedures, personnel and associated hardware that are necessary to make the decision to initiate a warning. As described in Chapter Two, there are several decision components in the integrated national warning system, but they are functionally segregated. Thus, there are separate decision components for attack warning, severe storm warning, etc. The decision components are also geographically or jurisdictionally segregated. As a result, attack warning, which is national in scope, has a single decision component, while local threat warning has many decision components, each serving a given locality. The decision component has the responsibility for deciding that a threat is of sufficient importance to require warning the agencies or segments of the public served by the system.

Using these definitions, we may then define a warning system as a communications system over which an official message is transmitted and disseminated from a decision maker to a recipient. The message provides advance information of a physical threat to lives and property, including information on the nature, scope and imminence of the threat, and indicates a course of action for the recipient. The warning message flows in one direction only, from the decision component to the recipient.

The following sections describe the components of the integrated warning system and how they operate. The first three sections deal with the decision components and recipients of three subsystems. In describing the operation of these components and how they interact with the recipients, criteria are stated for describing the common transmission and dissemination components necessary to provide the warning channel between them. The system is described in terms of components, channels and nodes. No attempt is made to specify types of equipment that should be used in specific functions. The approach is kept general to ensure that when hardware is considered for a particular application it will be chosen to meet the needs of the system.

THE ATTACK WARNING SYSTEM

Prior to an attack taking place, there is a high probability that our nation's intelligence apparatus will detect the preparations being made by the enemy. This is particularly true if the enemy is recognizably hostile to the United States and capable of mounting a major attack. Furthermore, it is unlikely that an attack would be initiated without an immediate cause in the form of some political point at issue between the enemy nation and our own. Therefore, particularly in the case of a large scale attack, it is reasonable to expect that we will have advance signals indicating the existence of a threat. The major exceptions to this type of analysis are: 1) an Nth country attack designed to provoke an all-out exchange between major powers, and 2) a failure of our government to interpret the signals properly.

Given a period of crisis buildup, the passive defense capability of the country can be strengthened by increased-readiness actions. The initiation of such actions must be controlled, however, if they are not to appear as provocative preparations for a preemptive attack on our part. Because the President is responsible for the conduct of international affairs, the control of such crisis actions must reside with him. Furthermore, it would be desirable if he could use increased-readiness measures as a tool in crisis negotiations. Therefore, decisions to give increased-readiness directives to the organizational recipients must emanate from the President.

The time constraint under which increased-readiness warning will be given may vary. Actions initiated early in the crisis may require little more than a slight quickening of the governmental pace, while actions taken late in the crisis may require all-out crash efforts if they are to be effective. Because speed may be necessary for some of these warnings, the system must be capable of transmitting all warnings with minimal delay. However, since not all messages will require the same speed of transmission, a priority scheme may be employed.

The ability to address specific parts of the national organizational recipient network will be necessary in cases where specific areas of the country are threatened, or where specific actions are required from certain organizations. If we define geographic regions whose governments have joined together to develop a common emergency operating plan, then it is reasonable to delineate such an area as the smallest geographically-defined part of the system that will need to be addressed specifically.

The primary addressee of preattack warning will be the organizational recipient. There may come a time during a particular crisis, however, when the President determines that an attack is imminent and that the public must be advised to carry out protective actions. Therefore, the President must be provided the capability to broadcast a warning on short notice prior to the actual incidence of an attack. In this case the form of the warning will be a voice message broadcast over the recognized official public dissemination component.

In order to maximize the impact of the warning on the public, particularly since we assume it will be broadcast prior to the detection of an actual attack, it would seem necessary to have the President himself deliver the message. An alert signal should precede the broadcast of the warning for two reasons: 1) to maximize the size of the audience, and 2) because the warning will result in terminal action by the public. Therefore, notification that such a public warning is to be given must be sent to the organizational recipients with highest priority to ensure that the alert-warning process will be synchronized in localities where the alert signal portion of the dissemination component is activated separately from the voice portion.

Clearly, if we had the capability now to address the entire nation on as little as five minute's notice, we would have a far better warning capability than we actually do. The first goal should be to provide a national warning capability with a short response time. As the number of tactical options available to the passive defense agencies increases, smaller segments of the public will have to be addressed. It does not appear, however, that anything smaller than the previously-defined common geographical area would need to be addressed.

The primary hardware terminals of the decision component should be located in the nation's capital. Alternate terminals should be provided at any relocation sites that might serv the President in a time of crisis. In addition, there must be capability to patch into one of these terminals from any other location where the President might be.

Warning of a detected attack must be disseminated both to the organizational and public recipients without delay. Such warning could emanate from the President, from the National Military Command Authority, or from NORAD, depending on the type of attack, the amount of prior warning and the national defensive strategy that is selected. Decision components must be working then in close coordination in any case, and the selection of the point of origin for the actual warning message should be a part of this coordinated effort. The effect on the warning system is simply that there must be a means of inputting the decision information at NORAD headquarters as well as in Washington. In a sophisticated system capable of graduating its response to the scope of attack, a warning may go to all recipients, both organizational and public or only to selected segments of either or both.

A final aspect of decision component configuration needs to be considered--that of redundancy and alternate decision points. Should nuclear weapons begin to detonate without warning, as in a surprise SLBM attack, people in the surrounding area who escape the direct weapon effects will need no alerting signals but will need warning of delayed local effects and instructions regarding appropriate protective measures.[1] There is little that the national warning agencies can do for the affected area in this case. However, the necessary post-impact warning and instructions could probably originate from local organizations if adequate means are provided.

There may be a requirement to pass knowledge of the event in both lateral and upward directions--the first to provide advanced warning to other areas threatened by delayed effects surrounding the impact area, and the latter to notify the higher levels of government that an attack has taken place. In both cases, the lateral and upward communication serves as a threat sensor and evaluation input, and is outside the operation of the warning system. If the national attack warning decision components are still operational, they will receive this threat information and can pass it to the rest of the nation not yet hit by the attack. If they are inoperative, other means for lateral dissemination of the threat information can be provided by the agencies where national threat sensor and evaluation information will be available before the attack takes place. Given reliable communications from these agencies to the recipients, national attack warning can be completed without the need of backup decision components.

The public dissemination of attack warning will be accompanied by an alert signal. The signal will mean only that a dangerous threat situation exists and that the hearer should seek a source for the voice warning message. The alert signal and warning message must be synchronized in order to maximize the size of the audience and limit conf sion by public recipients.

Finally, because warning must precede the actual impact of the attack, there is no need to provide backup facilities to the decision components of the attack warning subsystem that are responsible for providing national warning. If a

1. See R. I. Condit, Warning Times and Procedures for Getting People Into Shelter from Fallout, Stanford Research Institute, May 1965.

national warning is not given because of a complete surprise attack, regional, state and local warning of the effects of such an attack will originate within lower levels of the system, even though this process is inherently slow and less reliable than is the operation of the national warning system.

NATURAL DISASTER WARNING SYSTEM

The decision component of the natural disaster system for long-range warning is composed of those Environmental Sciences Service Administration (ESSA) facilities responsible for forecasting severe natural disasters.

Natural disaster forecast warnings are communicated to both organizational and public recipients. In contrast with the attack warning system, there is no requirement for the natural disaster warning system to address recipients on a nationwide basis; rather, the emphasis is placed upon providing means for addressing specific elements of the national organizational network. Since both systems use the same transmission components, meeting the natural disaster warning requirement would actually result in a bonus capability for the attack warning system (i.e., the ability to address recipients on a selective basis).

The agencies included in the organizational recipients of the forecast warning portion of the subsystem will include state and local governmental disaster control agencies, facilities included in the dissemination components of the subsystem, and local Weather Bureau facilities. Thus, the only added terminals in the transmission component of the warning system are at the local Weather Bureau facilities. Warning to the organizational recipients must be in hard copy form to avoid delays and errors, and for record-keeping purposes.

In the natural disaster forecast warning process the public must be addressed at some indeterminable time after the organizational recipients. The urgency with which such warnings are disseminated will vary. Long-term hurricane forecasts do not require immediate dissemination, nor do tornado alerts, which may be forecast several hours in advance of the anticipated storms. Seismic sea-wave forecasts require more urgency in those areas that are close to the point of origin, but the degree of urgency varies with distance from that point. Because forecast warnings are not likely to be extremely urgent (as contrasted with attack warnings considered in the discussion of the attack warning subsystem above), there is no need to sound an alert signal in conjunction with their issuance. In view of the possibility that no threat will materialize in any particular locality, despite the forecast, there could be a degradation in the degree of public credibility in the alert signal if it is used with such warnings. The only exception that seems to warrant special consideration in this regard is a warning that for some reason has less than the normal time-delay associated with it; thus it appears warranted to use an alert signal in those communities close to the point of origin of a seismic sea-wave.

Imminent weather warning originates at the local level in the local Weather Bureau facility, and is based upon actual observation either by sighting or by electronic sensing apparatus. Procedures for originating such warning must ensure that the coordination of all warning is vested in the local Weather Bureau Office, so that the warning is based upon professionally-evaluated information. In this situation, there is no question that the threat is real and that the time for protective action is critically short. The organizational recipients and public must be addressed simultaneously. The alert signal must be sounded both to maximize the size of the audience and to convey the idea of urgency to the public. The area of coverage for this type of warning may exceed the area threatened by disaster. For instance, a county may constitute the smallest addressable subset in the system. Even though only one city or town within the county is threatened, it is essential that the remainder of the county be alerted to ensure that those threatened will receive the warning. The voice warning message disseminated to the public must then specify exactly which portion of the population is threatened in order to prevent confusion and overreaction.

In areas where alerting devices such as sirens may be employed for either attack or natural disaster situations, there may be some question as to whether anyone besides civil defense officials (as the local Weather Bureau) should be authorized to sound the alert. This problem may be at least partially resolved by the recent OCD directive to use a wavering siren tone exclusively for attack alerting, and a steady tone for peacetime emergency alerts.[1] However, the primary factor in overcoming any confusion here would be a well-coordinated alerting and warning combination in which radio would used to disseminate explicit warning information after initial alert by the sirens.

There are two sets of priority considerations to deal with: 1) priority within the natural disaster warning subsystem, and 2) priority within the overall warning system between the attack warning and the natural disaster warning subsystems. Within the natural disaster warning subsystem the priority problem tends to disappear, because forecast warnings and imminent warnings are given in separate time periods. If a conflict arises, the imminent warning dealing with the most dangerous threat clearly should have priority. The different points of origin for the two types of warning helps resolve any conflicts, as does the fact that imminent warnings are generally given to smaller geographic areas than are forecast warnings. A tornado forecast warning may cover several states, but a warning of an imminent tornado need cover only several counties, or perhaps an even smaller area.

LOCAL WARNING SYSTEM

The local warning subsystem provides an orderly means for notifying the public of disaster threats that arise out of purely local conditions. Warning of such threat conditions is the responsibility of local governmental agencies such as the fire and police departments. If disaster strikes, the local government is

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1. Redefinition of Meaning and Application of Civil Defense Warning Signals, Memorandum for state and local civil defense directors, Office of Civil Defense, 1 December 1966.

also responsible for taking steps to limit the damage and protect the population in the threatened area.

Some localities have developed systematic methods for warning their populations of such threats, but the scope of operations proposed here is more ambitious than are most such systems. The SIGALERT system in Los Angeles, California, is an example of the arrangement proposed. This system provides a means whereby emergency broadcasts can be transmitted to the public over participating commercial radio stations. Control of the system is exercised by the Los Angeles Police Department. The local warning subsystem, as proposed, provides the final element in the integrated national warning system that will ensure that the public can be given timely warning of any potentially-disastrous threat to their lives and property. An integrated warning system gives the public one source to turn to for such information--a source whose credibility and authenticity is increased every time it disseminates a warning. From the civil defense standpoint, this configuration means the increased likelihood of an effective public response to an attack warning, because the source for such warning has become recognized as authentic and credible through its use in other threatening situations.

The decision component of the local warning subsystem must be centralized in some local governmental agency. It is unlikely that many cities could afford to have the function performed by an independent agency, or perhaps even more important, could keep such an agency busy enough on an ongoing basis to justify the arrangement. Therefore, the local police or fire department communications service appears as a likely agency to fill the role. The decision component then serves as a filter center to receive notifications of emergency conditions from other government agencies or the public, and to determine which are of sufficient gravity to issue as public warnings. The decision component must be provided the capability to input such information to the public or to the organizational dissemination component, depending upon the gravity of the threat and the amount of time available for response to that threat. The geographic extent of the local warning subsystem must be determined by the number of local governments that choose to cooperate in establishing it. The goal here is to ensure ultimately that everyone in the country lives within the coverage area of a local warning subsystem.

