TOP SECRET

THE REPORT TO THE PRESIDENT
BY THE
TECHNOLOGICAL CAPABILITIES PANEL
OF THE
SCIENCE ADVISORY COMMITTEE

FEBRUARY 14, 1955

VOLUME I

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF DEFENSE MOBILIZATION
WASHINGTON, D. C.

TOP SECRET
RESTRICTED DATA
ATOMIC ENERGY ACT - 1954

~~TOP SECRET~~

KD-370

COPY No. 14

MEETING THE THREAT OF SURPRISE ATTACK

TECHNOLOGICAL CAPABILITIES PANEL

OF THE

SCIENCE ADVISORY COMMITTEE

VOLUME I

Washington - February 14, 1955

~~RESTRICTED DATA~~

This document contains restricted data as defined in the Atomic Energy Act of 1954. Its transmittal or the disclosure of its contents in any manner to an unauthorized person is prohibited.

~~TOP SECRET~~

SCIENCE ADVISORY COMMITTEE
EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF DEFENSE MOBILIZATION
Washington 25, D. C.

Dear Mr. President:

We have the honor to transmit, through Arthur S. Flemming, Director of the Office of Defense Mobilization, the report of the Technological Capabilities Panel on the problems arising out of the threat of surprise attack. This Panel was formed and a study undertaken in response to a suggestion made by you on March 27, 1954 to the Science Advisory Committee of the Office of Defense Mobilization.

During the past four months, the forty-two members of the Panel have consulted with many qualified persons. We acknowledge with deep appreciation the generous help of all who were consulted, the information which has been made available to us, and the opportunity which you have given us to make this study.

Respectfully,

The Steering Committee,
Technological Capabilities Panel

J. R. Killian, Jr., Director
J. B. Fisk, Deputy Director
J. P. Baxter, Member
J. H. Doolittle, Member
L. A. DuBridge, Member
L. J. Haworth, Member
M. G. Holloway, Member
E. H. Land, Member
R. C. Sprague, Consultant

TOP SECRET

PREFACE

THE OBJECTIVES OF THIS STUDY

The report examines the present vulnerability of the United States to surprise attack and ways whereby science and technology can strengthen our offense and defense to reduce this hazard.

In undertaking this study, the Technological Capabilities Panel has been governed by the following considerations:

We have interpreted technology broadly, attempting to be systematic in examining both the possibilities of innovation and the circumstances that may insure or optimize the proper use of our technical strengths.

We have evaluated the "big jumps"—the technical ideas and possibilities that may greatly alter our position in the immediate and the long future. We recognize that many programs, already authorized and under way, will continue to increase our military strength.

We have been acutely aware that technical innovation alone cannot be expected to give us complete security or to provide panaceas for the difficulties inherent in our relations with Russia. We do believe that technical innovations can be a powerful instrument for creating the strength and the deterrence which can prevent war.

In giving primary attention to surprise attack on the U.S. homeland, we recognize that there are other courses of action open to the USSR—alternatives such as attack in Europe or "brush fire" engagements, local actions which, bit by bit, permit the Communist world to expand.

We cannot consider surprise attack without examining it in the broad context of offensive-defensive power. We are convinced that both "offensive" and "defensive" forces are essential to accomplish the general mission of defending the United States. Both are deterrents to surprise and, should war begin, both contribute to the destruction of enemy power. Neither one alone is adequate to defend the United States.

TOP SECRET

THE SCOPE OF THE STUDY

With these broad objectives, limitations, and considerations in mind, the Technological Capabilities Panel has sought to investigate how the creative resources of science, engineering, and technology may make additional contributions toward:

Increasing our capacity to get more positive intelligence about the enemy's intentions and capabilities and thus to obtain, before it is launched, adequate foreknowledge of a planned surprise attack. This is our first defense against surprise attack.

Increasing still further, through innovation in technology, our retaliatory power as a deterrent to surprise attack and to insure against defeat if deterrence fails.

Strengthening our defenses as an additional deterrence to surprise attack and to blunt the attack should it occur.

Achieving security and reliability of communications, with attention being directed to the vulnerability of our overseas communications to interruption by the enemy.

Understanding the effect of technology upon the manpower requirements of the military services, particularly upon the availability of skills necessary to maintain complex equipment.

TABLE OF CONTENTS

VOLUME I

VOLUME II

PART III

VOLUME II (Continued)

VOLUME II (Continued)

TOP SECRET

PART I

SURPRISE: ITS NEW IMPORTANCE AND MEANING

How Evolving Weapons Technology is Imposing New Requirements on Our Military Strength, Readiness and Organization; Also a Summary of Volume II.

Restricted Data

RESTRICTED DATA

TOP SECRET

SURPRISE: ITS NEW IMPORTANCE AND MEANING

1. THE THREAT

Since the fateful explosion over Hiroshima in 1945, atomic weapons have undergone an inexorable evolution. In comparison to a non-atomic, pre-Hiroshima bomb, the first atomic bomb was more powerful by a factor of 8000. In comparison to that *atomic* bomb, today's *thermonuclear* bomb is more powerful by a further factor of 250. In the same period, there has been a steady evolution in the range, speed, and altitude of bomber planes, with the result that today few parts of the world are beyond the reach of aircraft capable of delivering nuclear weapons.

This evolution of nuclear bombs and the means to deliver them has given warfare a potential for swift, complete destruction and sudden decisiveness that is revolutionizing our concepts of offense and defense.

This air-atomic system can wreak death and destruction on a scale almost beyond knowing, and certainly beyond any sensibility to shock and horror that men have so far experienced.

For example:

> Each one of hundreds of bombers can carry and deliver atomic or thermonuclear bombs tailored for complete destruction of its assigned target, and one bomber can carry several times the TNT equivalent of all the high explosive dropped by the Allies on Germany in World War II.

For example:

> It has been computed that one 10-*megaton* bomb exploded in Washington would produce 1,300,000 casualties. We know already of the destruction produced at Hiroshima by a 15-*kiloton* bomb.

For example:

> A one-megaton bomb on a major U.S. city could be the most catastrophic military-social setback in American history.

Discoveries underlying thermonuclear weapons enormously increase the potential explosive power of a given atomic stockpile. An enemy stockpile which seemed modest could suddenly become potentially large and comparably devastating. Technology thus has magnified the power and potential of the United States and, by implication, of her enemy. These discoveries also increase the possibility that nations other than the United States, Russia, and England might ultimately develop a significant nuclear capability and thus affect the bipolarity of our present balance of power. This is a possibility to be mindful of and not a present threat.

These weapons and methods for their delivery are capabilities already achieved by the United States. We can be certain, however, that our possession of such weapons means that the USSR can also possess them. Today Russia has a limited capability for intercontinental air delivery of nuclear weapons, but their TU–4 bombers on one-way missions could reach most targets in the United States; with refueling they could reach all targets. The Soviets have enough TU–4 aircraft and enough bombs.

The critical number of U.S. targets is not large. It may be less than 50. We believe that 200 nuclear bombs of megaton and kiloton yield, if delivered on selected targets with practical accuracy, could decisively defeat us, and that a first attack could be fatal if we were surprised and unprepared. Indeed two hundred or more bombs of *kiloton* yield delivered on target, while not decisive, could be devastating if not catastrophic. The USSR clearly has an air-atomic capability that constitutes a present threat to the United States.[1]

The Soviets are probably developing missiles which are air-launched, surface-launched, and perhaps long-range. They have a large fleet of submarines capable of reaching our harbors. They have access to merchant ships that use our harbors. There are numerous ways in which weapons, including the essential parts of nuclear weapons, could be shipped or slipped into the interior of the country. There is the loophole of the "diplomatic pouch" which, while extensively studied, requires continued review.

While discussing the delivery of nuclear weapons primarily by aircraft we shall not lose sight of dangers of other delivery methods for nuclear or other weapons to which we may be particularly vulnerable. An attack using such methods is unlikely to be decisive of itself, but it could be a truly significant supplement to a main attack delivered by air.

2. THE NEW IMPORTANCE OF SURPRISE

With a hazard of such magnitude before us, the importance of every decision in regard to our military planning becomes magnified. A mistake in planning, in preparation, in strategy, in disposition of forces, in alertness could be fatal. The U.S. policy of not initiating war, together with the present U.S. capability to retaliate, emphasizes the value to an enemy of achieving surprise. The ability of air-atomic power to cripple, if not destroy, augments the need for the United States to minimize the possibility of surprise attack. Clearly the consequences of surprise are so great that every effort to eliminate it is justified.

From the logic of the present situation, the power of our retaliation being what it is, it is hard to imagine the USSR attacking the United States without seeking to achieve surprise.

[1] In analyzing the threat to the United States we have found no study available in government that provides a coordinated symmetrical comparison of the U.S. and Soviet military positions. As a first step in such a symmetrical analysis, we suggest that an appropriate agency be given the authority and information to make a comprehensive comparison of U.S. and Soviet Bloc target systems (including Bravo, Romeo, and Delta type targets) in the context of a single study.

For the first time in history, a striking force could have such power that the first battle could be the final battle, the first punch a knockout. Thus surprise takes on a wholly new significance.

Surprise may take many forms and combinations—surprise in time, in space, in kind. The enemy's tactics and strategy, though anticipated, might be successful if our detection were inadequate, unalert, sabotaged, or if the information obtained were improperly interpreted or acted upon. We might focus too much on high-altitude attack and be faced by a devastating low-altitude attack. We might expect attack from the north and be hit from the south. We might be well prepared for any air attack at any time, yet find that the bulk of an attack had resulted from clandestine delivery, coupled with delivery by missile and by sea.

3. THE REVOLUTION IN WEAPONS: ITS NATURE AND SIGNIFICANCE

Essential to the background of this study is continual awareness of the recent revolutions in the realm of concentrated explosive power. Accordingly, familiar nuclear knowledge has been assembled in the next few pages in order to present those logistic and economic consequences of these revolutions that must be kept in mind.

High explosives in recent wars have been used in separate weapons or bombs in sizes that range from as little as one-tenth of a pound to as much as 10,000 pounds. Each weapon or bomb has had its own military use and each has been well exploited. The upper limit of about 10,000 pounds was set, of course, not by the maximum destructive effect desired, but by the capacity of World War II aircraft to carry and deliver such loads.

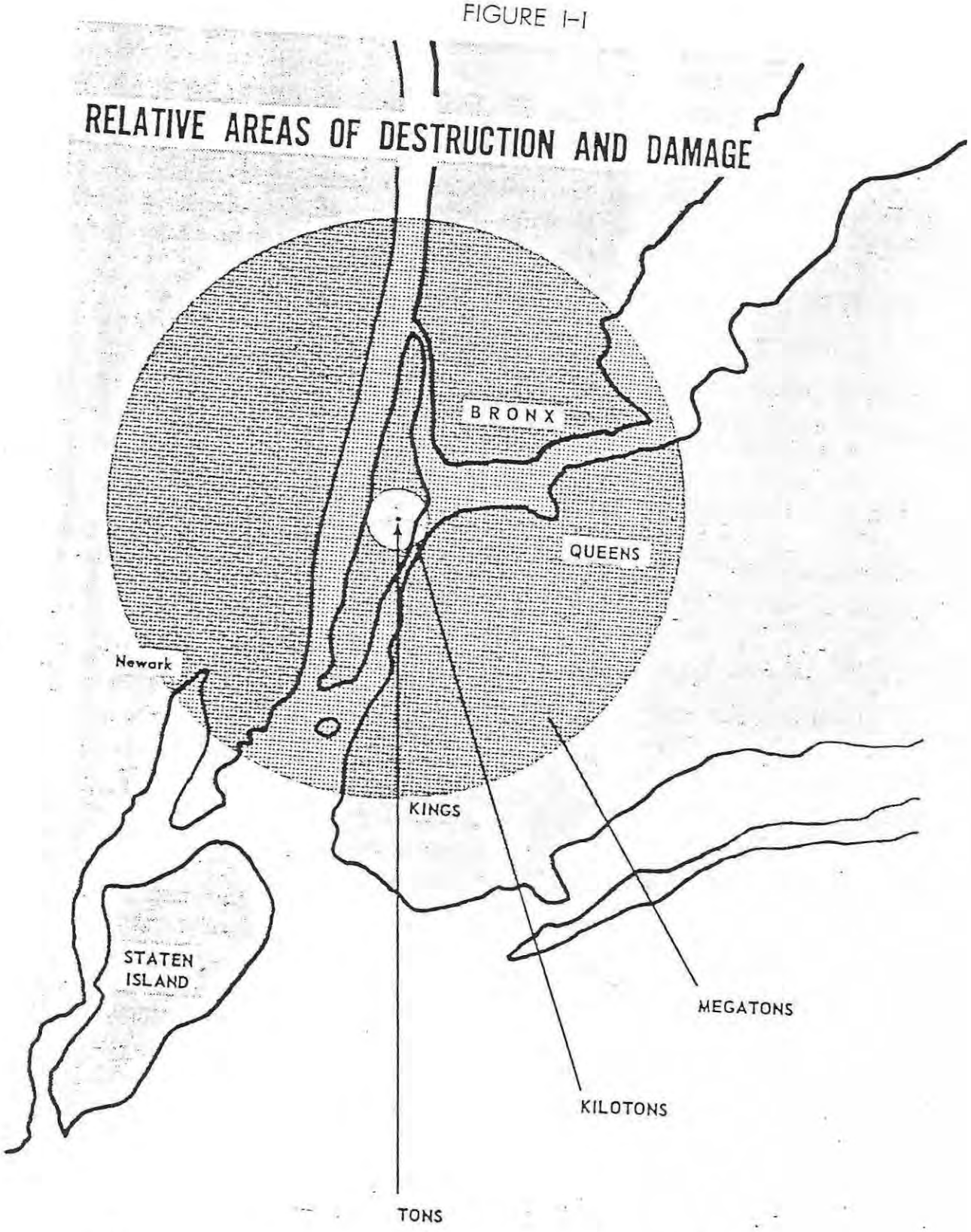
In 1945 this restriction was dramatically removed by the first atomic bomb. In one step, as we have noted, the energy released by a single 10,000-pound bomb was increased by a factor of about 8000; the area of destruction by 400 times.