The local warning subsystem will also play a role in attack situations, serving as the means by which the Emergency Operations Center (EOC) delivers warning and direction and control information to the public. Warning of delayed fallout in localities not hit by direct weapons effects can be based upon the communication of RADEF conditions, and local RADEF readings, among adjoining areas. If the national attack warning decision component cannot provide such warning, it must originate at the local level.

THE TRANSMISSION COMPONENT

We have now described the functional subsystems of the national integrated warning system in terms of their decision components, recipients and procedural requirements. These determinants establish the requirements for the transmission and dissemination components of the system. This section will describe the transmission component.

The transmission component serves a dual purpose in the system: 1) it serves as the primary warning channel for the organization recipients, and 2) it also serves as the activating and programming network for the dissemination component. It is estimated that the number of terminals in the transmission component will be approximately 3500 in a configuration where commercial broadcast stations are not used as dissemination elements, and more than double that number if they are used.[1] In the transmission component, the destination of the message is selected by the decision component, and the message goes to the selected destination that

1. This estimate is based on the NADWARN Proposal of ESSA which contemplates providing Teletype warning service to 2900 communities. The minimum number is increased to include selected state and county as well as local governments.

may be a single terminal or a set of terminals. The number of terminals in the system makes it unlikely that single addressee messages will ever be sent. It is reasonable to assume that all addressing will be either nationwide, or to fairly large sections of the nation.

In the following description of the channel requirements it is not necessary to assume that full-period dedicated circuits are to be used or even that a common type of configuration or equipment is required on a nationwide basis. The channel may be described as connecting two component nodes, but the final configuration may have several intervening nodes added. If the proper channel exists, any intervening switching points are immaterial to the discussion as long as they do not degrade the capability of the system in meeting its operational requirements.

The primary network within the transmission component will be the channels connecting warning decision components (both for attack and natural disasters) with the organizational recipients and the dissemination facilities. Since the organizational recipient terminal of the attack warning has slightly different requirements than the terminal at the dissemination facilities, separate channels may be required.

In this configuration, a synchronizing mechanism or procedure to ensure coordinated alerting and warning dissemination can be achieved either at the decision component end (by transmitting time phase messages over the separate channel) or at the terminal end (by providing a coordination channel between the organizational terminal and the dissemination facility terminal). The first alternative runs the risk of losing the synchronization in transmission due to switching mismatches between the two networks. The second alternative is preferable, since a voice coordination channel may also be used to provide program material to the dissemination facility in local warning subsystem operation. In this configuration however a separate network must be provided between the natural disaster forecast warning decision components and the organization recipients.

The primary channel can also be used for selecting and activating the broadcast of a pretaped voice message at dissemination facilities by means of switching devices. The use of this technique would depend on the configuration of the dissemination component. It would be more difficult to use such switching methods in a configuration that used commercial broadcast stations, since this would tend to take facility control away from the station operator. Such methods would be more feasible with a dissemination component using special-purpose warning broadcast facilities.

A final requirement in the primary channel is that terminal equipment be equipped with a positive-alerting device to call the attention of personnel at the receiver to the fact that a warning is being receiver. At organizational locations this alert signal must be clearly perceptible at a position manned on a full-time basis. At a dissemination facility, particularly at a commercial broadcast facility, every precaution must be taken to ensure that the receipt of the warning message will be known, including visual signals if necessary.

A voice channel is required in the transmission component to enable the programming of the live voice-warning message to the dissemination component from the attack warning decision component. The quality of transmission must be at least equal to a radio network-programming line in order that the President's voice be recognizable. This is the only required voice channel in the transmission component.

The voice channels in imminent natural disaster warning and local disaster warning do not enter the transmission component of the warning system, and are discussed below under the dissemination component.

To conclude this section, we list a few existing and planned communications networks that could provide a basis for the transmission component of an integrated national warning system. None of these facilities is capable of being used without major modification for increasing its area of coverage and/or improving its reliability.

The primary network could be built around, or include, any of the following nationwide networks: the Department of Defense Automatic Digital Network (AUTODIN) and Automatic Voice Network (AUTOVON), the General Service Administration Advanced Record System (ARS), and the privately-owned Associated Press (AP) and United Press International (UPI) Teletype networks. These last two systems are currently served by the Emergency Action Notification (EAN) System, which can link them up into a national network on very short notice. The proposed ESSA Natural Disaster Warning Teletypewriter Network, the OCD Decision Information Distribution System (DIDS) and OCD National Warning System (NAWAS) are also included in the list.

None of these systems has a national control point with the addressing capability required by the system. None has the required reliability, though this could probably be achieved by using portions of several of them redundantly. Finally, none currently has terminals at all of the required locations for warning use.

Voice channels for Presidential use exist in the three existing nationwide radio broadcasting network facilities. These reach sufficient radio stations to provide nationwide coverage, and this coverage can be extended by lease arrangement with the network and the telephone company, or by off-the-air monitoring techniques at nonnetwork stations.

THE DISSEMINATION COMPONENT

General Requirements

The dissemination component comprises that portion of the warning system that broadcasts the warning to the public. We use the word "broadcast" in the literal sens, meaning to spread in all directions. Therefore, the dissemination component does not need to depend solely on radio or television broadcast facilities. Fixed or mobile public address systems, multiple-ringing telephone systems, or any other communications mechanism that can carry information from a single origination point to a large number of unspecifically addressed locations, will also serve to broadcast the warning.

Primarily, the audience for the dissemination component is the general public. The term "public" is a useful one for our purposes, but only as it describes the population of a locality at limited times of the day, week or year. At most times, the persons who comprise the public can be differentiated into identifiable units that can be contacted and communicated with in more efficient ways than when they are thought of only as "the public." For example, during the day large groups are clustered together as employees of industry, as students in schools, as customers of businesses, or as attendees at public events. Even at night they can be classified as residents of neighborhoods. Therefore, there are means by which emergency agencies specifically can address major segments of the public, and disseminate warning to them with greater efficiency, then if the warning is merely broadcast on an area basis. Identifying these groups and making arrangements to get warning to them in the most effective way must be a goal of the warning program at the local level. No matter what technical improvements are made in the physical means of warning dissemination, a failure to implement and maintain an industrial, institutional and commercial warning program and a neighborhood warning organization could result in less-than-optimum warning when the need arises. Such programs provide a means of increasing the power of the warning system by introducing what might be termed an amplification factor at the local level. A 125 db civil defense siren might have an effective coverage area of less than a square mile in a noisy industrial area, at a cost in excess of $3000 initially plus annual operating expenses. On the other hand, an industrial warning program can effectively cover the entire industrial complex of a city by a single telephone call and by prearranged dissemination of warning within the various plants by means of whistles, flashing lights and industrial public address systems. The same is true for commercial business locations, schools, hospitals, and all other places where people gather for social and economic reasons. Therefore, an important portion of an effective dissemination component in the integrated national warning system results from the implementation of effective ancillary programs to increase the effective coverage of the system.

Another important portion of an effective dissemination subsystem results from the development of an automatically-activated home warning receiver. Despite the potential effectiveness of neighborhood organization in improving the nighttime response of the population to warning, some more direct and immediate means of reaching the sleeping public is required, not only in the surprise attack situation but for certain short-notice natural and local disasters, and even in a nuclear attack situation preceded by a crisis buildup.

The last component of the dissemination subsystem for an integrated national warning system results from the consolidation of all warning dissemination into a uniform process. This unification can make public response a working part of the overall system: first, it will increase public response to warning when members of the public know that there is a single source of warning and that the source will not only tell them what the threat is but what to do about it; second, it will also increase public tolerance of false alarms, since there will be a greater chance for a sufficient number of valid warnings to offset any degrading effect that an occasional false alarm might have.

Dissemination of Local Warning

Several viewpoints apply to the examination of the dissemination component: 1) it is possible to regard the dissemination component as a self-contained local warning system with all the elements of the national warning system duplicated in miniature, and 2) it is possible to look at it as the final component in the national warning system. Unlike the other components in the integrated national warning system, an element of the dissemination component that serves a given locality is geographically self-contained, having no direct lateral connection with other elements of the component in different localities except by going back through the transmission component. Therefore, any element of the component can, with the addition of a decision element, function as a complete warning system.

Considering the local element of the dissemination component as a self-contained warning system for the moment, it is possible to see that two decision components, and a means of programming the warning messages for the actual broadcast mechanism, are required. The decision components are: 1) the local Weather Bureau office responsible for warning of imminent natural disasters, and 2) a local governmental agency responsible for determining which of the many other local emergency situations are sufficiently grave to require public warning. These agencies accordingly require a channel over which they can transmit warning to the broadcasting or disseminating facility. In the national transmission component, virtually all messages received at the dissemination component are in hard copy form, primarily because of the need to provide copies for the record, but also to ensure uniformity and accuracy in the information content of the messages. At the local level the need for record copies is no longer mandatory. The need to ensure uniformity and accuracy in the message content is still required, however. Since both types of locally-originated warning are highly time-critical, the most rapid way of disseminating them is directly by voice. If accuracy in message content is to be ensured within the time constraint involved, the best solution is to let the representative of the warning agency disseminate the warning directly to the public.

In discussing the warning system operation at the national and regional level, it was pointed out that the smallest subset of the public recipients that would have to be addressable would be the individual local area. When examining the local warning system, however, it is also possible to see that it is advantageous to have a subset-addressing capability at this level also. The degree of addressing capability will be largely determined by the dissemination media used. A radio or television station cannot limit its coverage for warning; hence, it can only broadcast to its normal service area. On the other hand, public address systems (outdoor and indoor) cover only specific areas and can reach specific segments of the population. The use of mobile public address systems also provide a means of delivering a warning to a specific subset of the population for a specific purpose. A similar situation exists with a multiple-ringing telephone system that could limit the area of warning to that covered by a single exchange. The ancillary local warning programs discussed above greatly facilitate this subset-addressing capability. Therefore, the means exist for limiting the area over which warning is disseminated, in certain cases. In the local area it also appears possible to warn specific areas in a message broadcast to the general audience without degrading public confidence in the system. On the basis of past disaster experience, it is likely that if a person hears a warning intended for others on the other side of town, he will listen out of curiosity and will also recognize that next time the warning may be for him.

An alerting mechanism for calling people's attention to the delivery of a warning message will continue to be a requirement in the local system. An automatic radio receiver will undoubtedly improve the capability to reach the public indoors, and may also improve the effectiveness of existing siren installations. As we envision the operation of the warning system, any alerting signals will mean only that a dangerous situation exists, and that a warning message is about to be, or is being, disseminated. Freed from all meaning as to directing a course of action to the hearer, the outdoor alert signal can be used in all cases of extreme urgency to maximize the audience for the warning message. The operators of the warning system must, of course, bear the responsibility not to overuse the alert signal.

The dissemination media for warning in the local area will vary with each locality. Certainly, commercial radio broadcasting facilities will be almost universally available. Public address systems of many types, including background music systems in commercial and industrial locations, are also widespread. Research is currently underway to determine the feasibility of multiple-ringing telephone systems. The introduction of special-purpose governmental radio broadcast facilities for public warning, while not out of the question, may not be required at the local level in view of the number of existing resources.

We have described the elements that will constitute the local warning systems. Local plans and procedures are necessary to bind these elements into an effective operational system. In addition, programs to educate the public about the purpose of warning, and the way in which the warning system operates, are necessary to assist the system in fulfilling its mission.

Local Dissemination of Attack and Natural Disaster Forecast Warning

The previous section was devoted to warnings of threats that arise at the local level and can be handled without entering the transmission component of the integrated national warning system. This section will deal with the dissemination to the public of warnings that originate at levels above the locality and must be transmitted to the locality for dissemination.

Attack warning dissemination is a matter of extreme urgency demanding the minimum system response time and the sounding of the alert signal as soon as possible to allow the maximum possible time for public response. On the other hand, natural disaster forecast warnings usually require less urgency in their delivery, and are therefore not preceded by an alert signal. Their broadcast is handled similar to regular news broadcasts.

The local attack warning dissemination element must have a means of: 1) alerting the facility operator to the fact that a warning message is about to be transmitted to him, 2) programming the alert signal and warning message over the facility, and 3) switching the facility over to the local emergency operating agency for input of direction and control information. Generally, the warning process will be accelerated as more of the above functions become automated.