The second, equally dramatic step, the fission-fusion bomb, gave a second factor of about 250 in comparison to the first atomic bomb; a second factor of about 40 times in area of destruction. The energy release from a 10,000-pound megaton bomb is more than 1,000,000 times that of its high-explosive blockbuster ancestor; from blast alone, the area of destruction is more than 10,000 times as great (Figure I–I). To this is added heat, radiation and the phenomenon of "fall-out," all of which are of potential military value. A 5-megaton bomb, detonated at ground level, will carry into the upper atmosphere several million tons of highly radioactive earth and debris, much of which would soon fall out over a large area. This area may be several thousand square miles and may be lethal to exposed inhabitants if they are unaware of their danger or uninstructed on simple precautionary measures.

Thus, in one decade, the explosive power of a bomb weighing 10,000 pounds has increased from 5,000 pounds TNT to the equivalent of more than 10,000,000,000 pounds—from 2½ tons to 5 million tons—without changing the weight of the bomb or the difficulty of its delivery.

The total tonnage of high explosives delivered on Germany in World War II was less than 3 megatons. This was made up of over 5,000,000 bombs, and required 1,500,000

FIGURE I-1


RELATIVE AREAS OF DESTRUCTION AND DAMAGE
BRONX
QUEENS
Newark
KINGS
STATEN ISLAND
MEGATONS
KILOTONS
TONS

sorties over a period of 4 years. It is, of course, clear that one 3-megaton nuclear bomb could not have accomplished the same result. However, a megaton bomb dropped in the center of one of our large cities could do today what many thousands of bombs and planes did then on a similar target. A few hundred planes with kiloton and megaton bombs tailored to each target could have accomplished the World War II strategic bombing mission in a few days at most.

The spectrum of weapons is essentially continuous, from the smallest to the largest H.E. bombs, from the largest H.E. bombs to the smallest atomic bombs, and on to the megatons. The important discontinuity between conventional and nuclear weapons lies not in the mechanism of energy release but in the energy released from a given weight of weapon, and in the cost of obtaining energy release at the target. This cost is primarily that of maintaining the delivery capability, and is proportional to the weight of the weapon. Thus the factor of $8000 \times 250 = 2{,}000{,}000$ in energy release per ton between high explosive and fission-fusion is reflected in a decrease by a factor of about 1,000,000 in cost of energy release on target (Figure I–II).

What is to be expected from nuclear weapons technology in the future? We can expect nuclear weapons ranging from a fraction of a kiloton to many megatons tailored to meet specific military needs: strategic, tactical, air defense, antisubmarine, and other. It appears to us that for future nuclear weapons the factors of 8000 and 250 will not be followed by further dramatic increases; that our fission-fusion bombs are already close to their ultimate yield in energy release per ton. The most that we can expect is a factor of 2 or 5 or perhaps 10; and, for some time to come, we should base our planning on a figure of [redacted] (Figure I–III).

We can build, if we choose, at the expense of a large quantity of fissionable material, a *very* heavy weapon of *very* large yield [redacted]. Such a weapon could be delivered by ship but not by air.

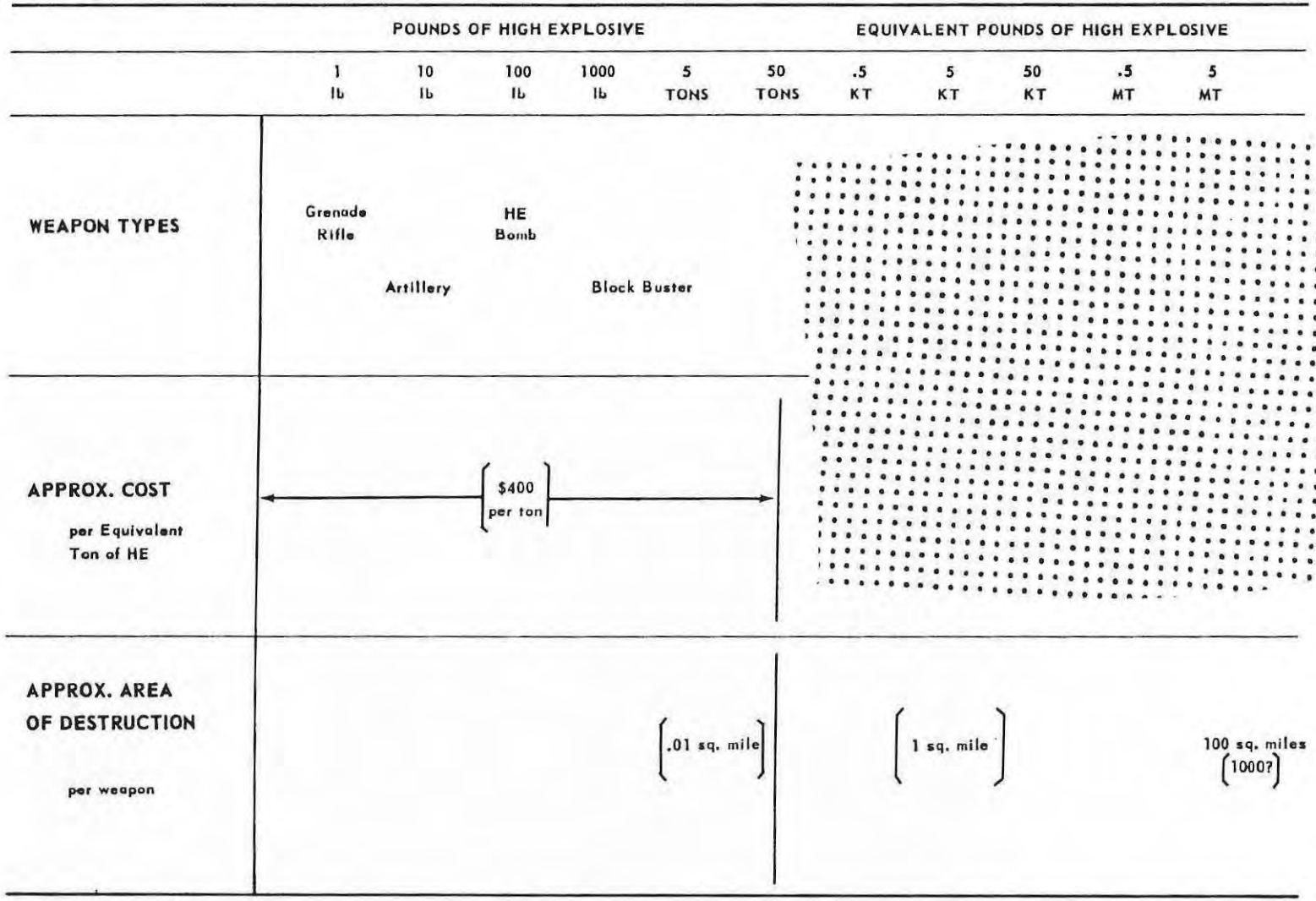
All this is the revolution in weapons as we see it. Its significance lies, in part, in the tremendous advantage given to the attacker who can mount a large-scale, surprise attack.

We now have sizable stocks of kiloton bombs, and a few megaton bombs. Our stocks of large-yield bombs will also be appreciable within a year or two. We know that the Russians have tested kiloton bombs. We know that they have tested one bomb of approximately one-megaton yield and that they are producing both plutonium and uranium–235. We do not know that they have yet achieved a multimegaton capacity; but we are not safe to assume that they have not. We must assume that they can and may.

Within the context of surprise attack, we recognize some of the hazards of "unconventional" weapons and delivery methods; of bacterial and chemical agents, of clandestine use of nuclear weapons to augment a direct attack. We believe that these are possibilities and that it is technically feasible to construct megaton bombs which could be disassembled into pieces small enough for clandestine use. But our primary attention has been focused on the vulnerability of the continental United States to a large-scale attack with nuclear weapons.

FIGURE I-II

SPECTRUM of WEAPONS



TOP SECRET

Page 9 denied in full.

Throughout this report great emphasis is given to the decisive potential of thermonuclear, megaton bombs. This emphasis should in no way imply that atomic, kiloton bombs are not weapons of massive, if not decisive, power when employed in adequate numbers.

4. A TIMETABLE OF CHANGE IN OUR MILITARY POSITION RELATIVE TO RUSSIA

In order to clarify the effects of evolving technology on our military position relative to Russia, we have constructed a timetable showing the pattern of change that seems inherent in the developing weapons technology over the next decade or so.

This timetable reflects a careful evaluation of the present status and future trend of military technology, particularly the technology of air-atomic power. It also assumes the correctness of the current national intelligence estimates of the corresponding Soviet air-atomic power. It is obvious that a serious error in these estimates of Russian capabilities would destroy the foundations on which this timetable is constructed. At present we see no better alternative than to base our assumptions on these estimates.

A framework of this kind, showing the changes possible in our position relative to the USSR, is of fundamental importance in analyzing the problem of surprise, in planning our program of military technology, and in the formulation of broad national policy with respect to national security and to our relations with the USSR. The periods and possibilities described below must be considered in our planning if we are to give proper weight to the technological factors.

Period I—The Present Phase

Because of our air-atomic power we have an offensive advantage but are vulnerable to surprise attack.

Characteristics

1. Because of the strength of SAC and our large capability in atomic bombs, the striking power of U.S. is great relative to USSR.
2. We do not yet have large multimegaton capability.
3. No reliable U.S. early warning; our defense system is inadequate; therefore SAC is vulnerable and U.S. is open to surprise attack.
4. Evidence is accumulating that Soviets are developing their long-range delivery capability.

Effects

A. Neither the U.S. nor the Soviets can mount an air *strike* against the other that would surely be decisive.[1] The U.S., however, could mount a sustained air *offensive* that would inflict massive damage and would probably be conclusive in a general war.

[1] Decisive is defined as follows: (1) ability to strike back essentially eliminated; or (2) civil, political, or cultural life reduced to a condition of chaos; or both (1) and (2).

B. Because of our vulnerability, Soviets might be tempted to try a surprise attack. They might be so tempted in order to attack before we achieve a large multimegaton capability.

Period II (Starting 1956/57—Ending 1958/60)

We will have a very great offensive advantage relative to USSR and will be less vulnerable than previously to surprise attack.

Characteristics

1. We will have achieved substantial numbers of multimegaton weapons in addition to our large stockpile of atomic bombs. Soviets will not have.
2. Some improvement in Russian delivery capability.
3. Both Russia and the U.S. are achieving increased defense capability but both continue vulnerable to surprise attack.

Effects

A. Our deterrent power greatly increased; our military power relative to that of Russia at its maximum. The U.S. can mount a decisive air strike; the USSR cannot. In the event of conflict the U.S. would be severely damaged, but would emerge a battered victor even if the USSR mounted a surprise attack on the U.S.

B. Because the U.S. will have a substantial stockpile of multimegaton weapons and the ability to deliver them on target, this is a period, possibly of short duration, when the U.S. will possess great relative military strength. Our military superiority may never be so great again.

An intensive study should be undertaken to determine what diplomatic and political policies will be most appropriate during Period II to turn it to our best advantage and to the advantage of the free world. These policies should recognize that any war which might occur would result in severe damage to the U.S. despite our great relative strength.

Period III

This is a period of transition from Period II to Period IV involving the occurrence in some order of the following characteristics:

Characteristics

1. The development by the Soviets of a multimegaton capability. The firing of a multimegaton weapon would be positive evidence that the Soviets have begun to develop a capability with this weapon. The absence of such an explosion is not positive assurance that they have not begun to develop this capability. Although possible, the stockpiling of multimegaton bombs would be improbable without a test firing. The Russian test firing of August 1953 was not conclusive evidence of their ability to make a modern multimegaton weapon.
2. The availability to the Soviets of a large number of high-performance jet aircraft capable of reaching U.S. targets.

3. Substantial strengthening of U.S. defenses, including the achievement of an effective continental defense system and the reduction of the vulnerability of our strategic delivery systems.
4. Continued improvement in U.S. delivery capabilities, probably offset to some extent by further improvement in Russian defense.

These four characteristics will occur somewhat gradually so that overlap in time is almost inevitable.

Effects

A. If our defenses against conventional attack are strengthened before the USSR has attained a multimegaton capability and adequate delivery forces, the deterrent power of the U.S. is increased.
From the standpoint of military strength, this would continue to be a phase favorable to the U.S.

B. Deterrent effect of U.S. power dangerously lessened if Soviet production of multimegaton weapons and an adequate conventional delivery capability is achieved prior to the development of an adequate U.S. warning and defense system and before we have achieved a reduction of the vulnerability of our strategic delivery systems. Under these conditions, Soviet possession of such weapons and delivery capabilities would place the U.S. in danger of surprise attack and possible defeat.
This situation might develop as early as 1958. If we permit our military position to worsen to this extent, we will be in a poor position to ward off Russian political and diplomatic moves or to make such moves of our own.

Period IV (Indefinite in length; possibly beginning within a decade)

An attack by either side would result in mutual destruction.

This is the period when both the U.S. and Russia will be in a position from which neither country can derive a winning advantage, because each country will possess enough multimegaton weapons and adequate means of delivering them, either by conventional or more sophisticated methods, through the defenses then existing. The ability to achieve surprise will not affect the outcome because each country will have the residual offensive power to break through the defenses of the other country and destroy it regardless of whether the other country strikes first.

The intercontinental ballistic missile can profoundly affect the military posture of either country with respect to Period III and Period IV. If the U.S. were to achieve an intercontinental ballistic missile capability first, it could maintain that position of advantage, described in III–A above, so long as the Soviets did not have this missile capability. If the Russians achieve an intercontinental ballistic missile capability first, they might gain a comparable position of advantage.

Period IV is so fraught with danger to the U.S. that we should push all promising technological development so that we may stay in Periods II and III–A as long as

possible, and, if we pass into Period IV, may escape from it into another period resembling II or III–A.

It is recognized that Period IV would be a period of instability that might easily be upset by either side and that a world catastrophe might occur.

Should we arrive at a condition where the contest is drawn and neither contestant can derive military advantage (i.e., Period IV), we need not assume that this state is unchangeable or that one country or the other cannot move again into a position of relative advantage. We see no certainty, however, that the condition of stalemate can be changed through science and technology. This does not mean that some now unimagined weapon or development, far afield from any present weapons system, might not provide an advantage to one side or the other.

Implications of the Timetable

The periods of relative military strength which we have delineated reflect our own appraisal of the technological, intelligence, and military factors affecting our military position in relation to that of Russia. While we originally had other objectives in constructing the table it is apparent that it has implications for our diplomatic policy and international negotiations. It seems clear, for example, that Period II (also Period III–A) may be from the standpoint of relative military strength a very favorable period for political moves and diplomatic negotiations.

We emphasize that even though our *relative* military strength may change in the manner suggested in the table, we still remain in a position where the United States can be grievously hurt.

The timetable points up other urgencies in our program. We must press forward in the United States to fill the gaps and correct the weaknesses in our offense and defense. Our capacity to maintain a position of advantage will depend upon our carrying through, thoroughly and without delays, the remedies already available, authorized, or planned to overcome present weaknesses.

We must also press forward to develop more sophisticated offenses and defenses. We must constantly seek new technological breakthroughs that will bring about significant advances in our military power. The Russians will certainly do everything possible to achieve an advantage by searching for big advances in their weapons technology.

In the succeeding parts of this report, we have sought to point out the places where we need to carry through, to expedite, and to complete currently accepted improvements in our weapons systems which will provide new strength in both offense and defense. We have sought to suggest the new decisions, undertakings, and developments which we believe to be important to the continued buildup of our military strength. We have tried to pick up those promising developments that might be important new advances in technology and in intelligence. All these things that we analyze, report upon, and recommend are designed to keep us in a position of advantage in terms of the timetable we have constructed.

5. NUCLEAR STRIKING POWER

Attention in this section is devoted to those parts of the military force which now and in the future have some capability of inflicting damage directly upon targets in the Soviet homeland by means of air delivered bombs. This section, therefore, deals primarily with the Air Force and appropriate parts of the Navy. The Army, while an essential element of U.S. military strength, does not normally engage in long range aerial bombing.

Bombers of more modern design will soon enter the U.S. inventory and their successors must be developed. The availability of lightweight thermonuclear weapons in quantity will give significance to the striking power of small aircraft. Seaplanes may hold special promise. In the future are the possibilities of nuclear propelled aircraft and of ballistic missiles.

In maintaining a nuclear striking force superior to that of the USSR, the United States must strive for quality rather than quantity. The increases in the yield per ton of nuclear bombs have brought about corresponding increases in the power of the nuclear striking force. Since present U.S. technology is already near the upper limit of yield per ton of bomb allowed by nature, we cannot expect for long to maintain ascendancy over the Soviets through better bomb technology.

Superior delivery systems are, therefore, necessary for the maintenance of superior nuclear striking forces. The significant problem of delivery systems is the active opposition of the enemy. First, the U.S. nuclear striking force must be reasonably invulnerable to a surprise attack; and second, the delivery systems must be able to penetrate the Soviet defenses without unacceptable losses. The central problem of delivery systems can, therefore, be divided into two parts—ground vulnerability and air vulnerability.

Ground Vulnerability

Today the Strategic Air Command represents essentially the entire U.S. nuclear striking force. With large numbers of bombers concentrated on a small number of poorly defended bases, it is unacceptably vulnerable to even a small-scale surprise air attack. The Department of Defense, recognizing this, has various programs under way to reduce the ground vulnerability of the striking force. None of these will be available during the next two or three years when warning is a minimum and the Soviets have some capability for neutralizing the U.S. nuclear striking force and destroying U.S. cities. There are emergency measures which could be taken during this period to decrease the ground vulnerability of the Strategic Air Command and which should be considered in relation to the immediacy of the threat.

Warning is most important for preventing the destruction of the Strategic Air Command by a surprise nuclear attack. This has been recognized and great effort properly is being put on improving the warning system. Within two or three years ample warning of an air attack of substantial size should be available.

Of almost equal importance to warning is the reaction to it. The basic necessary reaction is bomber dispersal to the air within the warning time. Additional bases are

necessary, are being planned and should be provided to limit to a reasonable number the bombers at risk at each base, and to permit the bombers of the Strategic Air Command to be airborne towards target within the warning interval. With the bombers airborne there is additional time for interpreting the warning and making the decision to attack the USSR. One serious delay in the reaction time of the Strategic Air Command will be eliminated when nuclear bombs are more immediately available to the nuclear striking force.

The new significance of the striking power of small aircraft, which would come with the availability of lightweight megaton bombs in quantity, should be taken into account in future planning. Our presently programmed light bomber, fighter-bomber and attack aircraft, if given a megaton striking capability, would be a force with which the Soviets must reckon when planning an attack. By increasing the number of aircraft which the Soviets would need to destroy, the Soviet force required would be larger and more likely to be detected, thus increasing the difficulty of their mounting a successful surprise attack.

It is recognized that our short range forces, to be most effective, must be deployed near Soviet borders, where they would be subject to attack, even by Soviet short range bombers, which exist in large numbers. The mobility of our forces can be increased and, therefore, their vulnerability decreased, through use of short range take-off and landing techniques. Under way are research and development programs aimed towards practical methods of achieving mobility for land based aircraft. The carrier at sea gives an example of a short range force, all elements of which are mobile.

In the future a considerable degree of dispersal and mobility might be achieved through the use of seaplanes, and they might become an important part of the U.S. nuclear striking force. The Department of Defense should conduct further studies and experimentation to determine the feasibility of a seaplane nuclear bomber force.

Long-range nuclear striking forces would be more secure if based in the United States. A true intercontinental force, without dependence on tankers or forward bases, would therefore be a real "jump" in the capability of the U.S. striking forces. Improved aerodynamic design (e.g., boundary layer control) may lead to a substantial increase in range in a given airplane. Perhaps of greater immediate promise are the development and use of high energy fuels. The programs for aerodynamic improvements, and for high energy fuels and propulsion systems capable of using these fuels should be vigorously supported. Supplies of these high energy fuels adequate for development and testing of engines and equipment should be manufactured and made available at an early date. Somewhat further in the future is nuclear propulsion for aircraft which promises to provide radii of action unlimited when measured in terms of the dimensions of the earth and would permit the U.S. bomber forces to strike anywhere in the world. It could have this long range even at low altitude. The program directed toward development of aircraft nuclear propulsion systems should continue to receive support. However, the date of achieving a significant nuclear-

powered bomber capability is sufficiently uncertain that it would be wise to continue developing improved chemically-powered bombers for the intercontinental mission.

Air Vulnerability; Ballistic Missiles

High speed and high altitude have been primarily exploited in order to avoid enemy defenses. These are worth further exploitation. In addition, more emphasis should be given to the development of a significant very low altitude capability for the U.S. nuclear striking force. This is important because of the difficulty of defending against very low altitude attacks. As we have noted, the nuclear propelled aircraft could have intercontinental range even at low altitude. In the future it may become necessary for our striking force to have the capability of destroying the enemy's defense system in order to penetrate these defenses with acceptable losses.

The ballistic missile, when available, will exploit speed and altitude to so great an extent, that defensive measures will be complex and costly, if they can be developed. The achievement of a ballistic missile capability would furnish an important increase in nuclear striking capability for either the United States or the USSR. It is important that the United States achieve such a capability first. The development of an intercontinental ballistic missile is being directed and carried out by competent organizations and it has a high priority. It should continue to receive the very substantial support necessary to complete it at the earliest possible date.

We believe that the development of a medium range ballistic missile would be for either the United States or USSR an easier development, more certain of success in a shorter time than the intercontinental version. The Department of Defense should, therefore, establish a program to develop a medium-range ballistic missile for strategic bombardment. A land-based system would probably be easier to develop than a ship-based system; however, ship basing probably would allow better coverage of Soviet Bloc targets, would be mobile and would be free of political restraints.

It is important to note that there will be a continuing need for manned bombers even after the achievement of a capability with ballistic missiles.

We have discussed a number of ways of increasing the U.S. nuclear striking power, most of which are active Department of Defense programs. To maintain superior U.S. nuclear striking power these programs should continue and the others we have discussed should be approved and supported. There are many other programs also directed towards maintaining superior U.S. nuclear striking power. The fact that we have not mentioned a program carries no implications of any kind.

Radioactive Fall-Out

We discuss this complicated problem on page 55 of Part III of this report, and the reader wishing more detail should consult this section.

In summary we recommend that: (1) Current studies directed toward better understanding of the hazards which may result from the detonation of a large number of nuclear weapons should be continued. (2) Plans for the military use of nuclear bombs should not at this time be restrained because of the long-term radiological hazard.

6. DEFENSE OF NORTH AMERICA [1]

The Objectives of Defense

In our studies of defense measures we have tried to recognize all major threats to the continental United States and to consider defense against them in the broadest possible terms.

Defense against these threats has two aims: to protect in the event of war and, by virtue of this protection, to discourage attack.

Pursuit of these aims is jointly shared with our offensive forces. Our striking forces must blunt the attack at its source; defense must protect our retaliatory power as well as our people and our cities. Together they provide overall strength and a substantial deterrent to war.

In its role as a deterrent, the defense need not necessarily be capable of stopping all forms of attack completely, but must, in the enemy's view, make attack extremely hazardous. Faced by our retaliation and by limits on his sustaining power he dare attack only with reasonable certainty of large initial success.