Natural disaster forecast warnings are of such a nature that they must be transmitted to the local dissemination facility in such form that they are recognized as emergency information and are given high priority on the facility's programming schedule.

APPENDIX A

MESSAGE CREDIBILITY

I. INTRODUCTION

To be credible, a warning message must accomplish three tasks. First, the message must motivate the recipients to perform appropriate adaptive actions. Disaster researchers have noted that during times of crisis people's actions tend to follow certain social and psychological patterns. It is possible for a warning message to use those patterns of behavior to guide an endangered population into appropriate protective channels.

The second task of the warning message is to communicate the warning information in the most meaningful terms possible. Although little is known of the precise interpretations people place on words used in previous warning messages, it is possible to construct future messages so that each word in each sentence has maximum effect on the recipients.

Third, the warning message must be self-authenticating, in terms of the medium over which it is disseminated and of the voice used to deliver it. The authenticity task is lightened somewhat by the fact that people regularly use radio and television to obtain important news as quickly as possible. Also, they are inclined to regard information from these sources as being quite reliable. Selecting the appropriate voices to deliver warning messages over these media is a rather complex, although not impossible, undertaking.

This appendix describes research findings that apply to the three tasks of message credibility as defined above. Based on the research findings, recommendations are made on how warning messages can be made credible. A final section discusses the effects of a specific situation (a population recently awakened) on warning message instructions, and the ability of the recipients to carry the instructions out.

II. MOTIVATING THE WARNING RECIPIENT

This section is in two parts. The first describes a theory of motivation during threatening conditions. The second part proposes a set of guidelines to be used in motivating adaptive behavior through the warning message.

THE READINESS TO ACT

In times of danger a person's readiness to act is largely dependent on his perception of the threat. If he believes the threat is immediate and real, his motivation will be high. If the threat seems distant, his motivation will be less. Irving L. Janis theorizes that there are a number of situational factors that will influence a person's perception of the threat.[1] These factors, and the influences they may exert, are quoted below.

> "1. ANTICIPATED INACCESSIBILITY OF EXISTING ESCAPE ROUTES
>
> Under conditions where a personal or community disaster is anticipated, the strength of vigilance tendencies will be increased by any warning communications or physical sign interpreted by the perceiver as indicating that a currently-available escape route will become inaccessible to him once the danger materializes."[2]

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1. Janis, Irving L., "Psychological Effects of Warning," in George W. Baker and Dwight W. Chapman, editors, Man and Society in Disaster, Basic Books, Inc., New York, 1962, pp. 55-92.

2. Ibid., p. 74.

"2. ANTICIPATED NEED FOR SELF-INITIATED ACTION

The strength of a person's vigilance tendencies will be high or low, depending on whether the available verbal information and physical signs lead him to expect that, if the anticipated danger materializes, his own actions will have high or low importance with respect to mitigating danger. Vigilance increases when the person is exposed to signs indicating that adequate protection for himself and his family will require self-initiated action; vigilance decreases when the person is exposed to signs indicating that he can rely on others to protect him and his family."[1]

"3. ANTICIPATED RESTRICTION OF ACTIVITY

Under any conditions of threat, including those in which a person does not expect his own activity to play a significant role in reducing his chances of being victimized, the strength of his vigilance tendencies will be increased whenever he is exposed to communications or physical signs indicating that at the time of danger impact his own activity will be restricted."[2]

"4. ANTICIPATED RESTRICTION OF SOCIAL CONTACTS

The strength of vigilance tendencies will be increased whenever a person is exposed to communications or physical sign indicating that during a period of oncoming danger he will be out of contact with authority figures, members of his primary group, or other significant persons upon whom he is emotionally dependent."[3]

Janis' theory of motivation during times of danger helps explain why people do not always respond adaptively to warning messages. For example, if they mistakenly believe that an existing escape route will remain open during the danger

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1. _Ibid._, p. 75.
2. _Ibid._, p. 76.
3. _Ibid._, p. 77.

period and the warning message does not dispell that impression, they are not likely to respond in time to escape. It thus becomes the responsibility of the credible warning message to effectively motivate the recipients by guiding their perceptions of the situation into adaptive channels.

FACTORS IN MOTIVATING ADAPTIVE BEHAVIOR

The work of Janis and other researchers is used in this section as the basis for suggesting certain factors to be considered in the composition of the warning messages. Supporting data from natural disaster and other emergency situations is provided, as appropriate. Actually it is recognized that it would be extremely difficult to include the following features in the terse message that would probably be issued in something like a tactical attack warning situation. The suggested qualities are probably more appropriate to messages which might be broadcast during a crisis buildup or following an initial warning given well in advance of the expected disaster.

The Warning Message Should Recommend Protective Actions That Increase the Recipient's Social Contacts

The need for social contacts with family members and other significant people is known to increase dramatically during crisis periods. As Williams says: "Anxiety over loved ones is a dominant and entirely predictable response in disaster. Much activity will be devoted to searching for loved ones and seeking information about their welfare."[1] Similarly, the need for social contacts may be seen when civil leaders and trusted news sources fail to issue news bulletins during a crisis. Public confidence suffers a drop corresponding to the low level of information.[2]

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1. Williams, Harry B., "Some Function of Communication in Crisis Behavior," Human Organization, Summer, Vol. 16, No. 2, 1957, p. 18.

2. Of Janis, op. cit., p. 78.

The credible message in this context will contain information and instructions that lead the recipients to adaptive behavior, increasing their opportunities for social contact. For example, the message might contain informat on on the rate at which fallout shelters are being filled, or instructions to carry a portable radio for the latest information from officials.

The Warning Message Should Specify the Relationships Between the Threat and Familiar Events

Human beings have the persistent tendency to interpret stimuli within a familiar setting; even the flying saucer believers are visited by little green men who employ radio-like communication systems.[1] In a threat situation this phenomenon can work against successful adaptation in two ways. First, the population may associate warning and threat cues with previously-known events of little danger. Natural disasters such as floods and hurricanes frequently engender such responses. Those who have lived through several near-misses or false alarms are often convinced that they will survive the next.[2]

If the threat is actually unfamiliar, the threat cue may be subject to a variety of misinterpretations. In the 1953 tornado in Worcester, Massachusetts, a location generally considered immune to tornadoes, the threat cue (the funnel-like cloud in this case) was interpreted as anything from smoke to a thunderstorm.[3] Secondly, there is the possibility of becoming over-vigilant and of assigning all unusual cues to the threat category. This behavior pattern tends to spread

1. Bruckner, H. Taylor, "Flying Saucers Are for People," Trans-Action, May/June 1966, Vol. 3. No. 4, pp. 10-13.

2. See, for example, Stephen B. Withey, "Reaction to Uncertain Threat," in Baker and Chapman, op. cit., pp. 116-118, and Roy A. Clifford, The Rio Grande Flood: A Comparative Study of Border Communities in Disaster, Publication 458, Nati National Academy of Sciences-National Research Council, Washington, D.C., 1956, p. 79.

3. Robinson, Donald, The Face of Disaster, Doubleday and Company, Garden City, 1959, p. 23.

the person's attention span over too many possible stimuli. As Withey notes, it would be best "...if we are not <u>overconcerned</u> with our welfare but save our energies for those events that do in fact require defensive or avoidance behaviors."[1] The point is well illustrated in the words of a near victim to a widespread gas explosion: "Every time we smell a little smoke or hear noises, such as probably everyday noises that we never noticed before—because everybody is on the alert now—we're all ready to get out of the house."[2]

If the population will in any event try to associate the threat with familiar phenomena, it appears that the warning message could do it first and more appropriately. The threat of radio-active fallout should not be interpreted as being similar to such innocuous phenomena as rain clouds, or those as panic-inducing as clouds of "certain death." Rather, the warning message should use descriptive terms that paint mental pictures of a danger to be avoided by taking reasonable precautionary measures. The threat of fallout might be likened to "a wind-driven dust storm, carrying its own special disease—radiation sickness." Warning messages used for other threats could employ analogies that control the associations between the danger and familiar events in a similar way.

<u>The Warning Message Should Establish Social Consensus on the Existence of Danger and the Need to Act</u>

Consensus is "...defined as that general agreement in thought and feeling which tends to produce order where there was disorder."[3] It may also be used to denote the process of producing a new order to replace an existing one. Such is the function of a credible message in the warning environment. For a member of the public to make an effective adaptation to threat, he must reorder his

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1. Withey, op. cit., p. 115.
2. Quarantelli, E. L., "The Nature and Conditions of Panic," <u>The American Journal of Sociology</u>, 1954, 60, p. 275.
3. Gould, Julius and William L. Kolb, (eds.), <u>A Dictionary of the Social Sciences</u>, Free Press, New York, 1964, p. 128.

perception of his environment from a "normal" to a "danger" condition. In effect, a warning should produce a change from an attitude of "there is no danger," or "the danger doesn't apply to me," to one that recognizes that "I am in danger." When each person has made this shift in attitude, a new social consensus on the existence of danger has been reached. With such a consensus, unified protective actions are more likely.

It is easy to see how disorderly crisis behavior can be turned into constructive social consensus. After the alert is sounded and the awareness of potential danger is in the air, people usually turn to others and to their radios and television sets for confirmation of the danger. Their actions may consist of checking with the closest person available, looking around (or outside) to observe any unusual activity, phoning relatives or a reliable source (police, civil defense or fire departments), or turning on a radio or TV set.[1] Statistics for this behavior are found in surveys of air raid siren false alarms. During a siren false alarm in Concord, California, fully 63 percent went or looked outside, 37 percent discussed the sirens with others, and 19 percent took no action.[2] Comparable results were found by Mack and Baker in their study of three unanticipated air raid warnings.[3] Meeting the need for additional confirmation of a threat situation can be done by specifying some of the actions being taken by others. This allows the public to obtain reinforcement for taking individual actions.

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1. Jammed police switchboards and reports of people contacting others are commonly reported in disaster literature.

2. Bosak, Nora, et al., Investigation of a Siren False Alarm in Concord, California, 14 July 1965, TM-L-2870/010/00 (Draft), System Development Corporation, 30 June 1966, p. 17.

3. Mack, Raymond W. and George W. Baker, The Occasion Instant: The Structure of of Social Response to Unanticipated Air Radio Warning, Publication 945, National Academy of Sciences—National Research Council, Washington, D.C., 1961, pp. 12, 15, 20-22, and 31-33.

The Warning Message Should Provide a Realistic Estimate of the Danger to the Recipients

People tend to be overly-optimistic when they assess the probability of being endangered by a disaster. A person not only wants to believe that the threat will not materialize, he fully expects it not to affect him if it should occur; and, until there is no doubt in his mind that he will be a victim unless he acts, he tends to resist taking action until it is either too late or until he correctly estimates that it is almost too late. Floods and hurricanes offer the most obvious examples of this behavior. Despite excellent advance warning (even days early), there are always people either to be rescued from the roofs of houses or to be found hungry and homeless after the storm is spent. Mute testimony is also provided by the dead found after many natural disasters where warning was issued in time.

The belief in personal invulnerability presents a particularly difficult problem. Since the person will make his own estimates of danger, it appears that the best procedure in preparing warning messages is to stress those certainties that are known. Rosenthal accomplishes this in his proposed radio warning message by repeating that "the United States is under nuclear attack" and "you are in danger—you can save your life if you immediately take shelter."[1] In this example, a person hearing the message would have little recourse but to assess the threat in the probabilities stated by the speaker; the statements are completely unequivocal in that respect. Weather warnings are using a similar approach. For Hurricane Faith, the U.S. Weather Bureau issued a statement to the public that the danger of the storm was "definite and great."[2]

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1. Rosenthal, M. I., Proposed Radio Warning System Alert Signal and Warning Messages, TM-L-1960/030/00, System Development Corporation, 30 June 1965, p. 45.

2. UPI News, San Juan, Puerto Rico, reported in Los Angeles Times, 26 August 1966.

The Warning Message Should Provide Realistic Escape Alternatives

When people in a disaster situation believe either that there is no escape or that there are a large number of escape alternatives open, they tend to reduce their efforts to save themselves. These reactions probably are a function of individual personality as well as of the threat situation. There is little a warning message can do to change human personality. However, an effective message could work to nullify the tendency to reject information when the escape and control alternatives seem either closed or too open. To do this, the message content will have to spell out in as positive a way as possible how the person can escape the threat. The escape route offered should be fairly general, allowing him to apply it to his unique circumstances. For example, the Weather Bureau advises for tornadoes: "Take cover at once in a safe shelter, preferably underground."[1] This is specific enough in its reference to underground shelters, as is preferable, but general enough that it does not direct the person to spend precious time searching for a specific shelter.

The Warning Message Should Foster a Willingness to Listen to the Warning

The problem of achieving a perceptual shift from "normal" to "disaster" is of major importance to the warning process. People who are not thinking in terms of danger are less likely to perceive various signs and statements as threat cues, and will fail to take appropriate precautionary actions. Lacking objective danger signals, such as a tornado funnel or smoke from a fire, many threat conditions must depend largely on the warning message to affect the change in "set." It has already been suggested that one way to accomplish this is to describe the various preparatory activities being undertaken by others.

At an earlier stage, however, the warning message must establish an audience willingness to listen. In part, this is a function of the alerting signal and

1. Kutchenreuter, Paul H., (Chairman, Natural Disaster Warning Survey Group), A Proposed Nationwide Natural Disaster Warning System, Department of Commerce, October 1965, p. 102.

the entire message, but where at all possible the message should lead off with an attention-getting device. In journalism this should be a headline designed to capture the reader's attention, tell the story, and grade the news.[1] The use of "attack," "emergency," and "false alarm," suggested by Rosenthal to "flag" the message, serves this purpose in the proposed Radio Warning System,[2] With a single word the recipient's attention is attracted; he understands something of the message to follow and realizes the level of urgency it will have.

One purpose of attracting attention is to make the recipients more responsive to and aware of information relating to the threat. Also, attracting the population's attention to a valid, informative warning message will assist in the decision-making process. Brody, in his investigation of the effects of commitment to decisions on subjective confidence, found that an "initial commitment to a decision tends to increase initial confidence."[3] Thus, if people are provided with the impetus for making a correct initial decision, and become committed to it, their confidence level will remain high during the crucial period of action.

The Warning message must serve at least two additional and related functions. First, it must communicate its content in a completely nonambiguous fashion. Second, it may have to counteract rumors and distortions already at large in the community.

The importance of language to behavior is discussed in Part III below. Language in the warning message may have ultimate importance for a large number of persons. Choice of a word with double meanings, use of a "weak" term where

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1. Taylor, Howard B., and Jacob Scher, Copy Reading and News Editing, Prentice Hall, New York, 1951, pp. 137, ff.

2. Rosenthal, op. cit., p. 43.

3. Brody, Nathan, "The Effects of Commitment to Correct and Incorrect Decisions on Confidence in a Sequential Decision-Task," American Journal of Psychology June 1965, p. 256.

a "strong" one is available, construction of a confusing sentence, or inclusion of vague "facts," may begin a process of disbelief and maladaptive behavior difficult to halt. Rumors feed on an ambiguous situation perceived by the public as being important. Also, as Williams has stated: "...most of us would rather hear that we are safe than that we are in danger. Incompatibility, vagueness and ambiguity of warning messages give us the chance to make the optimistic interpretation. By and large, the burden of proof seems to be on the warning system."[1]

The problem of existing rumors, introduced by some other information within the environment, can have serious implications for the warning process. For this reason the warning message may have to act as a refuting agent to counteract existing misinformation. Thus, such facts as are known about the threat condition, what it is, how soon it will strike, its identifying characteristics, and the nature of damages it will cause, should all be stated.

III. LANGUAGE IN A WARNING MESSAGE

All warning depends upon language for communicating with the recipient. This section describes the significance of language for human behavior, and suggests a research approach for establishing the most effective words in a warning message.

THE IMPORTANCE OF LANGUAGE FOR BEHAVIOR

The importance that language has in the lives of each of us can hardly be understated. Whorf notes the determining effects of language on the way we relate and respond to the physical spectrum of our environment. He says: "We cut nature up, organize it into concepts, and ascribe significance as we do, largely

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1. Williams, Harry B., Disaster Warnings, National Academy of Sciences, reproduced by U.S. Weather Bureau, 15 November 1957, p. 9.

because we are parties to an agreement to organize it in this way—an agreement that holds throughout our speech community and is modified in the patterns of our language."[1] Hertzler ties our very social behavior to the language used to effect it when he comments that: "Most of what happens socially—that is, over and above a man's own limited fields of personal action, is mediated by language, incited and propelled by language, instructed and programmed by language, directed and controlled by language."[2]

In the warning process, the problem of credible language is one of selecting words that are meaningful to the recipient. Laffal comments that: "Language does its work by evoking experiential associations which are suggested by the pertinent words... The meaning (of words) reflects a fundamental behavioral and attitudinal shift in the listener in response to the stimulus."[3] Thus, the effective warning message must use words that have meaning for the population, meanings capable of directing into controlled, adaptive channels the behavioral and attitudinal shifts that occur.

WORD MEANING MEASUREMENT

It is not enough simply to point to a need for "meaningful" warning messages. The meanings attached to words and sentences are not constant in time, place, or social group. What is required is a technique for assuring that the words and sentences used in warning messages have the same meaning for most of the warned population.

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1. Whorf, B. L., in John B. Carrol, (ed.), Language, Thought, and Reality: Selected Writings of Benjamin Lee Whorf, Technology Press of MIT, Cambridge, and John Wiley and Sons, New York, 1956, p. 213.

2. Hertzler, Joyce O., A Sociology of Language, Random House, New York, 1965. p. 281.

3. Laffal, Julius, Pathological and Normal Language, Atherton Press, New York 1965, pp. 41-42.

A technique for measuring the less-obvious aspects of word meaning is the semantic differential (S-D) scale devised by Osgood, Suci and Tannenbaum.[1] First used in the 1950s, this instrument has received increasing attention from psychologists, osciologists and others concerned with assessing the subjective interpretation of words. The semantic differential plots the affective associations of stimulus words so that they can be averaged for groups of individuals. The plots are determined by ratings made of the stimulus word as it relates to bipolar sets of adjectives describing the qualities of evaluation, activity and potency (that is, does the word seem "good" or "bad," is it an "active" or a "passive" term, and does it seem "weak" or "strong)."

The procedure used for obtaining these ratings is to ask subjects to judge the meaning of the stimulus word against a series of descriptive scales such as are seen below:

(Stimulus) SHELTER

(Evaluative)	GOOD	___/	X /	___/	___/	___/	___/	___	BAD
(Potency)	STRONG	X /	___/	___/	___/	___/	___/	___	WEAK
(Activity)	FAST	___/	___/	___/	___/	___/	___/	X	SLOW
		+3	+2	+1	Neutral	-1	-2	-3	

The numbers on the lower line are the affective values placed on the stimulus by the subject. Average scores of these words delineate the meaning of the term to the group of raters. The scores can be used to measure differences or to determine similarities in word meaning among different groups.

1. Osgood, Charles E., George J. Suci, and Percy H. Tannenbaum, The Measurement of Meaning, University of Illinois Press, Urbana, 1957.

The semantic differential method can be used in at least two ways by those concerned with warning messages: 1) to determine the consistency of meaning for critical terms in the warning message and, 2) to select words with the greatest likelihood of producing the desired affective response. To achieve either goal, considerably more research must be done to determine the meaning of key terms to large groups of people. Some work in this direction has already been done by Heise in his compilation of a 1000-word semantic differential dictionary.[1] An indication of the use of the semantic differential can be seen in the listing below of what could be a warning message. The semantic differential scores are listed to the right.

WORD	EVALUATIVE	ACTIVITY	POTENCY
TO	(Scores not listed)	.87	-.19
SAVE	1.11		
YOUR	(Scores not listed)		
LIFE	.65	.49	-.66
TAKE	.24	.90	-.08
COVER	.49	-.80	.50

As seen by the scores for the individual words, none were considered to be very positive or very negative by the subjects used for this study. This is partly a function of the sample (average age 18.0 years) and of the explanatory phrases used with each term, e.g., LIFE (it is his own life)[2] that makes the definitions inconsistent with the meaning of the sentence. is last point is forcefully brought home by Solomon, who notes that: "While deriving its meaning from the words that compose it, a sentence in turn to some extent shapes and defines the meaning of each word it comprises."[3] It is suggested that either semantic

1. Heise, David R., "Semantic Differential Profile for 1000 Most Frequent English Words," Psychological Monographs: General and Applied, Vol. 79, No. 8, Whole No. 601, 1965.

2. Ibid., p. 23.

3. Solomon, Louis B., Semantics and Common Sense, Holt, Rinehard and Winston, Inc., New York, 1966, p. 62.

differential analysis of phrases and whole sentences be performed, or that a new technique for measuring the effectiveness of warning messages be devised. In the latter case it would be possible to present test messages to judges in which the phrasing is varied with each presentation.

In lieu of a fully-researched vocabulary, warning message writers should be provided with a set of usable criteria for choosing among a number of words or sentences by the semantic differential method. Depending on the effect desired, a warning message writer would do well to evaluate his words against the three qualities by which meaning can be measured. When the effect desired is approval, the words chosen should rate high in the evaluative component. If action is required, the words should be high in activity with "good" evaluative elements. When caution is desired, the words should be high in potency and evaluation, but lower in activity. When the choice is between two words or two sentences, the one that seems to deploy most effectively the qualities of word meaning under the circumstances should be selected.

IV. MASS MEDIA DELIVERY OF WARNING MESSAGES

For a warning message to be believable it must be delivered by a reliable media in an authoritative manner. To the public, all media are not equally reliable, and therefore not equally authoritative. This section describes the findings of investigations into public use of different media to obtain information during crisis periods, and public attitudes toward these media.

PUBLIC USE OF MASS MEDIA

If a warning message is to establish believability, it must reach the public in time, and through a medium relied on by the public as a source of important information. Some idea of public reliance on the mass media for important information can be seen in the patterns of media use and the rate of dissemination found by communications researchers.

The National Opinion Research Council (NORC) learned that 68 percent of the adult population was aware of the assassination of President Kennedy by the time the President was declared dead.[1] At six p.m. (CST), five and one-half hours after the shooting, fully 99.8 percent had heard the news. The major sources providing the news, as reported by the NORC sample, were radio or television (47 percent), and friends via personal contact or telephone calls (49 percent). The remainder first learned the news from newspapers or other sources.

Comparable results were found by Banta[2] in a survey conducted on the day after the assassination among Denver, Colorado, residents; by Greenberg[3] in a Northern California telephone survey; and by Mendelsohn[4] who surveyed 200 residents of Colorado.

In the study by Banta, 82 percent of the respondents learned of the shooting before the President died; that is, after 10:30 p.m. (CST).[5] However, only 22 percent heard of it either from radio or television, the remainder having first heard from personal contacts. This study also included data on the believability of the first reports. Depending on the source, those claiming complete belief varied from 44 percent (informed by radio or television) to 15 percent (those

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1. Sheatsley, Paul B., and Jacob J. Feldman, "The Assassination of President Kennedy: A Preliminary Report on Public Reactions and Behavior," Public Opinion Quarterly, Vol. 28, No. 2, Summer 1964, pp. 189-215.

2. Thomas J. Banta, "The Kennedy Assassination: Early Thoughts and Emotions," pp. 216-224.

3. Bradley S. Greenberg, "Diffusion of News of the Kennedy Assassination," pp. 225-232.

4. Mendelsohn, Harold, Broadcast Versus Personal Source of Information in Emergency Public Crisis: The Presidential Assassination, University of Denver, Denver, Colorado, undated, mimeo.

5. Banta, op. cit. p. 218.

informed by casual acquaintances). While this indicates a relatively high degree of initial credibility for the mass media, a majority of the population did require subsequent confirmation, even if it amounted only to repetition of the basic facts from additional sources.

Similarly, data found by Greenberg indicates that 88 percent of the Northern California population had heard before the President's death that the shooting had taken place.[1] Half reported that they had heard it within 15 minutes of the event, 70 percent within 30 minutes, and 90 percent within 45 minutes. The source of initial reports for these "Early Knowers" (Greenberg's term) was radio or television. A full 84 percent of the Early Knowers eventually heard the news of the President's death from radio or television. The reaction of the 12 percent who heard the news after the first hour was to obtain additional news as quickly as possible from radio or television.

Results compiled by Mendelsohn do not include an analysis of when the sample learned of the assassination, but do note the sources used.[2] Altogether, some 56 percent were first informed over the mass media (39 percent radio; 17 percent television). The others learned via personal contacts (32 percent) or various sources combined, including those who could not recall their sources or those who gave no answer (12 percent).

The rapidity with which the news of the assassination was disseminated could be attributed to the uniqueness of the situation, save for the fact that other news items of significance receive nearly equal promptness in transmission.