The Problems of Defense

The requirements of defense are vast and complex. We must defend a huge area against a large, varied and changing threat of partly unknown nature. We must be prepared to do so at an instant's notice and with a degree of success beyond all previous demand. The tools are intricate and many of the problems are at the very limits of technology.

Unfortunately, assignment of the task does not fit naturally into the present organization of our military forces. Its various elements—distant warning and continental surveillance, interceptor forces and ground-based weapons, defense against submarines and destruction of their missiles—are shared among diverse groups from all three Services. Inevitably there are problems of responsibility, of command, and of the proper meshing of equipment.

The system now sketched out for continental defense is the largest integrated system ever conceived to perform a specific task. It is, unfortunately, not yet being planned as an integrated entity. There exists no agency with both the competence and the authority to do this planning. There is inadequate coordination between operating and development agencies. The development of specific weapons and equipments is often spread through a number of laboratories and contractors with insufficient attention to overall system needs. The procurement and operational introduction of already-developed equipment is slow and cumbersome. Promptness and decisiveness are lost through wide dispersion of the decision-making process.

In spite of all these problems, an important beginning toward an effective defense has been made by the military services and other agencies of government. Organizational improvements have been made. The creation of CONAD was a major advance, and its growing effectiveness will continue to strengthen our defense. New and better

[1] In studying the defense of North America, the Panel has informed itself about the progress of Project Lamp Light, sponsored by the Departments of the Navy and of the Air Force.

weapons have been developed and procured. We have the beginnings of a continental radar net. Unfortunately, however, the nation was slow to recognize the need, the program was late in starting, and the system is as yet embryonic.

As a consequence of all these factors—the magnitude and complexity of the problem, the organizational readjustments required, and lateness of our start—the United States is at present unacceptably vulnerable to surprise attack. Our military defenses are as yet numerically deficient and have serious qualitative weaknesses. The defenses could be avoided or overwhelmed and might even be unaware of an attack until the first bomb exploded. Under these circumstances our cities could suffer millions of casualties and crippling damage, and enough SAC bombers and bases could be destroyed to reduce drastically our ability to retaliate.

Many steps are being taken to improve this situation. A Distant Early Warning line is to be installed. Additions and improvements are being made or planned in the continental radar net to give better high and low altitude cover and to extend the system outward from our continental boundaries. New and improved weapons are being developed and procured. All of them we enthusiastically endorse. Even with these and other planned and programmed measures there will remain, however, great and continuing need for improvements to match and keep up with the increasing threat.

General Conclusions

The threats which exist now may continue for many years. They are primarily nuclear weapons carried by intercontinental aircraft, by mine-laying vessels and submarines, and by missiles launched from seaborne platforms. Refinements of the airborne carriers, and ultimately intercontinental ballistic missiles, must be expected in the future. We must also be alert to other still more obscure dangers—to clandestine introduction of nuclear bombs, to covert or windborne attack with biological agents.

We have considered the technical problems of defense against these threats. We have studied our present defenses and the programs to improve them. We have found great sources of strength and grave weaknesses and have examined measures for improvement. If our conclusions were to be put into a single sentence, it might be this:

> Although technology is important, in the end our success at defending ourselves will depend upon the effort we put in and how well we organize that effort.

This generalization stands upon two others:

> First, there is no unique perfect weapon or technical trick that is going to make defense an easy job. Against even the present threats we will need strategic intelligence, warning of—and surveillance of—a potential or approaching attack, the best of destructive weapons well deployed and efficiently brought to bear, protection of people by shelter and evacuation, and protection of recuperative strength by stockpiling and dispersion. There is no magic formula to simplify this list. We need every element and we need it in time.
>
> Second, most of the basic technical problems raised by the threats of attack by manned bombers and from the sea have been solved; the rest seem solvable.

It is the scale of our technical effort, and its planning and integration in detail, which need attention. Above all and throughout, we must strike a realistic balance between technical perfection and timeliness.

Granted solutions to the technical problems the question rises—Can we build *enough* defense and can we build it *fast* enough? The answer hinges on innumerable factors, many of an intangible nature. We have analyzed those within our competence, calculating some, and estimating others. We have concluded:

The nation can afford enough protection against the air and seaborne threats to create a serious obstacle to effective attack, an obstacle whose appreciation by the USSR would be a direct and forceful deterrent. To defend at this level demands an increased and balanced effort which must be matched to the increasing threat.

Defense Against Air Attack

The ultimate objective of an air defense system would be to recognize an attack at its instant of launching, to keep it under constant surveillance, and to destroy it by immediate and continuing counterattack. Since all of this is not now feasible and, in particular, since defensive fighting forces are now limited in range, actual fighting must, perforce, be confined primarily to a much smaller area within and surrounding our continental limits; activities beyond that zone are largely confined to the acquisition of information regarding the attack. It is therefore convenient to speak of "warning" (which also includes surveillance) in the remoter areas, and "active defense" carried out within a smaller "combat zone."

A. *Air Warning and Surveillance.* To ensure that defensive forces will be in readiness, that striking forces can be dispatched or evacuated, and that non-military measures can be activated, requires at least two hours of advance warning; more would be preferable. At present we do not have this capability.

The warning system must provide information in depth. Warning itself can be achieved by radar lines in remote locations. The more remote a line, the earlier it provides information, but the less certain is the nature of that information. Hence, any single line must be a compromise between timing of the first warning and the positive nature of that warning. A more effective system would include several (at least two) lines, the outermost to give an early alert of possible attack, the innermost to give unmistakable signal of actual attack while enemy forces are still several hundred miles from our perimeter. The radars in this line would also provide the defense with surveillance information necessary for analysis of the attack and effective deployment of defensive forces.

These considerations must be modified in practice by geographical, topographical and climatic factors, and by political considerations. Fortunately, we are surrounded by large areas of friendly territory and oceans giving us considerable latitude.

We endorse the planned Distant Early Warning Line (DEW), including the seaward portions and urge its installation without delaying for technical or geographic refinements.

In addition to the fixed lines, it is desirable to have available at suitable locations on the DEW line, radar-equipped planes ready to shadow an incipient attack and forward information as to its strength, location and course, thus providing a reasonable substitute for continuous radar cover in the intervals between the lines.

Additional benefits would also be derived from fixed radars and listening devices and from patrols in advance of the DEW line, particularly in the regions near enemy launching bases. In addition to possible intelligence and warning information they would serve as harassment to the enemy, for example in conducting refueling operations. Definite benefits would result to our allies and to ourselves by integrating the DEW line with future radar nets in Europe.

Complete warning must be comprehensive. Fortunately, however, the early warning requirement is bounded, since once the system is achieved it will not be appreciably affected by the size of the Russian threat.

It is clear that the problem of providing air warning is global. It involves operations on land, on the sea, and in the air. It extends from temperate zone to polar icecap. It is shared by all of our armed forces and by our allies. No part of the defensive system is more important.

B. *Active Air Defense.* The devastating and widespread effects of single weapons, together with the probable strength of enemy air attacks, demand a very high attrition on attacking forces. Such attrition can be assured only by substantial defenses in depth. The air defense system visualized and being constructed by the Continental Air Defense Command has this concept. It is based on interceptors guarding our perimeter and interior, and on ground-based missiles and guns surrounding our most critical centers. Information for the control and direction of the interceptor force and for alerting the local defenses is provided by a "ground environment" consisting of fixed radars and a communication network.

At present this system has serious technical weaknesses, especially at both extremes of altitude. Jet bombers can overfly both our radar net and our interceptors; our radar is poor and our weapons virtually helpless at very low altitudes. These weaknesses are recognized and steps are being taken to correct many of them. Others will require further technical development.

We are convinced that nuclear warheads offer the best means of ensuring a very high "kill" by our defense weapons, air-to-air and ground-to-air. They should be adopted as the major, though not the exclusive armament for our air defense forces.

We are also convinced that to conduct effective combat at very high altitudes demands a drastic revision of the function and traditional form of the interceptor aircraft. The burden of speed and maneuverability in combat must be shifted to the air-to-air missile and the interceptor must become an airborne launching platform having adequate radar and the range and mobility needed to marshal forces against a concentrated attack.

As the Russian threat increases with the inclusion of megaton weapons, stronger defense will be essential and a premium will be placed on destroying attackers long before they reach heavily populated regions where damage can result from a downed or jettisoned bomb. Defense must be extended seaward and northward beyond these populated regions. Radar surveillance and interceptor bases should be advanced northward, and surveillance extended seaward to a distance approximately twice effective interceptor range. Realistic rules for engagement must develop with extension of the battle outward.

In addition to the need for the improvements mentioned above, it will be necessary to increase the quantity of defensive weapons, and to continue to do so as the threat increases. Fortunately, the elements of the ground environment need not be increased accordingly.

Many of these improvements and extensions have already been recommended by CONAD and others. Substantial increases in our total defenses are contemplated and are essential. Although not all of the technical means are yet in hand, the problems seem solvable.

Defense Against Sea Attack

We are at the present time vulnerable to attack from submarines and surface vessels. Although plans are underway for partially overcoming these threats, we have at present little in the way of defenses against them.

For the present, a possible attack is limited to a relatively narrow coastal belt which, however, contains all of our ports, many of our major cities and some of our military installations. The slowness of the primary vehicles benefits the defense if attack is discovered in advance. However, the difficulties of discovering submarines and weapons carried in commercial shipping enhance the possibilities of surprise.

Protection against seaborne attacks can best be accomplished by taking measures against the seaborne carriers before launching of a missile or penetration of a harbor. Such a defense requires continuous and accurate information on all surface craft and submarines within potential striking range; means for identification of unknowns for close surveillance of submarines and suspicious surface vessels; and policies permitting diversion or, when necessary, direct military action in areas well beyond our territorial waters as presently defined.

An important element in the picture should be a continuous and accurate plot of all surface and sub-surface vessels. Not only will this serve to aid in the close surveillance of individual vessels but advanced information of an incipient attack might be inferred from concerted movements of remote submarines or suspicious surface craft.

The programmed Atlantic and Pacific Lofar ("Caesar") systems for deep water submarine detection should be expedited

Harbor defenses should be activated in all our principal ports for protection against mining, particularly nuclear mines.

Non-Military

Since our active defenses would not impose complete attrition on an enemy attack, protective measures are essential to reduce our overall vulnerability, to protect our people and to provide resiliency for post-attack recovery.

Civilian defense to protect our people is essential to avoid catastrophic casualties in the event of a successful attack. The threat already imposed by fission weapons will in the near future be greatly amplified by the increased destructiveness of thermonuclear weapons and by the danger of radioactive fall-out over large areas contiguous to possible targets. New and comprehensive policies are needed to delineate responsibilities and to guide programs for constructing shelters and for evacuating appropriate segments of our target cities. Such policies should be based on an immediate study of the new implications of multimegaton weapons by a competent and informed group. After implementation of the policies, the public should be fully informed of the nature of the threat, of the policies in effect, and of the measures required to afford protection.

In the event of atomic war, one of the most important elements in providing the requisite national resiliency will be the ability of the people to resume organized activity after the initial attack. We are concerned over the concentration of our essential civilian supporting industries in critical target areas and the lack of a positive national program designed to reduce this vulnerability.

Defense Against the Intercontinental Ballistic Missile (ICBM)

In the foreseeable future we may be faced with the threat of intercontinental ballistic missiles. Although the technical problems that must be solved in attaining a defense against this threat are extremely complex, there are sufficiently promising leads to justify an expanded and accelerated research effort on a broad front. There should be established a strong, balanced program of theoretical and experimental investigations of the basic problems of detection, interception and destruction.

We believe that one important element of defense against the ICBM—warning—is presently attainable. It is practicable to build a radar system providing approximately 15 minutes warning of the arrival of an ICBM and giving a reasonably good localization of the expected target area. Such a system would be of great value to our retaliatory forces and in saving lives, whether or not a successful defensive weapons system can be devised. In speaking of defense against the ICBM, we wish to make clear that defenses against manned bombers will continue to be vitally important after the advent of the ICBM.

7. OVERSEAS COMMUNICATION: INFORMATION AND EARLY WARNING

The network of Soviet jamming transmitters is very extensive and remarkably well coordinated. It represents a suspiciously heavy investment of material and human resources. We are compelled to infer that it has an important military function, and that this function probably is the disruption of our long-distance communications in the event of war or at any other juncture when such action appears profitable to the Soviets. To cut completely our trans-Atlantic communications, jamming of the high-

frequency (short-wave) radio circuits would have to be combined with sabotage or clandestine attack on our cable circuits.

At present, jamming the high-frequency circuits would leave us with extremely limited trans-Atlantic communications. Although the advent of new trans-Atlantic telephone cables will improve the situation during the next two or three years, the results of effective jamming will remain very serious. All communications across the Pacific are by radio and can be jammed.

For several years the Soviet jamming potential has worried people in government. Certain positive steps have been taken to provide less vulnerable trans-Atlantic channels of limited capacity, but the situation is still serious and will remain so until much more is done.

Jamming threatens not only military communications at and after the onset of war, but also the lines of communications involved in getting and acting on early warning. It is sometimes argued that jamming will not seriously impair early warning because the outbreak of full-scale jamming would be in itself indication of imminent surprise attack. We believe that we should not take comfort from such an argument.

The channels over which early warning will come can hardly be predicted in advance. In all likelihood, it will not be a single message that conveys the warning, but rather many pieces of information whose full significance is revealed only when they are assembled in the light of other current information. Hence any severe contraction of our communication channels, even if all are not cut off, may reduce the chance of getting useful early warning. The only way to remove this danger is to reduce the vulnerability of our communications systems to the point where a substantial communication capacity over both oceans can survive a determined jamming attack.

We believe that considerable reduction in vulnerability, particularly of our radio circuits, can be achieved by technical improvements and by organizational arrangements.

At present there is no one organization with responsibility for investigating the reliability of the overseas communications networks, planning improvements, and promoting needed technical developments. In some areas effective work is being done. However, promising new ideas, as well as known possibilities for reducing vulnerability of our present facilities, need exploiting. There are common meeting grounds to exchange information and insure against overlap and duplication, but there is no comprehensive agency to direct the effort.

In view of the great importance of global communications and the weakness of the present situation, it is believed that there is need for an agency having the powers suggested in order to take full advantage of the research and development resources of the country.

In addition to the gains that can be achieved by technical improvements, the value of pooling resources of the various armed services and commercial companies seems evident. "Pooling" is being done at present to advantage; however, there is no continuous over-all status reporting which includes all of the services and commercial companies. As a result, the present situation is *weak* in at least two respects: (a) there is no focal point at which the presence of widespread jamming or cable cutting can be

determined and evaluated as possible evidence of enemy intent, and (b) maximum advantage cannot be taken of the diversification of types of facilities or of routes and frequencies.

It is strongly urged, therefore, that consideration be given to the establishment of a military communications office for the continuous collection of current status information and with responsibility for the coordination of emergency traffic.

There are numerous technical possibilities deserving of exploitation. They are discussed at length in Part VI of this report. Briefly they are: protection against sabotage, increased transmitter power, improved antennas—all quite obvious; a new teletype system called "NOMAC," self-checking codes, high speed (SQUIRT) transmission, multi-frequency switching, facsimile, low speed CW transmission, the use of a Communication Zone Indicator (COZI), forward scatter transmission, Voice of America facilities as point-to-point circuits, new cables with attention paid to cable vulnerability—all fairly straightforward, if not obvious; and finally—neither obvious nor straightforward, but worth serious study and evaluation—transmission via meteor trails and transmission via artificial satellites.

This is not a complete list. It is given here only to point out that there are many important possibilities. Overseas communications is a national problem of immediate concern. It is a problem for which we see technical solutions.

8. INTELLIGENCE

A classic mission of intelligence is the provision of useful strategic warning of impending attack. By "strategic warning," we mean warning of an attack while it is in the preparative stage. For an air strike, this means warning before the bombers take off from their staging bases. This warning may be months, weeks, days, or hours before the first blow is felt. By the phrase "useful strategic warning," we mean strategic warning that is clear enough, and well enough used, to deny to the enemy the enormous advantages of surprise attack in modern war. Can we have, and can we depend upon having, useful strategic warning in the event of a sudden attack?

Our intelligence facilities are largely devoted to the problem of strategic warning. A great mass of data is continuously gathered, and from this those items most likely to be indicators of an attack in preparation are selected for review by capable groups of specialists. Experience has taught helpful lessons about the subtle nature of these strategic indicators. Today's methods include features designed to avoid past errors, at least in the detection and interpretation of suspicious indications.

We are brought to the conclusion that there is a good possibility that an enemy's preparations for a massive surprise attack on the United States would be detected. However, this possibility is not a certainty. Because the need for strategic warning is so very great, in the event of an attack, we have a correspondingly great urge to believe that the warning will be forthcoming. This human factor impairs sober, balanced judgment. Who can be *really* sure that the USSR could not slowly, quietly, over the months, assemble planes and crews for a sudden and possibly desperate attack on our SAC bases? Or what assurance do we have that the enemy may not develop an air

force so active that it might, at any time, conduct a maneuver that ends with the actual drop of bombs on our cities?

To find out what the Russians are up to we depend almost entirely on physical manifestations of activity. We detect *things* happening—physical activity and physical change—rather than secret decisions, intentions, and plans. For strategic warning, intelligence must detect and evaluate the evolution of the attack, which began long before with the buildup of the striking force, its vehicles, weapons, crews, and bases. A massive attack involving much logistic preparation and numerous attacking forces is far less likely to succeed in surprising us than attack by a very small force. (Presumably an enemy would not risk a small attack unless he judged our retaliatory forces to be vulnerable and our defenses to be weak.)

A complication in the strategic-warning problem arises because a surprise attack might involve real surprise in kind as well as in timing. Our intelligence may be thwarted if it is concentrated upon air forces and the first strike should be delivered from the sea. There are many possible kinds of attack, and of these, several might appear as reasonable courses to a potential enemy.

There is also a question as to the certainty of our putting strategic warning to effective use. This question assumes larger proportions when we allow for confused warnings, "spoofed" indicator boards, jammed communications, and even of sabotage to vital links in our response mechanisms. Moreover, just as we believe that our techniques in the discovery of strategic-warning indicators have improved, so also must we assume that the techniques of denying, confusing, and inverting these indications have advanced. The Soviets are not amateurs in these techniques.

Because we are unable to conclude that the United States surely will, or surely will not, have useful strategic warning in the event of a surprise attack, we recommend that our planning take serious account of both possibilities.

Apart from the provision of warning, intelligence has a larger role, in both hot war and cold. If intelligence can uncover a new military threat, we may take steps to meet it. If intelligence can reveal an opponent's specific weakness, we may prepare to exploit it. With good intelligence we can avoid wasting our resources by arming for the wrong danger or at the wrong time. Beyond this, in the broadest sense, intelligence underlies our estimate of the enemy and thus helps to guide our political strategy.

Our intelligence community has gained enough information about the Soviet Union to give what is probably a reliable picture of its levels of military preparedness, industrial development, and technological strength. This picture reveals a huge country, with great potential, still backward in many ways by our standards, but going forward rapidly, producing highly competent scientists and technicians in many fields, and devoting concentrated effort to the transformation of its brute strength into competence for modern technological war. Yet estimates of the specific *capabilities* and *immediate intentions* of the Soviets have, at their center, only a very small core of hard facts.

In the course of our studies we have had the extraordinary privilege of a guided tour through the U.S. intelligence community, with the opportunity to look and to question as we wished. We inquired into the ultimate foundations of our National Intelligence Estimates, with particular attention to those estimates on which much of our national policy in defense is based. Such typical estimates relate to the Soviet nuclear stockpile, to their jet-bomber force, and to their preparedness for long-range nuclear war. In our judgment, these are excellent estimates, meticulously prepared. Even so, no amount of analytic and synthetic thought can be a satisfying substitute for hard facts.

It has become exceedingly difficult to obtain significant information from covert operations inside Russia. The security zones at the border, the general restrictions in the interior, the thousands of security police, and the innumerable informers among the populace are brutally effective in limiting the infiltration, exfiltration, and usefulness of agents. Therefore, we must more and more depend upon science and technology to assist and to complement the best efforts in classical intelligence.

Intelligence operations already make much use of technological advances—in the form of radio, airplanes, parachutes, balloons, electronic devices for ELINT, audio devices, infrared equipment, and polygraphs. As science and technology progress, possibilities for new applications continuously appear. We envision as attainable in the near future a great increase in the usefulness of science in intelligence. Revolutionary new techniques will be devised to give us facts and answers instead of assumptions and estimates. Only a few illustrative examples can be mentioned here.

Do the Soviets have operative short- and intermediate-range missiles? Are they making progress toward an intercontinental ballistic missile? We do not know. A special high-power radar is being developed to look from outside at Soviet high-altitude missiles.

Air bases along the northern periphery of the USSR would be of special importance in a strategic air strike against the United States. Our reconnaissance of these bases is inadequate. The technology now seems to be available for mastery of the geographic factors in the polar region. Men, supplies, equipment, and shelter can be delivered to any part of the polar pack ice by air lift. Experience has shown that determined men, carefully selected and trained, with strong technological support, can survive and work under these arctic conditions. The information to be gained from the passive use of stations on the polar pack ice, especially if they can be near to and concealed from the Russian air bases, would be obtained by acoustic and electronic listening, by visual spotting, and possibly through use of the passive ends of fluttar links. We should proceed with development of the special equipment and training of the specialized personnel needed for intelligence operations in the region of the polar pack ice.

It is now possible to launch a small artificial satellite into an orbit about the earth. Existing rocket components could be used, and the cost would be modest. (This project is under consideration in the Department of Defense.) Such a satellite would be entirely harmless and could have some worthwhile although limited intelligence applications. When our intercontinental ballistic missile program is further advanced,

the propulsion units needed for larger, reconnaissance satellites will become available. We can obtain by this means, if certain technological problems can be solved, almost continuous surveillance—extensive, selective, and detailed enough to reveal objects (airplanes, trains, buildings) on the ground.

This Panel has examined other specific applications of science and technology to intelligence techniques. We chose to pursue several of these, partly to make some tangible scientific contribution and partly to study the technique of applying science in the intelligence domain. These case histories have strengthened our optimism that the physical and biological sciences can be made into new tools with which to dismantle the Iron Curtain.

Note: In order to keep this report out of a more restricted classification, the Panel has prepared for highly restricted circulation, two other reports on intelligence embodying recommendations and conclusions for transmittal directly to appropriate offices of the government.

9. MAINTAINING ALERTNESS

For many years it has been accepted as a truism that democracies have done badly at the outset of a war but win in the last round because of their greater industrial capacity, greater resilience, and staying power. The enormous increase in the power of nuclear weapons, however, has destroyed the basis for any such assumptions from now on. We had resilience enough to come back after the surprise air attacks on Pearl Harbor and Luzon; we did not have the alertness to prevent or blunt the surprise.

But resilience after a wide-scale attack with multimegaton bombs is something else again; the increase in the power of a single weapon by a factor of a million, as described above, is eloquent evidence that no nation can count on blundering its way through to victory in World War III. The possible penalty of inadequate dispersal or for a failure of strategic intelligence or early warning looms as portentous as an atomic cloud. Democracies can no longer feel entitled to a quota of mistakes in the first phase of a long war. Now the consequences of a single oversight, a single failure of alertness or of communications or of the power of decision, or an undue slowness in reaction time, might cripple the striking power on which the whole free world depends. If the first mistake is bad enough, there may be no road back.

We have said that the United States is now vulnerable to surprise attack. In the face of this fact and of the changing pattern of threat as described in our timetable, we have no choice but to maintain a taut readiness, an ability to minimize the possibilities of surprise, a capacity to keep ourselves resilient if it should occur.

We examine in some detail how we may achieve better intelligence, how we may assure an increase in early warning, and how we may defend ourselves. Assuming that we achieve effectiveness in all of these components of our defense against surprise, we still are left with the problem of how we make sure that we have quick and sure reaction to any moves the enemy might make. The alertness of our response to warning of an impending surprise attack may well decide the success or failure of the attack. We are thus led to place great importance on the readiness, alertness, and certainty of our entire system of reaction, decision, defense, and retaliation. We need to strengthen

this system wherever we can and to train and test it through periodic experiments and drills.

We can gain strength and certainty by adding parallel paths of communication and by duplicating the authority to order defensive and retaliatory responses. We do the latter at the price of losing centralized civilian control of responses, a price we cannot consider for all responses. But we can and should afford this price for the less complete responses which are not likely to endanger peace. We need clearly to separate, in our thinking, these gray precautionary, less complete responses from the black-or-whiteness of the ultimate, total, decision.

Experiments and drills are essential. The only way we can be reasonably sure of the adequacy of our procedures for rapidly making decisions and communicating these decisions is to conduct realistic tests of the entire decision-making, decision-implementing system. We have in mind something more specific than war-gaming or command-post exercises, desirable though these may be. To test our alertness will require a series of tests which assume different forms and degrees of warning and which carry through all the operations involved in our response to such warning—even to the point of getting both defensive interceptors and retaliatory bombers into the air.