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1. Greenberg, op. cit., pp. 226-227.
2. Mendelsohn, op. cit., p. 4.

In an hour-by-hour survey of the reported sources for learning of President Johnson's 28 July 1965 news conference on an escalation of the Vietnam situation, Sindlinger & Company found that 74.2 percent of the adults (18 and older) in the continental U.S. were "aware" of the conference within eight hours of its termination.[1] In the first few hours, most of those who were aware of it had learned through radio and television. After six hours had passed a larger number of those who knew reported a newspaper source, a fact accounted for by the technique of reporting multiple sources and not simply the first source. Words-of-mouth communications did not play a proportionally large part in the dissemination of this news: only four percent received the news from friends. The following table, abstracted from the text in the article, graphically describes the findings.

TABLE 2

Reported Source	Sampling Periods				
	To 4pm	4-5pm	6-7pm	8-9pm	Totals
Radio	48%	41%	40%	42%	41% (37,308,000)
Television	38	48	54	67	55 (50,186,000)
Newspapers	21	32	[illegible]1	70	54 (49,490,000)
Friends	18	6	10	9	10 (9,564,000)

PUBLIC CONFIDENCE IN BROADCASTING MEDIA

If the recipient of a warning message lacks confidence in the integrity of the communications media through which the message was delivered, his confidence in the message itself will be reduced. Thus, it is important to understand

1. Reported in "TV Major Source for LBJ Speech," Broadcasting, 2 August 1965, p. 68.

something of people's attitudes toward and confidence in the mass media; such an understanding will assist in appropriate delivery of the warning message.

The receptiveness of the population to television is most likely a function of the pervasive interest of the American public in news. In 1960, an in-depth study of television viewers' attitudes and behavior, conducted by the Bureau of Applied Social Research, Columbia University, revealed something of the extent of this interest.[1] The data cited here were determined from two nationwide samples of 1250 adults, surveyed simultaneously by the National Opinion Research Council and Elmo Roper and Associates.

In answer to questions affecting the likes and dislikes of the survey group, regular news and religious programs were the only classifications which received no negative response. Some 47% indicated that regular news was their favorite form of program.[2] Further, it was noted that while regular news took up only 20% of the available viewing time, the audience spent 29 percent of its viewing time watching news programs.[3] These results are in keeping with the fact that 54% of the sample indicated that television does not offer enough information.[4] Additional documentation is found in a study of Colorado residents of whom 75 percent believed that "it is absolutely necessary that we constantly keep up with the news as soon as it happens.[5]

Television is regularly used by most people as a responsible source of important news. The public confidence in the integrity of the news disseminated is

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1. Steiner, Gary A., The People Look at Television, Alfred A. Knopf, Inc., New York, 1963.
2. Ibid., p. 148.
3. Ibid., p. 166
4. Ibid., p. 188.
5. Mendelsohn, op. cit., p. 2.

remarkably high. For example, fully 44 percent of the people learning of the assassination of President Kennedy from television reported that they completely believed the newscast. Only 15 percent of those informed by friends were completely convinced by the initial report.[1] These data tend to support the usefulness of television as an excellent medium for delivering warning messages.

The high regard for radio as a reliable source of information by the American public is constantly being reinforced by the high quality performance of the medium during crisis situations. A case in point is what has been described as the "...largest power failure in history (which) began at about 5:15 p.m. on November 9, 1965..."[2] The blackout eventually covered most of the northeastern part of the United States, and affected about 30 million people in the United States and Canada.

Nash and Nash constructed a short questionnaire and began interviewing subjects on the streets of New York City two hours after the start of the blackout in that area.[3] They managed to collect data on the behavior and attitudes of a total of 103 people between 7 p.m. and 11 p.m. that same night. Of that number, only 16 percent reported that they had not received any information on the blackout from any source. A full 55 percent said they had listened to a radio to gain information at some time before the interview. Only 19 percent reported that their source was a friend, or gossip, and ten percent made no response. This response highlights the effectiveness of radio as "...a key factor in accounting for the normal behavior of the large portion of the city's population.[4]

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1. Banta, Thomas J., op. cit., p. 210.
2. National Industry Advisory Committee, Effect on Communications of Northeast Power Failure, November 9-10, 1965, prepared for Federal Communications Commission, 6 January 1966, p. 1.
3. Nash, George and Patricia Nash, Attitudes During the Black-Out, Bureau of Applied Social Research, Columbia University, 9 December 1965.
4. Ibid., p. 9.

Somewhat higher proportions were found in the National Association of Broadcasters' telephone survey conducted in the week following the power failure.[1] Of the 494 respondents, 77 percent listened to a radio at some time during the blackout. The effect that radio reports had was generally beneficial, particularly among those who were initially frightened by the unexpected failure. Those who experienced a feeling of relief upon hearing the radio, indicated that it was the factual content of the reports that gave the most reassurance. Others noted that the announcers' calm voices, cheerful manners, honesty and sincerity were also reassuring factors.[2] There was however a negative effect experienced by some of those who listened to the radio; they indicated that they began to feel concern after learning the magnitude of the blackout, although they were also worried about the safety of the public.[3]

V. VOICE DELIVERY OF WARNING

Intuitively, we can recognize the ability of a human voice to create in its audience a variety of emotional responses, from a soothing calm to sheer panic. In a warning context it is clear that the voice used to deliver the warning message should inspire confidence, retard panic, and encourage constructive actions. This section describes the qualities of speech that elicit emotional responses in an audience, and research into the effectiveness of a particular speech in changing attitudes. Recommendations are made on the voice qualities required to deliver warning messages and to fill in the times between messages.

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1. A Study of the Role of Radio During the Power Failure Blackout, National Association of Broadcasters, 9 November 1965.

2. The calming effect of the human voice is also discussed in Part V.

3. It is suggested that concern for public safety could be related to factual reports of people trapped in elevators and subways.

VOCAL QUALITIES OF SPEECH

The human voice communicates on a level far above the meaning of the words used. The tone of a voice, whether alarmed or annoyed, the use of sounds as laughing or crying to express a specific emotion, and the general condition of a voice (old or young, strong or weak) all convey meanings to the audience apart from the content of the speech. Though seldom researched, the ability of people to interpret accurately the emotional aspects of speech is not completely lacking in substantive content. Starkweather, for example, set up an experiment to determine how consistently people were able to judge the verbal (word) and vocal (tonal) aspects of the speech of subjects with known psychological traits.[1] The subjects were selected on the basis of blood pressure, and were evaluated as being dominant, assertive (bordering on hostile), and lacking concern for or awareness of others. Recordings of their speech were made while they were participating in three separate role-playing sessions designed to bring out these traits. Samples of the recordings were taken at designated times to obtain three 20-second examples of each subject's voice. These were processed into three versions for later judging. The first version was unchanged and just as the subject spoke it. The second speech sample was processed by electronic filters to separate the content from the tonal qualities; that is, to produce a spoken statement in which the words were unrecognizable but the tone of voice remained. The final version was a typewritten copy of the content of the subject's speech.

Each version was presented to groups of judges who were asked to rate the speaker on scales of aggressiveness and pleasantness. The judges were extremely consistent in judging the normal voice and content-free voices on both the aggressiveness and pleasantness scales. They were not so consistent in their evaluations

1. Starkweather, John A. "Content-Free Speech as a Source of Information about the Speaker," in Alfred G. Smith, Communication and Culture, Holt, Rinehard and Winston, New York, 1966, pp. 189-199.

of the typewritten copy of the subject's speech. The author suggests that the vocal component was more instrumental in the normal voice judgments than the words themselves, due to the higher associations between normal and content-free, than between normal and content-only presentations.

The results show that there can be substantial agreement among people on the qualitative aspects of voice communications. What remains is to perform a full-scale investigation of the vocal qualities required for warning messages, and identification of persons having appropriate types of voices.

EFFECTIVENESS OF A VOICE MESSAGE

Although it seems obvious that a voice message can change the attitudes and behavior of people during crises, there is little data on how much change will occur. Allport and Postman report on "...an unusual opportunity to measure the effectiveness of a solemn voice of authority speaking through the powerful medium of the radio in a time of crisis."[1] This study was conducted during the period of uncertainty over the losses suffered by American forces at Pearl Harbor, at the outset of World War II. A group of 200 undergraduates were polled on the question: "Do you believe that our losses at Pearl Harbor were greater, much greater, the same, less or much less than have been officially stated?" Almost 70 percent believed that the losses were greater or much greater. The remainder believed the official reports, or felt that there was less damage than stated. Three days after the survey was accomplished, President Roosevelt spoke to the public on the damage sustained in the attack. After the "Fireside Chat," the researchers again asked the question to another group of 200 undergraduates. This time they included a question as to whether the student had heard or read the President's speech. Those who had not, held the same proportional amounts

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1. Allport, Gordon W., and Leo Postman, The Psychology of Rumor, Russell and Russell, New York, 1965, p. 6.

of belief as did the first group. Those who were familiar with the speech had changed to the point where over half (54 percent) believed that the losses were the same or less than the President reported.

While the study does nothing to validate the presence of an emotional reaction among the audience at the time of delivery, it does show something of the degree of change in attitudes that can be effected by a voice message. Similar changes often are observed in disaster situations, but they are seldom researched in so thorough a manner.

THE VOICE OF WARNING

It can be inferred from past experience in broadcasting that two distinct functions must be served in the warning situation. First, the most urgent warning messages must be delivered to the audience as the occasion demands. The data presented in the preceding paragraphs strongly indicate that the actual warnings must be delivered by a speaker capable of inspiring belief in the messages and initiating constructive responses. Second, during times when there is no change in the warning situation and no new warnings are to be delivered, some other speaker must fill the "dead air" with suplementary information related to the disaster. The voice requirements for a "filler" speaker are oriented more toward one capable of preventing panic while reinforcing belief in the warning messages. This section describes the basic qualities for each type of voice, and makes recommendations on appropriate speakers.

The Voice of Authority

The most obvious voice suitable for warning message delivery is that of a known and respected leader. For national dissemination of warning, the voice of the President of the United States is the most familiar of the possible choices. At the state or local levels, some other person whose office commands public confidence would be appropriate. For prerecorded messages, and when such a leader is not available, the speaker should be chosen for his proficiency in controlling his vocal expressions. His voice should be confident and authoritative without being overly-assertive. He should be able to communicate the urgency of the situation without creating panic. Additionally, his mode of delivery and timing should be smooth, with proper emphasis to gain the full impact of his words. The rate of delivery should vary with the subject matter, but in no case should it exceed 160 words per minute if the audience is to fully understand the material.[1] A very slow delivery rate (below 115 words per minute) may seem halting or ragged to the audience, and often indicates uncertainty on the part of the speaker.[2] To be effective, the warning message must be delivered by a speaker who sounds as though he knows exactly how serious the situation is, and sincerely wants his audience to understand it as well.

The Filler Voice

During crisis buildups, or when the warning does not direct movement to shelter or some other terminal action, the gap between messages should be filled by a professional broadcaster. The broadcaster should be experienced in reporting disasters, and should be able to maintain a calm, confident and knowledgeable manner during this period. He should be able to quickly fill-in periods where there is no prepared material, with reviews of what has gone on before and summaries of the current situation. His voice should be able to instill confidence in the audience and to reinforce its belief in the validity of the warning messages. His voice must be supportive in the psychological sense of bolstering the morale of his listeners. He also should be able to read supplementary survival and other information to the audience so that it also is convincing.

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1. Cantril, Hadley., and Gordon W. Allport, The Psychology of Radio, Harper and Brothers, New York, 1935, pp. 181-183.

2. Ibid.

VI. WARNING A RECENTLY-AWAKENED POPULATION

A warning message that has been thoughtfully constructed and delivered generally will be received and understood by the public. During the late night and early morning, however, there is no assurance that recently-awakened people will be able to understand or act at their normal proficiency levels. This section describes research on the ability of recently-awakened people to perform complex tasks, and recommends some changes in warning messages delivered during this time period.

PERFORMANCE LEVELS OF RECENTLY-AWAKENED PEOPLE

After a series of accidents involving pilots who had been suddenly awakened, ordered to get into their aircraft and take off in pursuit of some unknown aircraft, the Air Force ordered an investigation of the factors involved in the crashes. There were three studies conducted that were concerned with the person's performance after sudden awakening.[1] The subjects were aroused by being shaken lightly and with a minimum of noise after the bedroom light was turned on. It took a maximum of two minutes to walk 60 feet to the room where the testing equipment was located. Each subject began performing immediately, and continued for ten minutes before returning to bed. Two types of tasks were used in the three studies. One was a simple motor task of switching a toggle switch on and off, and the other task simulated flying an aircraft. The subject was required to maintain the needles of four aircraft instruments within prescribed limits, using three simulated aircraft controls. A clock measured the time when all four instruments were in the prescribed limits.

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1. Listed in order of publication, these studies are: David E. Langdon and Bryce O. Hartman, Performance Upon Sudden Awakening, SAM-TR-62-17, USAF School of Aerospace Medicine, November 1961; Bryce O. Hartman, and David E. Langdon, A Second Study on Performance Upon Sudden Awakening, SAM-TR-65-61, USAF School of Aerospace Medicine, August 1965; and, Bryce O. Hartman, David E. Langdon and Richard McKenzie, A Third Study of Performance Upon Sudden Awakening, SAM-TR-65-63, USAF School of Aerospace Medicine, August 1965.

The investigators found that performance was poorer after sudden awakening, when compared to performance prior to going to sleep or performance after a night's sleep was completed. The performance level dropped as much 25 percent in reaction times in the toggle switch studies or in time-on-target in the simulated flight situation. However, it should be noted that these values represent only an additional second or two delay in response time. A difference of this size would be considerably more critical when flying an aircraft than when in the civil defense situation. The investigators also found that there was a gradual recovery after the decrement over the ten-minute performance period, although it never reached the presleep level. It was estimated that it would take from 25 to 30 minutes actually to reach the presleep level. Both the complex and simple task show simple linear recovery curves. Using some crude estimates of the depth of sleep at the time of arousal, they concluded that the deeper the sleep, the poorer the poorer the responses were in general.

Other experimenters have also observed this decrement in performance upon sudden awakening. For example, Pritchett found a 26 percent decrement in performing mental arithmetic immediately after awakening.[1] There was a very rapid recovery, however, during the first 90 seconds. After this there was a gradual recovery, although at the end of the 20 minutes performance was still below the presleep level.

Jeannert and Webb tested the ability of 20 male subjects to squeeze a dynamometer that measures the strength of the hand grip.[2] The subjects were tested before

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1. Reported in unpublished memo from Charles W. Simon to M. I. Rosenthal, System Development Corporation, Considerations in the Design of a Radio Warning System for Civil Defense Where Arousal-From-Sleep is a Requirement, 21 July 1966, p. 27. Simon states that Pritchett made this observation in an unpublished PhD dissertation at the University of Kentucky.

2. Jeanneret, Paul R. and Wilse B. Webb, "Strength of Grip on Arousal from a Full Nights Sleep," in Perceptual and Motor Skills Journal, Vol. 17, 1963, pp. 759-763.

going to sleep and after awakening the next morning. Each subject was required to stand up and squeeze the dynamometer three times for four different mornings. There was a 13 percent decrement in the tension of the grip upon awakening, as compared to hand grip before going to sleep.

In another study by Webb and Agnew, subjects when awakened from a deep level of afternoon sleep showed a significant decrement of their initial reaction times to perform a serial response task immediately after arousal.[1] The serial response task was one of pushing four buttons in a specified order; five orders were tested at ten-second intervals. Tests were made before sleep, and both before and after eating a meal. Tests were also made immediately following sudden arousal, and again six minutes later. The average values obtained were:

	PRESLEEP		POSTSLEEP	
	Premeal	Postmeal	Immediately	Six min. later
Average Reaction Time to Push First Button	2.32	2.36	2.96	2.27
Average Time to Push Four Buttons	3.60	3.91	4.59	3.97

Recovery seemed to occur within the first 60 seconds.

Although there is no reason to expect the public to be required to push a sequence of buttons or flip toggle switches in the event of an attack alert, the behavior involved in moving to shelter is at least as complex and demanding.

1. Webb, Wilse B. and Harman Agrew, "Reaction Time on Arousal from Sleep," in Perceptual and Motor Skills Journal, Vol. 18, 1964, pp. 783-784.

Thus, even though the cited studies are not perfectly analogous to the alert situation, and though it would be advantageous to perform a series of more suitable experiments, it is clear that performance is considerably reduced when people are recently awakened from sleep. Lacking more substantive data on the exact requirements for eliciting better performance from such a population, it is suggested that warning messages be kept fairly simple and be repeated at intervals for not less than a full hour. This should allow most of the population to be aroused by the alert signal and to recover their normal ability to perform.

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APPENDIX B

ORGANIZATION FOR CIVIL DEFENSE

I. INTRODUCTION

The purpose of this appendix is to depict the federal, state and local organizational structure of civil defense as it exists today, in order to clarify the relationships among the various governmental organizations.

There are three information chains that can be identified as linking organizations that have emergency responsibilities. The chains are not completely independent but it is convenient to distinguish among them, as is done in the following discussion. The functions of the Office of Emergency Planning (OEP) and other federal agencies below the regional level are not discussed in detail because, as can be seen from the descriptions, they are almost entirely in support of the states and local governments and in general are coordinated at the state level.

THE PRESIDENT

Legally, civil defense functions are vested in the President for delegation to departments and agencies in the Executive Branch as the changing character of nonmilitary-preparedness programs warrant. Executive Order 10952 dated 20 July 1961 assigned major civil defense responsibilities to the Secretary of Defense. Certain powers such as the emergency powers contained in Title III, and Sections 201 (b) and 402 of the Federal Civil Defense Act of 1950 as amended, were retained by the President.

The retention of these powers was necessary under the reorganization plan to enable appropriate departments and agencies of the Federal Government to be legally delegated civil defense responsibilities. Retention of these powers provided the authority for executive review and coordination of the civil defense activities of the departments and agencies with each other, and with the activities of the states and neighboring countries. Retention of these powers also provided the authority for extraordinary civil defense measures to be taken only after a proclamation of a state of civil defense emergency by the President.[1]

OFFICE OF EMERGENCY PLANNING

The Office of Emergency Planning is headed by a Director, who is assisted by a Deputy Director and three Assistant Directors, one of whom serves as the Director of Telecommunications Management. The OEP is divided into six major offices: Analysis and Research, Program Development, Government Readiness, Resource Readiness, Economic Affairs, and Program Evaluation. Eight regional offices coordinate readiness policies and plans at government field offices, and with the states and local political subdivisions. An OEP regional office is located at each of the eight OCD regional headquarters, and both share the same geographic areas of responsibility. (Executive Order 10952 defines OEP responsibilities.)

National Resource Evaluation Center[2]

The National Resource Evaluation Center (NREC) operates as part of the Office of Emergency Planning. Some twenty federal departments and agencies (which provide permanent staff to the Center) together with many other federal organizations provide data for the NREC Resource Library and participate in the various NREC study programs and readiness activities.

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1. "Responsibilities and Authorities," Federal Civil Defense Guide, Part B, Chapter 1, June 1965, p. 1.

2. Manual Procedures for Resource Evaluation, Office of Emergency Planning, 1 July 1965, Preface, p. i.

NREC applies advanced computer techniques to the tasks of damage assessment and resource evaluation in support of the Office of Emergency Planning and other federal organizations with delegated emergency responsibilities. These NREC tasks apply to preattack and peacetime planning, as well as to readiness for emergency operations.

NRED, through its Plans and Programs Directorate, collaborates closely with the Office of Civil Defense and with other Department of Defense organizations having related data acquisition, analysis or operational interests.

Civil Defense Advisory Council

"The Civil Defense Advisory Council, established by the Federal Civil Defense Act of 1950 (64 Stat. 1247; 50 U.S.C. App. 2272), advises and consults with the Director in respect to general or basic policy matters relating to civil defense. The Council is composed of the Director of the Office of Emergency Planning acting as Chairman and 12 other members appointed by the President, three representing state governments, three representing political subdivisions of the states, and six citizens of the United States of broad and varied experience in matters affecting the public interest."[1]

CIVIL DEFENSE RESPONSIBILITIES OF OTHER DEPARTMENTS AND AGENCIES

Executive Order 10958, 15 August 1961, as amended, assigned the responsibilities for medical stockpiling programs to the Secretary of Health, Education and Welfare, and the food stockpiling programs to the Secretary of Agriculture. Separate Executive Orders assign appropriate emergency-preparedness functions to other departments and agencies. "Executive Order 10346 ordered each federal department

1. United States Government Organization Manual, 1966-67, Office of the Federal Register, Revised 1 June 1966, p. 69.

and agency to develop civil defense plans for the use of their personnel, materials, and services in aid of the states during a civil defense emergency."[1]

Development of the plans for emergency preparedness require coordination among the federal departments and agencies. The federal departments and agencies must use to the maximum the capabilities of other agencies and departments that are qualified to perform or assist in assigned functions, by contractual or other agreements. They must coordinate such arrangements with national, state and local civil defense plans. Further, all Executive Orders assigning responsibilities to departments and agencies stipulate that the Director of the Office of Emergency Planning shall advise and assist the President in determining policy and coordinating the performance of functions with the total national-preparedness program.

OFFICE OF CIVIL DEFENSE

By Executive Order 10952 of 20 July 1961, except as otherwise provided in Section 2 of that Order, the President delegated to the Secretary of Defense all functions, including powers, duties and authorities contained in the Federal Civil Defense Act of 1950, as amended, that were vested in the President by Reorganization Plan 1 of 1958."[2]

Section 1 of Executive Order 10952 delegated functions, and called for the development and execution of the following programs: a) fallout shelter program, b) chemical, biological and radiological defense program, c) nationwide warning system, d) comprehensive communications network, e) postattack emergency assistance to state and local governments, f) continuity of government provisions by state and local governments, g) financial contributions to the state for civil

1. "Responsibilities and Authorities," op. cit., p. 2.
2. "United States Government Organization Manual, 1966-67," op. cit., p. 136.

defense purposes, including personnel and administrative expenses, h) nationwide postattack damage assessment program, and i) donation of federal surplus property. In addition, Section 3 of Executive Order 10952 authorizes the Secretary of Defense to redelegate within the DOD the functions delegated to him by this Executive Order.[1]

By Department of Defense Directive 5160.50, Civil Defense Functions, 31 March, 1964, the functions of civil defense were redelegated by the Secretary of Defense to the Secretary of the Army, with authority to redelegate. As a result of this Directive, the Secretary of the Army established within his office an Office of Civil Defense (OCD), headed by the Director of Civil Defense. In general, OCD provides: 1) direction, coordination, guidance and assistance in the formulation and development of the overall civil defense programs, 2) establishment of civil defense policies, programs and doctrines covering emergency operations, and 3) coordination of civil defense activities of the federal departments and agencies to insure that all program activities initiated within a state by OCD or other federal agencies are coordinated with the state prior to implementation.[2]

Office of Civil Defense Regions

The Office of Civil Defense Regions implement the policies and programs of Office of Civil Defense by working with the state civil defense agencies. Through the state civil defense agencies, OCD Regions maintain contact with the local civil defense organizations. Their work includes monitoring and coordinating civil defense programs. Another important function is the provision of assistance and guidance to federal field establishments, and to state and local governments.

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1. "Assigning Civil Defense Responsibilities to the Secretary of Defense and Others," op. cit., pp. 2-3.

2. "National Civil Defense Program," Federal Civil Defense Guide, Part A, Chapter 2, Office of Civil Defense, January 1965, p. 10.

Regional Civil Defense Interdepartmental and Interagency Coordinating Boards[1]

Each of the eight geographical regions served by Office of Civil Defense Regions have established an interdepartmental Regional Civil Defense Coordinating Board (hereinafter referred to as "the Board").

The Boards are primarily established for the purpose of advising and assisting the OCD Regional Directors in planning and coordinating civil defense operations. Composition of each Board includes representatives of all departments and agencies of the Federal Government that have been assigned specific emergency preparedness responsibilities, as follows:

Office of Emergency Planning (Observer)

Department of the Army (Principal DOD Military Representative)

Department of the Air Force

Department of the Navy

Defense Supply Agency

Department of Agriculture

Department of Commerce

Department of Labor

Department of Health, Education and Welfare

Department of Interior

Post Office Department

Atomic Energy Commission

Federal Aviation Agency

Federal Communications Commission

General Services Administration

Housing and Home Finance Agency

Interstate Commerce Commission

1. "Regional Civil Defense Interdepartmental and Interagency Coordinating Boards," Department of Defense Instruction ASD(A) No. 5030.25, Department of Defense, 22 December 1965.

The composition of the Boards will expand as additional agencies are assigned specific emergency-preparedness responsibilities.