Such tests should involve the whole system under all the simulated operational conditions which might accompany surprise attack. They should cover the entire flow of information and decision, and the response to this information and decision. One such test might involve the reception of early-warning information, the decision to respond to this warning, and the authorization by the President for planes to take off with nuclear weapons for a practice mission within the continental United States. We are convinced that such tests would throw light on possible weaknesses in our communications system and would give us a better understanding of how our decision-making process would work under conditions of surprise, and of how well the whole system responds to sudden information, interprets it, uses it correctly, and brings about positive action.

Test maneuvers with nuclear weapons must take place either in a period of international calm as a drill, or in a period of genuine alert as a near-final precaution, dangerous but essential. At other times, the dangers of accidental war may be too great. Many of the other tests and drills, however, can and should take place when a slight or moderate warning is at hand. Drills without notice are more realistic and effective. Drills based on intelligence give practice and test to the means by which intelligence is converted into decision. Above all, drills based on moderate warning, warning not thought to be serious, offer an additional chance of avoiding a recurrence of Pearl Harbor. Rather than fearing that the enemy may "spoof" our intelligence sources and distant warning lines, we must hope that he will do so realistically, and with moderate frequency. Realistic drills, based on intentional or unintentional "spoofs," are our surest course to reliable alertness, strength and resiliency, when and if the day of surprise attack comes.

The Strategic Air Command and the Air Defense Command have demonstrated the effectiveness of tactical exercises, as have other branches of the three services.

The emergency relocation drills sponsored by the Office of Defense Mobilization are important to the attainment of readiness within the Executive Branch of the government. Practice sessions to determine response to simulated warning of hostile intention and action would add much to exercise and test the thinking habits at the top of government, necessary for a speedy response to surprise attack.

The present studies by the staff of the National Security Council on the decision-making machinery associated with different types of alert constitute an important and necessary step in the development of realistic tests of national readiness and alertness. We are encouraged by the effort to complete these studies with dispatch.

Back of all this emphasis on alertness and reliability of information is the new problem which a near-total weapon has posed for the military and political executive: the problem of the total decision.

It is only wisdom on our part to believe that a clever enemy will discern the dilemma of the total decision. He can be expected to design any surprise attack to engender ambiguity in our early warning signals. He may discover and proceed to tantalize our indicator boards. He may disrupt our communications, even probe our radar nets, without making war. He may appear bellicose and then turn reasonable, again and again. If he has his way, the total decision will be for our executives an hour of extreme agony.

The total decision must be made almost spontaneously, else it will be too late. Its consequences being total, it cannot be delegated. Because it cannot be delegated, there must be absolute reliability in the pathway whereby the question reaches the executive. And there must be a prearranged program for alternate executives if there arises an insuperable block in the pathway.

In two senses there must be practice travel over this path. Obviously there should be rehearsals of the communication technique, accomplishing the testing of the whole variety of wire, machinery, and persons, and their security from covert disruption or substitution. But beyond this, on a higher plane, there should be the psychological rehearsal—the moral and spiritual preparation for the total decision, in urgency, in conflict, and in confusion. Rehearsals should be based upon actual and potential strategic-intelligence and tactical-warning situations. The findings should be used especially to sharpen the requirements for adequate early-warning signals.

Our military and political executives need not always reach a simple black or white decision in response to warning. There are the gray responses, those between purely defensive actions and unmistakably hostile actions. A particular set of warning indications might justify the full arming of SAC, or might justify no more than alerting of radars and ground observers. It is important that responses, as justified, be freely taken. This not only prepares for the immediate development but also gives invaluable exercise to the whole response and defense network. The low-level responses, of course, need not wait upon high-level decisions. Yet enough of the non-trivial alerts should pass through the early-warning chain to the highest levels, to provide a context for the psychological practice which we recommend.

With these needs and considerations before use, we reiterate the urgent importance of an examination of all the technical, procedural, and personal links by which early warnings are translated into responsive action.

There is a need to assign staff responsibility in the Executive Office of the President for promoting and monitoring the planning and execution of readiness tests and for insuring that the examination described above is carried through. This responsibility should include periodic reporting on the status of our national alertness in responding to surprise attack.

10. NEED FOR SKILLED MILITARY MANPOWER

The enormous gains in weapons performance during the past ten years have been achieved at the expense of complexity in our weapons systems. Atomic weapons and the radical extensions of speed, altitude and range of our delivery vehicles have engendered a wealth of innovations in electronic and mechanical equipments. The development of all-weather interceptors and guided missiles to cope with the correspondingly increased offensive capabilities of the USSR has resulted in weapons complexity of a high order in our defensive systems.

This increased complexity has multiplied military needs for technical maintenance personnel, particularly in the higher skill-experience levels. There are adequate numbers of men available to the Armed Forces to satisfy presently foreseeable requirements for maintenance personnel. The problem is one of quality—not numbers. It is the problem of retaining in the Service the best men in whose training this country has made a large investment.

It is essential that the Services have a professional "hard core" maintenance force; but it is impractical to attempt to build a professional maintenance force on the basis of draft, and enlistments encouraged by draft, without a career concept and long-term opportunity for promotions and rewards comparable to opportunities in private industry.

The proposals contained in the President's recent message to the Congress on military manpower fully recognize the importance of retaining in the military services highly trained technical personnel. If adopted, it is hoped they will do much to create the incentives and national climate needed to accomplish this objective. The reenlistment situation for skilled personnel will require close watching to determine whether still stronger incentives are required.

Even if everything possible is done, there probably will still be a deficit of skilled military maintenance personnel for many years. This shortage can be partially corrected through more extensive use of industrial contractors. The services have used industrial contractor maintenance with considerable success in a limited number of situations. Industrial maintenance seems especially well suited to jobs in the ZI. Use of industrial type maintenance by the military is not without difficulties. But the problems of adapting civilian maintenance to a variety of military operations appear solvable. Further, industrial contractors must not be used in a manner to aggravate the competition for personnel with the services. Special consideration should be given

to using industrial contractors in field maintenance and in the maintenance of test facilities.

Although it is probably not possible to predict with precision the exact types of military equipment and the nature of their deployment for the next five to ten years, it is important for the services to develop long-range requirements for skilled maintenance personnel based on various assumptions as to types, numbers and locations of equipment. This must be done for the entire Department of Defense if future requirements for skilled personnel are to be anticipated as early as possible, so that timely corrective actions can be taken.

11. STRATEGIC PLANNING AND TECHNOLOGY

New weapons create not only their own special problems, but also domains of concern which in some ways transcend the weapons themselves. One such is the military mission to be performed, often involving all three services, each using some similar weapons in all three media—land, sea, and air.

Military missions in earlier wars have been relatively clear cut. Through World War I the traditional fighting roles of armies and navies, while supplementing each other, did not interact importantly. Armies fought land battles, fleets fought sea battles and delivered supplies to the armies. With World War II, considerable change had already come. High speed communication was world-wide. World-wide transportation by air had begun. Battles were in three dimensions. Ships at sea were vulnerable to attacks launched from land, and land armies to attacks from the sea. Air, sea, and land forces shared in many common battle objectives.

The *objective,* the functional military job, is the dominant thing. The forces and weapons we may have must be put together in the best manner to accomplish the objective. Recognition of need for coordination led to the establishment of the Armed Forces Staff College in 1946. Addressing the students of that institution in 1948, General Eisenhower stressed the technique necessary "to put men together who have been trained in different services and who operate in different media."

The need increases. Today's problems are more urgent and more complex. They are well illustrated by the example of Continental Defense. Global offensives demand global defenses; there are no longer any natural barriers recognized by a comprehensive offense. Continental Defense is not a one-service job; it is a national military objective, of very broad scope. It requires the best techniques and many different techniques, the best integration of them into an effective system, and renewed understanding that this defense problem does not separate naturally into three parts: there is one comprehensive, functional military job to be done.

The threat is manifold: bombs deliverable by air and by sea; by planes crossing land or ocean, by missile, by ship or by submarine. The defense must have eyes and ears, a central nervous system, quick-acting brains and a fighting response when necessary. Three services take part in the defense: The Navy in controlling ships, detecting and killing submarines; in giving early warning of air attack over the oceans; of intercepting enemy aircraft. The Army provides "point" defense with anti-

aircraft guns and Nike missiles. The Air Force has the large radar detection net and the mechanization for surveillance and for control of interception, and an interceptor force to destroy enemy bombers.

Within the context of surprise, there are other examples of national problems with technological implications which bridge several departments, for which we do not now see a natural home. We will cite three, all of which are discussed elsewhere in this report. They are: communications, particularly overseas communications, on which we may have to rely for warning; electromagnetic warfare, both offensive and defensive; and large-scale experiments to test realistically all aspects of our national alertness and response. These examples go beyond a particular service and beyond the Department of Defense; yet they are important, perhaps vital, parts of our defense.

Science and technology have changed and will continue to change and complicate the character of war. The new weapons have brought into focus new military objectives. The new objectives create further needs which science and technology are called upon to satisfy; needs to devise and produce, integrate and test weapons, counter-weapons and systems of weapons that will best serve the functional military objectives.

Our professional military men have a primary, military responsibility, for which they are primarily trained. Our professional technical people have an increasing responsibility to assist their military counterparts. Just as techniques are necessary to put men together who have been trained in different services, so is it necessary that techniques be found for men trained in research and development to work more intimately with the military planners to meet common objectives.

Recommendations on organizational matters *per se* do not fall within the purview and assignment of this Panel, nor does organization, alone, ever solve all problems. We feel compelled, nevertheless, to express our conviction that within the Department of Defense lie significant opportunities to bring technology and military planning closer and more effectively together.

As an initial step to this end, we endorse earlier recommendations and plans that there be a man trained and experienced in science or technology, with proper administrative experience and ability, appointed as Assistant Secretary for Research and Development to serve these ends in each of the three services.

12. TOWARD A WEAPONS SPECTRUM FOR LIMITED WARS

This report has dealt mainly with surprise attack in the context of total general war. We have not considered the possible applications of science and technology to the development of special weapons for peripheral wars, although in the course of this study we inevitably have speculated on the possibilities.

We are impressed by recent developments in controlled fragmentation such as the Army's "JACKSTRAW" and associated weapons. This is but one example of the innovations that might be made in "conventional" weapons. We believe that technology might help in the further development of weapons to be used in local wars where indigenous troops, without either technical or extensive military training, may

do the fighting. Progress may be possible in achieving new weapons which are easy to use, and readily transportable. There is a wide field for science and technology to augment the talented and responsible personnel in the military services already working on such weapons.

There are also possibilities for the special application of nuclear weapons and tactics to limited areas. Nuclear explosives might be useful for controlled fragmentation or for other kinds of weapons designed to deny to the enemy some specified area, without destroying the area.

We have emphasized that there is no important discontinuity in explosive force from the largest H.E. bomb to the smallest fission bomb. It is important that this fact be clearly made known. Small fission weapons may be of decisive importance in peripheral wars.

We fully appreciate the complexities involved in dealing with peripheral wars and the careful and continuing attention being given to it by our military, diplomatic and political authorities. We are convinced, however, that, through a greater application of scientific and technological innovation, major contributions can be made in our approach to this problem. This potential for help has not been adequately exploited. We strongly recommend, therefore, that a study group be appointed to undertake an exhaustive examination of the weapons technology for peripheral wars. Such a technical study might be but a part of a more comprehensive examination of the peripheral war problem.

13. A SENSE OF URGENCY WITHOUT DESPAIR

These considerations and possibilities lead us finally to the conclusion that if we are to preserve a status of superior military strength or even if we are to endure and survive the less favorable state of stalemate we must maintain a strong program in basic science and other policies which help our science to flourish and our technology to be strong. In the long future, the security of our nation may depend upon weapons and methods not now imagined but which could evolve out of a vigorous and creative program in pure science, or in other fields of thought.

While this report deals mainly with technology and its use to prevent or defeat surprise attack, it has been influenced throughout by these additional convictions:

> That survival is not enough; that a state of indefinite insecurity is not enough; that a condition of stalemate is not enough. Instead, the United States has the will and the resources moral, political, economic, and technological to maintain a degree of strength, alertness, and resilience that deters aggressors and that provides the basis for a sense of steady confidence without complacency, a sense of urgency without despair.

We may survive the hazards of the years ahead provided we show the courage, the firmness, and the greatness to stand steady at home and in the contest of ideologies to enlarge and strengthen the free world as a cohesive community of nations.