STATE AND LOCAL CIVIL DEFENSE[1]

The precise civil defense organizational relationships within each state vary among the states. However, the responsibility for administration and command of civil defense activities within each state is exercised by the Governor through his state civil defense agency. Each local government civil defense organization is commanded and administered by the head of each of the local governments. The civil defense organizations of state and local governments serve their respective executive heads as coordinators for preattack development of civil defense capability, and for postattack emergency operations.

During an emergency involving any geographical area of a state, the Governor both declares and terminates a "state of emergency" by proclamation. Emergency operations of affected civilian communities continue until the Governor decides to terminate the emergency.

During an emergency, the chief executives of state and local governments assume direct control of all government and civilian forces and resources subject by law to their authority. This includes those federal civilian employees and materials made available to state and local governments. Further, the Governor can invoke martial law, and obtain the services of the National Guard through the Office of the Adjutant General. However, military resources used in support of civil defense remain at all times under military command. The Governor can also obtain support and assistance from the Federal Office of Civil Defense (OCD) and the Office of Emergency Planning (OEP) through the OCD and OEP regional offices.

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1. A State Civil Defense Training Plan: An Organization and Training Development Research Study, TM-L-3099 (Draft), System Development Corporation, 12 August 1966, pp. 2-1, 2-8.

State Civil Defense Agency Role

The responsibilities of the state civil defense agnecy are primarily those of coordinating the emergency operating capabilities of the state-level agencies (such as Health and Medical, Public Works, Law and Order, etc.) with each other and with their counterparts at the local levels of government. This coordination includes the functions of serving as an organizational link to the Federal Office of Civil Defense, guiding the support activities of various departments or agencies of state government, and assisting local civil defense agencies in planning, funding and coordinating the mobilization of their resources.

Relationship to Other Civil Defense Echelons

State civil defense agencies and local civil defense units receive support and guidance on their civil defense programs from Federal OCD working through the OCD regional offices. Financially, OCD arranges and is responsible for approval of federal contributions in support of state and local civil defense programs. These federal monetary contributions amount to 50% of the acquisition cost of eligible civil defense equipment and services.

In addition to fiscal assistance, OCD and OEP guidance is given state and local agencies in support of their programs for development and management of: 1) state fallout shelters, 2) emergency warning and communications systems, 3) procedures for continuity of government, and 4) emergency resources.

The state civil defense agency relationship to the local civil defense agencies is primarily one of the state-level agency monitoring the local agencies and providing guidance and assistance whenever possible.

BIBLIOGRAPHY

1. "Actions for Increased Civil Defense Readiness," Federal Civil Defense Guide, Part G, Chapter 5, Office of Civil Defense, February 1965.

2. "Aerospace Doctrine," United States Air Force Basic Doctrine, AFM1-1, Department of the Air Force, 14 August 1964, (mimeographed copy).

3. AFM Editors, AFM Fourth Annual Military Electronics Systems Catalog, Armed Forces Management, July 1966.

4. AFM Editors, AFM Fourth Annual Military Systems Catalog, Armed Forces Management, March 1966.

5. Air Force Operational Reporting System RCS: AF-V21, AFM 55-11, Vol. 1, and Supplement 1A (dated 17 June 1966), Department of the Air Force, 18 November 1965.

6. Air Force Operational Reporting System RCS: AF-V21, AFM 55-11, Vol. II, Department of the Air Force, 15 February 1966.

7. Allport, Gordon W., The Psychology of Rumor, Russell & Russell, Inc., New York, New York, 1965.

8. A Provisional Concept of Emergency Operations Under Nuclear Attack, Office of Civil Defense, Unnumbered, First Draft, 15 September 1966.

9. "Are the Assets of the NCS Responsive to National Needs?," Armed Forces Management, April 1966, pp. 55-60.

10. Assigning Civil Defense Responsibilities to the Secretary of Defense and Others, Executive Order 10952, as amended, 27 September 1962.

11. "Assigning Civil Defense Responsibilities to the Secretary of Defense and Others," Federal Civil Defense Guide, Part B, Chapter 1, Appendix 3, Office of Civil Defense, 15 April 1963.

12. "A State Civil Defense Training Plan: An Organization and Training Development Research Study," TM-L-3099(Draft), System Development Corporation, 12 August 1966.

13. A Study of the Role of Radio During the Power Failure Blackout, National Association of Broadcasters, 9 November 1965.

14. AUTOVON Implementation Manual, Volume I, Defense Communications Agency, November 1964.

15. Baker, George W., and Chapman, Dwight W. (eds.), Man and Society in Disaster, Basic Books, Inc., New York, 1962.

16. Banta, Thomas J., "The Kennedy Assassination, Early Thoughts and Emotions," Public Opinion Quarterly, Volume 28, No. 2, Summer 1964, pp. 216-224.

17. Bobrow, D. B. (ed.), Components of Defense Policy, Rand McNally and Company Chicago, 1965.

18 Bornstein, A., Strategic Conflict Studies, SM-47696, Volume 1, Douglas Missile and Space Systems Division, January 1966.

19. Bosak, N. M., et al., Investigation of a Siren False Alarm in Concord, California, 14 July 1965, TM-L-2870/010/00 (Draft) System Development Corporation, 30 June 1966.

20. Bourcy, Lt. Col. Robert A., "AUTODIN Worldwide Automatic Digital Network," Signal, March 1966, p. 16.

21. Brody, Nathan, "The Effects of Commitment to Correct and Incorrect Decisions on Confidence in a Sequential Decision-Task," American Journal of Psychology, June 1965, pp. 251-256.

22. Bruckner, H. Taylor, "Flying Saucers are for People," Trans-Action, Volume 3, No. 4, May/June 1966, pp. 10-13.

23. California Flood Operations, California Department of Water Resources, November 1965, mimeo.

24. Cantril, Hadley, and Allport, Gordon W., The Psychology of Radio, Harper and Brothers, New York, 1935

24. Cleveland, Harlen, "Crisis Diplomacy," Foreign Affairs, Volume 41, No. 4, July 1963, pp. 638-649.

25. Carroll, John B., Language and Thought, Prentice-Hall, Englewood Cliffs New Jersey, 1964.

26. "CD Warning Saves Lives in Kansas," Regional News, Region Six, Volume 3, No. 2, Office of Civil Defense, Denver, Colorado, May 1966.

27. Chapanis, Alphonse, "Words, Words, Words," Human Factors, February 1965, pp. 1-17.

28. Clifford, Roy A., The Rio Grande Flood: A Comparative Study of Border Communities in Disaster, Publication No. 458, National Academy of Sciences - National Research Council, 1956.

29. Civil Defense Functions, Department of Defense Directive 5160.50, 31 March 1964.

30. Civil Defense Warning Requirements Study, TM-L-900/001/00, System Development Corporation, 31 January 1963.

31. Civil Defense 1965, MP-30, Office of Civil Defense, April 1965.

32. Classified Supplement to Civil Defense Warning Requirements Study (U), TM-L-900/002/00, (Secret), System Development Corporation, 31 January 1963.

33. Committee on Armed Services, Hearings on Military Posture and H. R. 9637... Before the Committee on Armed Services, House of Representatives, Eighty-Eighth Congress, Second Session, Washington, D.C., January 1964.

33. Committee on Armed Services, Hearings on Military Posture and H.R. 13456... Before the Committee on Armed Services, House of Representatives, Eighty-Ninth Congress, Second Session, Washington, D.C., March 1966.

34. Communications and Warning, Section III: Tidal Wave Warning, Bulletin No. 2, Section III, Revision #2, California Disaster Office, 1 October 1964.

35. Cottrell, Hugh B., et al., Public Health Service Report on Operation Chlorine, Department of Health, Education and Welfare, 1963.

36. "County Responsibility for Distribution of Weather Warnings and Advisories," Weather Bureau Manual-Issuance 843, Volume III, Chapter B-15, U.S. Weather Bureau, 25 July 1963.

37. Crane, Edgar, Marketing Communications, A Behavioral Approach to Men, Messages and Media, John Wiley & Sons, New York, 1965.

38. Daley, W. E. Listing, Appendix, and Annex to Federal Civil Defense Guide, (Part G, Chapter 5) TM-L-2454/007/01 (Draft), System Development Corporation, 15 July 1966, pp. 11-12.

39. Danzig, Elliott R., Thayer, Paul W., and Galanter, Lila R., The Effects of a Threatening Rumor on a Disaster-Stricken Community, Publication No. 517, National Academy of Sciences - National Research Council, 1958.

40. Davis, L. W., et al., Development of "Typical" Urban Areas and Associated Casualty Curves, The Dikewood Corporation, April 1965.

41. Dyson, F. J., "Defense Against Ballistic Missiles," Bulletin of the Atomic Scientists, June 1964, pp. 12-18.

42. "Effectiveness, Responsiveness of National Com..nd System Vital to U.S. Security," Armed Forces Management, July 1966, pp. 43-52.

43. Federal Register, (29 F.R. 5017), Office of the Federal Register, 10 April 1964.

44. Finney, John W., "A Nuclear Treaty Seems Closer," The New York Times, 13 November 1966.

45. "Fiscal Year 1967 Program Emphasis," Federal Civil Defense Guide, Part B, Chapter 3, Appendix 1, Office of Civil Defense, May 1966.

46. Flew, Anthony, (ed.), Logic and Language, Doubleday & Company, Inc., Garden City, New York, 1965.

47. Foster, Lt. Commander William F., "The National Communications System," U.S. Naval Institute Proceedings, April 1965, pp. 139-140.

48. Fritz, Charles E. and Mathewson, J. H., Convergence Behavior in Disasters, Publication No. 476, National Academy of Sciences - National Research Council, 1957.

49. Getler, Michael, "U.S. Opti g for New, Low-Cost ABM," Technology Week, Volume 18, No. 25, June 20, 1966, pp. 14-16.

50. Gilpatric, R. L., "Our Defense Needs: The Long View," Foreign Affairs, 42(3), April 1964, pp. 366-378.

51. Gould, Julius and Kolb, William L. (eds.), A Dictionary of the Social Sciences, Free Press, New York, 1964.

52. Greenberg, Bradley S., "Diffusion of News of the Kennedy A sassination," Public Opinion Quarterly, Volume 28, No. 2, Summer 1964, pp. 225-232.

53. Grosser, George H.; Wechsler, Henry; and Greenblatt, Milton (eds.), The Threat of Impending Disaster, The M.I.T. Press, Cambridge, Mass., 1964.

54. Hahn, Walter F. and Cottrell, Alvin J., Ballistic Missile Defense and Soviet Strategy, Research Paper P-140, Institute for Defense Analysis, Arlington, Virginia, October 1963.

55. Hargreaves, Major Reginald, "The Mechanics of Communication," Military Review, December 1965, pp. 87-95.

56. Harris, D. Lee, Characteristics of the Hurricane Storm Surge, Technical Paper No. 48, U.S. Weather Bureau, 1963.

57. Hartman, Bryce O. and Langdon, David E., A Second Study of Performance Upon Sudden Awakening, SAM-TR-65-61, USAF School of Aerospace Medicine, Brooks AFB, Texas, August 1965.

58. Hartman, Bryce O.; Langdon, Davis E.; and McKenzie, Richard, A Third Study of Performance Upon Sudden Awakening, SAM-TR-65-63, USAF School of Aerospace Medicine, Brooks AFB, Texas, August 1965.

59. Hayes, Paul L., Earthquake Risk in Southern California, Southern California Civil Defense and Disaster Association, 1965.

60. Heise, David R., "Semantic Differential Profiles for 1000 Most Frequent English Words," Psychological Monographs, General and Applied, Volume 79, No. 8, Whole No. 601, 1965.

61. Hertzler, Joyce O., A Sociology of Language, Random House, New York, 1965.

62. Higgs, William J., et al., Social Motives and Decision-Making Behavior in Interpersonal Situations, Technical Report No. 4, University of Illinois, Urbana, September 1965.

63. Hodgson, John H., "Earthquake Mechanisms," Science Journal, April 1966, pp. 30-36.

64. Iacopi, Robert, Earthquake Country, Lane Book Company, Menlo Park, Calif., 1964.

65. Ikle, Fred C. and Kincaid, Harry V., Social Aspects of Wartime Evacuation of American Cities, Publication No. 393, National Academy of Sciences - National Research Council, 1956.

66. Inderwiessen, Frank, Alarm Requirements for Near System Receivers, Midwest Research Institute, Kansas City, Missouri, undated.

67. Interdepartmental Committee for Meteorological Services, 1966 Hurricane Plan, April 1966.

68. Interim Report for the Office of Civil Defense, NEAR System Study, TM-L-1505/040/01, System Development Corporation, 31 March 1964.

69. Ivanoff, D. and Harrison, D., International Environment: 1965-1975, SM-49226, Douglas Aircraft Company, Inc., October 1965.

70. Jeanneret, Paul R. and Webb, Wilse B., "Strength of Grip on Arousal From a Full Night's Sleep," Perceptual and Motor Skills Journal, Volume 17, 1963.

71. Killion, Lewis M., An Introduction to Methodological Problems of Field Studies in Disasters, Publication 465, National Academy of Sciences - National Research Council, 1956.

72. Kitchenreuter, Paul H. (Chairman, Natural Disaster Warning Survey group), A Proposed Natural Disaster Warning System, Department of Commerce, October 1965.

73. Kutchenreuter, Paul H. (Chairman, Tornado Survey Team), Weather Bureau Survey Team Report on Palm Sunday Tornadoes of 1965, U.S. Weather Bureau, May 1965.

74. Laffal, Julius, Pathological and Normal Language, Atherton Press, New York, 1965.

75. Lamoureux, Robert L., et al., Emergency Operating System Development Project, Warning Task, TM-L-2454/001/00 (Draft), System Development Corporation, 22 October 1965.

76. Lamoureux, Robert L., Radio Warning System Interim Operational Requirements, TM-L-1960/021/02, System Development Corporation, 1 February 1965.

77. Langdon, David E. and Hartman, Bryce O., Performance Upon Sudden Awakening, SAM-TR-60-17, USAF School of Aerospace Medicine, Brooks AFB, Texas, November 1961.

78. Ligda, Myron G. H., et al., Hurricane Reconnaissance with Airborne Radar, U.S. Navy Weather Research Facility Norfork, Virginia, June 1961.

79. Luce, Gay Gaer, and Segal, Julius, Sleep, Coward-McConn, Inc., New York, 1966.

80. MacCurdy, J. T., The Structure of Morale, Cambridge University Press, London: Bentley House, 1943.

81. Mack, Raymond W. and Baker, George W., The Occasion Instant: The Structure of Social Response to Unanticipated Air Raid Warning, Publication 945, National Academy of Sciences - National Research Council, 1961.

82. Manual Procedures for Resource Evaluation, Office of Emergency Planning, 1 July 1965.

83. Maxham, William P., Federal Civil Defense 1946-1963: A Study in Organization and Administration, The American University, Washington, D.C., Ph.D Dissertation, August 1964, reproduced by University Microfilms Inc., Ann Arbor, Michigan, 1966.

84. Mendelsohn, Harold, Broadcast Versus Personal Sources of Information in Emergency Public Crisis: The Presidential Assassination, University of Denver, Undated memo.

85. Moore, Harry Estill, Tornadoes Over Texas, The Hogg Foundation for Mental Health, 1958.

86. Murray, Edward J., Sleep, Dreams, and Arousal, Meredith Publishing Company, New York, 1965.

87. Nash, George and Nash, Patricia, Attitudes During the Black-Out, Bureau of Applied Social Research, Columbia University, 9 December 1965.

88. "National Civil Defense Program," Federal Civil Defense Guide, Part A, Chapter 2, Office of Civil Defense, January 1965.

89. National Industry Advisory Committee, Effect on Communications of Northeast Power Failure, November 9-10, 1965, Federal Communications Commission, 6 January 1965.

90. National Warning System (NAWAS) Operations Manual, FG-E-1 2, Office of Civil Defense, January 1964.

91. Now's the Time to Prepare for Hurricanes, Factory Management and Maintenance. Plant Operation Library No. 159, McGraw-Hill, August 1956.

92. Oliver, Jack E., "Prospects for Earthquake Prediction," Science Journal, February 1966, pp. 44-48.

93. Operating Standards and Procedures Manual (RAWARC) Internal Weather Bureau RAREP and Warning Coordination System, Sixth Edition, U.S. Weather Bureau, July 1964.

94. Osgood, Charles E.; Suci, George J; and Tannenbaum, Percy, H., The Measurement of Meaning, University of Illinois Press, Urbana, 1957.

95. Oswald, Ian, Sleep, Penguin Books, Baltimore, Maryland, 1966.

96. Paschall, Col. Lee M., AUTODIN and AUTOVON Management and Implementation, Signal, March 1966.

97. Pedersen, Lt. Commander John C., "Soviet Reporting of the Cuban Crisis," U.S. Naval Institute Proceedings, October 1965, pp. 56-63.

98. Perry, Stewart E.; Silber, Earle; and Bloch, Donald A., The Child and His Family in Disaster: A Study of the 1953 Vicksburg Tornado, Publication No. 394, National Academy of Sciences, National Research Council, 1956.

99. Perry, Will H., Jr. (Chairman, Natural Disasters Committee), Natural Disasters, United States Civil Defense Council, 1965.

100. Posrar, W. W., et al., (ed.), American Defense Policy, The Johns Hopkins Press, Baltimore, Maryland, 1965.

101. Press, Frank and Brace, W. F., "Earthquake Prediction," Science, Volume 152, No. 3729, 17 June 1966, pp. 1575-1584.

102. "Program Planning and Emphasis," Federal Civil Defense Guide, Part B, Chapter 3, Office of Civil Defense, 15 June 1963.

103. Quarantelli, E. L., "The Nature and Conditions of Panic," American Journal of Sociology, 60, 1954.

104. Ray, James T., Martin, Edmund O. Jr., and Allusi, Earl A., Human Performance as a Function of the Work-Rest Cycle - A Review of Selected Studies, Publication 882, National Academy of Sciences - National Research Council, 1961.

105. "Responsibilities and Authorities," Federal Civil Defense Guide, Part B, Chapter 1, Office of Civil Defense, June 1965.

106. "Regional Civil Defense Interdepartmental and Interagency Coordinating Boards," Department of Defense Instruction, ASD(A) No. 5030.25, Department of Defense 22 December 1965.

107. Robinson, Donald, The Face of Disaster, Doubleday & Company, Inc., Garden City, New York, 1959.

108. Rosenthal, M. I., Proposed Radio Warning System Alert Signal and Warning Messages, TM-L-1960/030/00 (Draft), System Development Corpoation, 30 June 1965.

109. Rozen, M. E., "Some Reflections on Civil Defense," Bulletin of the Atomic Scientists, June 1964, pp. 21-24.

110. Scorer, R. S., "Origin of Cyclones," Science Journal, March 1966, pp. 46-52.

111. Scott, William A., Public Reaction to a Surprise Civil Defense Alert in Oakland, California, University of Michigan, Survey Research Center, 1955.

112. "Severe Local Storm Warning Service," Weather Bureau Manual--Issuance 955, Vol. III, Chapter B-18, U.S. Weather Bureau, 21 December 1965.

113. Sheatsley, Paul B. and Feldman, Jacob J., "The Assassination of President Kennedy: A Preliminary Report on Public Reactions and Behavior," Public Opinion Quarterly, Vol. 28, No. 2, Summer 1964, pp. 190-215.

114. Simon, Charles W. and Emmons, William H., "Responses to Materials Presented During Various Levels of Sleep," Journal of Experimental Psychology, Vol. 51, No. 2, February 1956, pp. 89-97.

115. Simon, Charles W., Considerations in the Design of a Radio Warning System for Civil Defense Where Arousal-From-Sleep is a Requirement, unpublished memo to M. I. Rosenthal, System Development Corporation, 21 July 1966.

116. Simon, Charles W., "Some Immediate Effects of Drowsiness and Sleep on Normal Human Performance," Human Factors, March 1961, pp. 1-17.

117. Sloan, Edgar A., Organization Psychology, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1965.

118. Smith, Alfred G., Communication and Culture, Holt, Rinehard and Winston, New York, 1966.

119. State Legislation and Federal Regulations Governing Maintenance and Operation of Flood Control Projects, California Department of Water Resources, 1960.

120. Starbird, Lt. General Alfred D., "Our Changing Strategic Communications," Industrial luncheon address published in Signal, July 1965, pp. 36-38.

121. Steiner, Gary A., The People Look at Television, Alfred A. Knopf, Inc., New York, 1963.

122. Stone, J. J., "The McNamara Story Continues," Bulletin of the Atomic Scientists, 22(4), April 1966, pp. 39-42.

123. Storm Data, Environmental Science Services Administration, Volume 8, Nos. 3-9, 1966.

124. Subcommittee on Department of Defense Appropriations, Department of Defense Appropriations for 1965, Hearings Before a Subcommittee of the Committee on Appropriations, House of Representatives, Eighty-Eighth Congress, Second Session, Part 3, Washington, D.C., 1964.

125. Subcommittee on Department of Defense Appropriations, Department of Defense Appropriations for 1966, Hearings Before a Subcommittee of the Committee on Appropriations, House of Representatives, Eighty-Ninth Congress, First Session, Part 3, Washington, D.C., 1965.

126. Subcommittee on Independent Offices, Independent Offices Appropriations for 1966, Hearings Before a Subcommittee of the Committee on Appropriations, House of Representatives, Eighty-Ninth Congress, First Session, Part 3, Washington, D.C., 1965.

127. Symposium on Medical Aspects of Stress in the Military Climate, Walter Reed Army Institute of Research, Walter Reed Army Medical Center, Washington, D.C., 1965.

128. Tannehill, I. R., The Hurricane, U.S. Weather Bureau, Rev. 1956, 1960.

129. Taylor, Howard B. and Scher, Jacob, Copy Reading and News Editing, Prentice-Hall, New York, 1951.

130. The Coast and Geodetic Survey, Its Products and Services, Publication 10-2, Department of Commerce, 1965.

131. The Weather Bureau and Water Management: Role of River Forecasting and Hydro-meteorological Analysis, U.S. Weather Bureau, 1965.

132. "Topeka Tornado Blunted by Warning," Regional News, Region Six, Volume III, No. 3, Office of Civil Defense, Denver, July 1966.

133. Tornado and Flood Alerting and Reporting Network, Bulletin No. 19, State of Minnesota, Department of Civil Defense, 4 May 1966.

134. Tornadoes, U.S. Weather Bureau, April 1965.

135. Treadwell, [illegible] [illegible]ane Carla, September 3-[illegible], 19[illegible]1, Office of Civil Defense, Region 5, Denton, Texas, 1962.

136. Tsunami, The Story of the Seismic Sea-Wave Warning System, Department of Commerce, undated.

137. "TV Major Source for LBJ Speech," Broadcasting, 2 August 1965, p. 68.

138. United States Government Organization Manual, 1966-67, Office of the Federal Register, 1 June 1966.

139. "USAF Severe Weather Service," Air Weather Service Manual, AWSM 105-41, United States Air Force, 22 June 1962.

140. Von Hake, Carl A. and Cloud, William K., United States Earthquakes, 1963, Coast and Geodetic Survey, 1965.

141. Wallace, Anthony F. C.,, Tornado in Worcester, Publication 392, National Academy of Sciences - National Research Council, 1956.

142. Ware, Robert and Harvey, O. J., A Cognitive Determinant Impression Formation, Technical Report #17, Contract No. 1147(07), University of Colorado, 1965.

143. Weather Modification, Seventh Annual Report for Fiscal Year Ended June 30, 1965, NSF-66-4, National Science Foundation, January 1966.

144. Webb, Wilse B. and Agnew, Harman, "Reaction Time on Arousal From Sleep," Perceptual and Motor Skill Journal, Vol. 18, 1964.

145. Whorf, B. L., Language, Thought and Reality, Selected Writings of Benjamin Lee Whorf, John B. Carroll (ed.), The Technology Press of Massachusetts Institute of Technology, Cambridge, and John Wiley and Sons, Inc., New York, London, 1956.

146. Williams, Harry B., Disaster Warnings, National Academy of Sciences, reproduced by the U.S. Weather Bureau, 15 November 1957.

147. Williams, Harry B., "Some Functions of Communication in Crisis Behavior," Human Organization, Summer, Volume 16, No. 2, 1957, pp. 15-19.

148. Wolfenstein, Martha, Disaster, Free Press, Glencoe, Illinois, 1957.

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Final report on the Warning System Research Support Project undertaken for the Office of Civil Defense under subcontract to Stanford Research Institute. The report describes the current warning environment, accordingly updates the requirements for an integrated national warning system, and then specifies a system design that will meet these requirements. Additionally, it discusses in detail various aspects of the warning problem, including organizational warning, natural disaster warning, civil and military warning, and warning message credibility.

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