TOP SECRET

PART II

LIST OF RECOMMENDATIONS

TOP SECRET

LIST OF RECOMMENDATIONS

1. GENERAL RECOMMENDATIONS

We recommend that:

1. After review by the President and the National Security Council of the "Timetable of Change in Our Military Position Relative to Russia," consideration be given to the recommendation in this timetable that an intensive study be undertaken to determine what diplomatic and political policies will be most appropriate during Period II to turn it to our best advantage and to the advantage of the free world. (See pages 10 through 13, Part I.)

2. The National Security Council formally recognize the present Air Force program for the development of an intercontinental ballistic missile as a nationally supported effort of highest priority.

3. Actions be taken to permit the present unacceptable ground vulnerability of the Strategic Air Command to be reduced more rapidly. We recommend, further, that the emergency measures, discussed on page 68 of Part III, be carefully examined by the National Security Council in relation to the immediacy of the threat.

4. The National Security Council examine the specific recommendations we have made for strengthening our continental defenses with a view to incorporating them in an early revision of NSC 5408.

5. The National Security Council examine the technical, procedural and personal links by which early warnings are translated into responsive national action. We recommend, further, that a mechanism be established within the Executive Office of the President for promoting and monitoring the planning and execution of readiness tests.

6. The National Security Council establish policies and take actions which will permit the full exploitation of the intelligence and other advantages which can be made available to us through the establishment of stations on the polar pack ice, particularly on the Eurasian rim.

7. The National Security Council initiate preparatory studies of the problems of international negotiation in the following areas growing out of recommendations of this report:

a. *Atomic Weapons in Air Defense.* Negotiations with Canada to provide our air defense forces with authority to use atomic warheads over Canada.

b. *Extension of the Planned Early Warning Line.* International negotiations for the seaward extension of the Distant Early Warning Line from Greenland via Iceland and the Faroes, to join future NATO warning systems.

c. *Remote Sea Monitor Line.* International negotiations for the installation of a submerged, sea traffic monitor line extending from Greenland to Iceland and to the United Kingdom.

8. A re-examination be made of U.S.-Canadian continental defense relationships with a view toward bringing about still more effective cooperation between the two countries.

9. A re-examination be made of the following principles or practices of international law from the standpoint of recent advances in weapons technology:

a. *Freedom of the Seas.* Radical extension of the "three-mile limit" to permit control of surface and subsurface traffic from the coastline to beyond the likely striking range of sea-launched nuclear missiles.

b. *Freedom of Space.* The present possibility of launching a small artificial satellite into an orbit about the earth presents an early opportunity to establish a precedent for distinguishing between "national air" and "international space," a distinction which could be to our advantage at some future date when we might employ larger satellites for intelligence purposes.

10. An agency be established, or designated, having responsibility for investigating the reliability of the overseas communications networks, and for planning and promoting technical and other improvements needed to achieve a considerable reduction in the vulnerability of our overseas communications.

We recommend, further, that a communications office be established, or designated, having responsibility for the continuous collection and evaluation of information on the current performance of all vital links of the overseas communications networks; and that this, or a related office, have responsibility for coordinating the rapid interchange and rerouting of traffic in the event of widespread interference with our communications.

11. A study group be appointed to undertake an exhaustive examination of the techniques and the weapons technology for peripheral wars. Such a technical study might be but a part of a more comprehensive examination of the peripheral war problem.

12. A study, as a follow-up to this present report, be sponsored by the Executive Office of the President within two years. The technology of national defense is dynamic in nature and requires continual review and evaluation to take into account international and political, as well as technological change.

2. SPECIFIC RECOMMENDATIONS

A. For Still Further Strengthening Our Striking Power, we recommend that:

1. The development of an intercontinental ballistic missile (with about 5500 nautical mile range and megaton warhead) continue to receive the very substantial support necessary to complete it at the earliest possible date.

2. There be developed a ballistic missile (with about 1500 nautical mile range and megaton warhead) for strategic bombardment; both land-basing and ship-basing should be considered.

3. The program for the development of high energy aircraft fuels, and propulsion systems capable of using them, be approved and receive strong support.

4. Supplies of high energy aircraft fuels adequate for development and testing of engines and equipment be manufactured and made available at an early date.

5. The program directed toward development of aircraft nuclear propulsion systems continue to receive strong support and that the program include a propulsion system for bombers.

6. The Strategic Air Command be provided additional bases in numbers sufficient to permit its bombers to be airborne towards target within the warning interval, as well as to limit to a reasonable number the bombers at risk at each base.

7. The new significance of the striking power of small aircraft, which would come with the availability of lightweight megaton bombs in quantity, be taken into account in future planning.

8. The Department of Defense conduct further studies and experimentation to determine the feasibility of a seaplane nuclear bomber force.

9. As a first step in comparing the capabilities and vulnerabilities of the United States and the USSR in a possible nuclear air war, a comprehensive comparison of U.S. and USSR Bravo, Romeo, and Delta target systems be undertaken in the context of a single symmetric study, using common terms of reference and a common framework of analysis.

10. For planning purposes, the maximum yield per weight of nuclear weapons be taken as [redacted]

11. For U.S. defense planning purposes, it be considered technically feasible for the USSR to deliver, by ship or by submarine, very large and heavy, though expensive, bombs having yields up to about [redacted]

12. For U.S. defense planning purposes, it should be considered technically feasible for the USSR to construct, for clandestine introduction into the United States, nuclear bombs having yields as high as megatons.

13. Current studies directed toward better understanding of the radiological hazards that may result from the detonation of large numbers of nuclear weapons be continued.

14. Plans for the military use of nuclear bombs should not at this time be restrained because of the long-term radiological hazard.

B. For Strengthening Our Continental Defense

Recommendations Essentially Covered in NSC 5408 [1]

1. We endorse the planned Distant Early Warning line, including the seaward portions, and urge its installation without delaying for technical or geographic refinements. We recommend early installation of the proposed extension of the North Canada Line to Greenland and shifting of the northern terminus of the Atlantic extension from Newfoundland to Greenland, in accordance with the suggestion of CONAD.

2. We endorse the planned additions of long-range radars and gap-filler radars to the continental United States and Canadian radar nets, including extensions of contiguous radar coverage to seaward (Atlantic and Pacific).

[1] In grouping our recommendations we have considered as incorporated in NSC 5408 those approved programs described in the November 1954 Progress Reports on NSC 5408.

Recommendations for Extending or Changing Emphasis in NSC 5408 [1]

3. We recommend that nuclear warheads be adopted as the major armament for our air defense forces and that this step be implemented by:

a. Expeditious development, procurement, and deployment of sufficient weapons to provide a high kill capability at an early date.

b. Commencement of negotiations with Canada to provide defense forces with authority for instant use of atomic warheads wherever needed over Canada.

c. Use of the high-altitude shot at the next atomic test series as a springboard for a public information program with the dual objective of allaying possible civilian fears and informing our enemies and allies that we are using our atomic capabilities for defensive purposes.

4. We recommend an intensified effort to create effective defenses at low and very high altitudes, and a broadened attack on the basic technical problems involved. Important elements of this program are:

a. Interim rules, pending completion of the warning and continental radar nets, to keep Nike batteries in alert status and free to fire on aircraft above a predetermined altitude.

b. Firm planning for the evolution of a radar net to match the needs and capabilities of the SAGE system.

c. Further development of air-to-air and ground-to-air nuclear weapons.

d. Development of interception systems and tactics specifically for high-altitude combat.

e. A bold attack on the critical problems of fire control and guidance for combat at low altitudes.

f. Accelerated development of specific low-altitude weapon systems.

g. A broad program of research and development in the field of radar.

h. An extensive and realistic study of the technical and tactical innovations needed to fight an air battle in the presence of determined enemy jamming and electronic cover.

i. A greatly enlarged program of field and operational trials and experiments to support the developments and investigations recommended.

5. We recommend that defenses against attack from or over the sea be—in plan, organization, and operation—an integral and coordinate part of the over-all continental defenses; this can be achieved only if the responsibilities, missions, and means now under the authorities of CONAD, CinCLant, and CinCPac are coordinated for joint action.

6. We recommend that programs for submarine detection and surveillance systems be advanced and modified as follows:

[redacted]

[1] In grouping our recommendations we have considered as incorporated in NSC 5408 those approved programs described in the November 1954 Progress Reports on NSC 5408.

7. We recommend that a positive program to invigorate our non-military defenses be instituted by:

a. Immediate initiation by the Federal Civil Defense Administration of a study of the casualties expected from typical thermonuclear attacks under various conditions of evacuation and shelter. This study, which should be made by a group with access to all necessary classified data, should point out at an early date the factors influencing the proper balance between shelters and evacuation and provide data for individual community planning.

b. Prompt formulation of a new national civil defense policy designed to cope with the new threat from thermonuclear weapons and radioactive fall-out from surface bursts.

c. Clear statements of this policy by the President and other high government officials, informing the public of the nature of the threat, the anticipated effects of thermonuclear weapons and the defense measures designed to give all individuals maximum opportunity for survival. These statements should provide the leadership required to give public assurance that, when this policy is implemented, megaton bomb attacks will not produce national collapse.

d. Re-examination and re-statement of the proper relationships that must exist between civil and military authorities in order to cope with the disaster conditions that may follow a large-scale attack.

e. Providing the Federal Civil Defense Administration with authority and the necessary funds to carry out an orderly and continuous research and development program designed to solve its own particular problems.

f. Further attention to measures to reduce the vulnerability of our essential civilian-supporting industries, in addition to those measures now directed toward the dispersion of direct war-supporting industries.

Recommendations Requiring New Action

8. We recommend further development of the warning and surveillance system by:

a. Early installation of a radar line 500 to 700 miles from our continental boundaries to provide the required unmistakable signal of an actual attack and to provide tracking information on which to base deployment of defensive forces. The planned mid-Canada line would furnish the northern element of this line.

b. Extension of the Distant Early Warning line from Greenland via Iceland and the Faroes to join the NATO warning system (virtually non-existent at present) at some point recommended by SHAPE. Long-range, land-based radars should be used wherever possible. They should be installed as soon as feasible, regardless of when other components can become operational. By themselves they could give satisfactory cover, except at low altitudes midway between stations.

c. Consideration of ultimate replacement of the Alaska-Hawaii line by a system of fixed radars along the Aleutians plus an overwater line to Midway. Such a system would increase initial warning and reduce the overwater link.

d. Determination of the effectiveness of Airborne Early Warning planes in trailing unknown aircraft crossing the Distant Early Warning line, as a step toward developing a distant surveillance capability.

e. Experimentation with fixed radars and listening devices and with irregular Airborne Early Warning patrol planes in important areas near the enemy's perimeter, particularly in the neighborhood of his forward launching bases. Should they prove effective, consideration should be given to their permanent adoption in appropriate areas (e.g., in refueling areas)—for intelligence purposes, to give possible early alert of potential attack, and to harass the enemy.

9. To exploit the full potentialities of defense in depth, to protect our peripheral cities, and to minimize the danger from large bombs anywhere within our borders, we recommend continuing outward extension of the combat zone, by:

a. Providing a zone of radar surveillance for about 300 miles beyond the programmed extensions of contiguous radar coverage over the Atlantic and Pacific; this need would be met by the zonal coverage provided by the radar line of recommendation 8a.

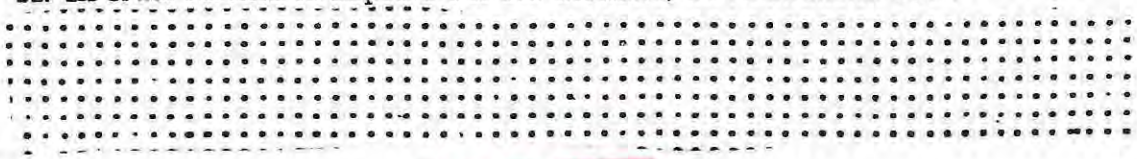
b. Extending prime radar coverage northward to approximately the mid-Canada line and low-altitude coverage (gap fillers) to a distance well beyond the heavily populated regions of Canada; taking steps to enable our interceptors to supplement the Canadian defense forces in this region (i.e., by obtaining the necessary agreements and bases).

c. Exploiting future improvements in interceptor ranges by corresponding extensions to seaward of the full weapons control capability, and of the surveillance-only zone beyond. [Note: Extension of the Atlantic zone may ultimately justify elimination of the Greenland-Azores warning line (recommendation 1), provided the Greenland-Iceland-Europe line (recommendation 8b) has been installed.]

d. Immediate development and installation of effective data processing and transmitting equipment and procedures to integrate overwater surveillance information into a system linked with the land based "ground environment."

10. Drastic revision of the function and traditional form of the interceptor aircraft to conduct effective combat at very high altitudes. We believe that the burden of speed and maneuverability in combat must be shifted to the air-to-air missile, and that the interceptor must become a launching platform having adequate radar and the range and mobility needed to marshal forces against a concentrated attack. We recommend a broad program of study and development to understand and exploit the potential of guided missiles in air-to-air combat.

11. In order further to improve our sea defenses, we recommend that:



[redacted]

12. We recommend that comprehensive programs be instituted to provide effective control of surface and, insofar as possible, subsurface traffic in both oceans from the coast lines to beyond the likely striking range of sea-launched attacks. For proper implementation:

a. International arrangements should be made for the establishment of information reporting procedures and of control measures.

b. Studies should be made of appropriate changes in the concept of the "three-mile limit" to permit actions in keeping with the threat; for realistic implementation of any policy changes, the missions of the Coast Guard and Navy must be amended and forces increased to equal the tasks of inspection and control.

c. Sea traffic plots should be established utilizing modern techniques for correlating, analyzing, storing and displaying traffic information gathered from both military and civilian sources. Traffic patterns as well as individual ship movements should be carefully watched.

d. Maximum utilization should be made of the surface surveillance capability of the seaward components of the air defense radar system.

e. The feasibility of shore-based low-frequency radar for long-range detection and tracking of surface traffic should be vigorously explored and, if warranted, systems should be installed.

13. Although the technical problems that must be solved in attaining a defense against intercontinental ballistic missiles are extremely complex, there are sufficiently promising leads to justify an expanded and accelerated research effort on a broad front. Accordingly, we recommend that there be established a strong, balanced program of theoretical and experimental investigations of the basic problems of detection, interception and destruction. We suggest that the newly established Special Panel of the Air Force Scientific Advisory Board give early consideration to the formation of a full-time technical group to carry out a rapid but thorough examination of the entire problem, with the objective of laying the framework for the expanded program.

14. One important element of defense against ICBM attack—warning in minutes—is attainable. We recommend the immediate initiation of component development, engineering design and planning for the installation of a radar detection system to provide the maximum practicable amount of warning on the approach of ballistic missiles to the United States from likely launching areas.

C. For Improvement and Better Use of Our Intelligence

1. Because we are unable to conclude that the United States surely will, or surely will not, have useful strategic warning in the event of a surprise attack, we recommend that our planning take serious account of both possibilities.

2. The fact that the probability of strategic warning increases with the size of the attack gives added support to the recommendations that our striking forces be further dispersed and that our defenses be strengthened.

3. We *must* find ways to increase the number of hard facts upon which our intelligence estimates are based, to provide better strategic warning, to minimize surprise in the kind of attack, and to reduce the danger of gross overestimation or gross underestimation of the threat. To this end, we recommend adoption of a vigorous program for the extensive use, in many intelligence procedures, of the most advanced knowledge in science and technology.

4. We need to examine intelligence data more broadly, or to invent some new technique, for the discovery of hoaxes. As a first step, we recommend a National Intelligence Estimate, with adequate safeguards, of our success in keeping secret our most useful techniques of intelligence. This estimate would suggest the extent to which an enemy might be manipulating the information obtained through these sources.

5. We require an automatic procedure to lower the security classification of certain information about enemy tactical capabilities and orders-of-battle as war starts.

6. There are generally recognized technical and administrative problems in the field of ELINT (electronic noise listening). This situation urgently needs attention. A combination of technical knowledge and adequate authority at a high level is required.

7. We should at once take steps to develop the special equipment and specialized personnel needed for intelligence operations in the region of the polar pack ice, the largest area contiguous to Russia still accessible to us.

8. Intelligence applications warrant an immediate program leading to very small artificial satellites in orbits around the earth. Construction of large surveillance satellites must wait upon adequate solutions to some extraordinary technical problems in the information gathering and reporting system and its power supply, and should wait upon development of the intercontinental ballistic missile rocket propulsion system. The ultimate objective of research and development on the large satellite should be continuous surveillance that is both extensive and selective and that can give fine-scale detail sufficient for the identification of objects (airplanes, trains, buildings) on the ground.

9. The growing principles and technology of information retrieval will advance and may revolutionize the handling of large masses of intelligence data. Their applications should be sought out more actively.

10. A heavy long-term investment should be made in the preparation of covert agents as eventual sources of high-level intelligence.

D. Through Better and Safer Communications

Overseas communications systems less vulnerable to jamming and sabotage are urgently needed. Without them, messages containing strategic-warning information

may not reach our intelligence centers at a critical time. We recommend the following technical improvements in communications equipment:

1. Immediate steps be taken to insure equipment integrity in the face of possible sabotage.

2. The program for increased transmitter power be given all possible encouragement.

3. Further study in improved antennas be carried on very actively.

4. Consideration be given to the value of adaptation of RCA self-checking code system equipment to military circuits.

5. Tests and other work on the NOMAC system be carried on with highest priority.

6. Further studies of feasibility and usefulness be made of high-speed (Squirt) transmission.

7. Further study be made of multifrequency switching to determine whether such military equipment should be developed.

8. In the design of future equipment, consideration be given to possible use of facsimile in the case of jamming.

9. The services be prepared to use CW (hand code) operations in cases where experienced operators can be provided.

10. Operational tests be made of the communications zone indicator (COZI) system under jamming conditions and, if results prove favorable, that the equipment be added to the communications system.

11. Jamming tests be made at reasonable intervals under conditions that will tax to the limit the ability of those charged with operating the facilities to use evasive techniques, alternate routings, and their operational understanding.

12. Extensive studies and tests be made immediately to determine the jamming characteristics of forward-scatter transmissions and that where it appears effective the services be encouraged to install such systems where geographic conditions permit.

13. Further work on the development of the Janet equipment for meteor-trail transmissions be encouraged.

14. Further study and evaluation of the artificial satellite transmission system be made.

15. The merits of Voice of America point-to-point circuits be studied in detail and, if the results look promising, immediate steps be taken for the implementation of a conversion program.

16. The problem of cable vulnerability be given thorough study in the light of the present political situation and modern technology for mining and cable cutting.

17. Efforts be made to bring to a conclusion present studies to determine:

a. If an old cable between San Francisco and Guam is worth acquiring and rehabilitating.

b. Whether a completely new broad-band cable in the Pacific area should be planned.

E. For Better Maintenance of Equipment, we recommend that:

1. A professional "hard core" military maintenance force for each service be developed of sufficient stability to satisfy future military needs for maintenance personnel.

2. Careful and continuing study be given to the effects of the recently enacted re-enlistment bonus, and, if enacted, of the proposals contained in the President's recent message to Congress to determine whether stronger incentives are required to correct the precarious lack of highly trained maintenance personnel.

3. Greater efforts be made to develop a career motivation for skilled maintenance personnel by providing an organizational environment that recognizes the skill attainments of such personnel and that permits a greater range of promotional opportunities.

4. More attention and emphasis be given to long-range personnel planning in the highly skilled technical manpower areas, and to the impact that planned new weapons systems will have on future requirements for technical maintenance personnel.

5. The specific use of industrial contractors for the maintenance of weapons systems in the ZI and overseas be given more extensive study by the Department of Defense. This requires investigation of the kinds of military operations that can be served through industrial maintenance contracts and of ways in which civilian maintenance can be adapted to the military system, particularly under conditions of emergency.

6. Consideration be given by each service to the organization of a select corps of maintenance personnel willing to serve extensive periods of time in the Arctic area, in anticipation of expanded military operations in that area.

GPO—State Service—3173

TOP SECRET

H-1104

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF DEFENSE MOBILIZATION
WASHINGTON 25, D. C.

May 14, 1956

Dr. Arthur S. Flemming
Director
Office of Defense Mobilization
Washington 25, D. C.

Dear Dr. Flemming:

In accordance with your request, the available members of the Steering Committee of the Technological Capabilities Panel have re-examined the timetable which it presented in its report to the President dated February 14, 1955. In the Introduction to this timetable on page 10 of that report, the Technological Capabilities Panel made the following statement: "This timetable. . .assumes the correctness of the current national intelligence estimates of the corresponding Soviet air atomic power. It is obvious that a serious error in these estimates of Russian capabilities would destroy the foundations on which this timetable is constructed."

The Steering Committee has now examined the timetable in the light of revisions in national intelligence estimates and has concluded that some of the dates given in this timetable as presented in February 1955 are no longer valid today.

Our conclusion is that we are now rapidly approaching the condition, which the Panel hoped we might avoid, described in the timetable as Period 3B.

This period was described in our timetable as follows:

"Deterrent effect of U. S. power dangerously lessened if Soviet production of multimegaton weapons and an adequate conventional delivery capability is achieved prior to the development of an adequate U. S. warning and defense system and before we have achieved a reduction of the vulnerability of our strategic delivery systems. Under these conditions Soviet possession of such weapons and

TOP SECRET

delivery capabilities would place the United States in danger of surprise attack and possible defeat."

In our 1955 report we stated that if this period developed it might come as early as 1958. It is now our conclusion, based upon the new intelligence available to us as of the date of this letter, that this period is approaching earlier than 1958 and indeed may be imminent. To express our conclusion in other terms, the period is rapidly approaching when the Soviets would have the means to carry out a decisive* surprise attack against the United States.

The intelligence estimates which lead us to this conclusion include the following:

1. The latest estimate of the increased amounts of nuclear materials in the Soviet stockpile.

2. The latest estimates of the kinds and numbers of Soviet long-range bombers.

3. Information on the Soviet test on November 22, 1955, of a thermonuclear weapon in the megaton range.

In addition to examining the above estimates, we have noted information which suggests increased Soviet air defense capabilities and evidence of substantial Soviet progress in the development of ballistic missiles. In the field of air defense, the Soviets have made greater progress than we anticipated and the United States slower progress.

In the light of this new intelligence and the consequent revision of our timetable, we urge acceleration of the efforts to reduce the dangers of a surprise attack. We attach especial importance to the protection of our strategic striking forces in view of the heavy dependence which U. S. security must place on an effective retaliation capability. To insure that we move as rapidly as possible through the difficult Period 3B of our timetable, we specifically suggest:

1. Expediting improvements in our radar warning and other components of our air defense system with

---

* Decisive defined as follows: (1) ability to strike back essentially eliminated; or (2) civil, political, or cultural life reduced to a condition of chaos; or both (1) and (2).

special emphasis on improving the performance against high altitude attacks.

2. Expediting the reduction in the vulnerability of the SAC force by improving its local defenses and by reducing the number of aircraft at risk at each base.

3. Continuing and emphatic attention to alertness, not only of our military striking forces and military defensive forces but at all responsible levels of Government (as delineated in our 1955 report), including, especially, accelerated efforts to reduce the reaction time to a surprise attack of the Strategic Air Command and other retaliatory forces.

The major objective of these measures is to protect the SAC structure and to enable the maximum number of its planes to get in the air within the tactical warning time available. In addition, we urge an aggressive continuation of all efforts to increase the probability of obtaining strategic warning of a Soviet surprise attack.

In our judgment, the above recommendations must be implemented if we are to make real progress in adequately reducing the possibility of surprise attack and in developing the ability to withstand one should it come. Without achieving these objectives we face the early possibility of losing our capability for massive retaliation.

Respectfully,

J R Killian, Jr.

J. R. Killian, Jr., Chairman
For the following members:
L. A. DuBridge
M. G. Holloway
J. B. Fisk
J. P. Baxter
L. J. Haworth
E. H. Land
R. C. Sprague, Consultant

~~SECRET~~

THE SECRETARY OF DEFENSE

WASHINGTON

June 14, 1956

Dear Mr. President:

Following our conversation of the letter which Dr. J. R. Killian wrote to Dr. Flemming regarding the views of the Technological Capabilities Panel, we have reviewed the recommendations made by Dr. Killian and his associates.

I am attaching for your information a copy of a memorandum which I have written to the Secretary of the Navy directing certain actions on the part of the Navy, and also a copy of a memorandum from the Secretary of the Air Force to me indicating actions which the Air Force is taking in this area.

I thought these two memorandums would be of interest to you.

With great respect, I am

Faithfully yours,

C. E. Wilson

The President

The White House

D.E.

ack. C.E.W. to Gen. Eisenhower

Attachments

Done by 20 Jun 56

SecDef Cont. No. S-06658

~~SECRET~~

June 2, 1956

MEMORANDUM FOR: The Secretary of the Navy

SUBJECT: Conversions to Radar Pickets

I have carefully considered the memorandum to you from Captain W. F. Bringle dated May 22, 1956. In view of the importance of an early achievement of a satisfactory condition of readiness in our early warning system, this appears to be a sound program to proceed upon without delay.

You are authorized to go ahead with the four radar picket conversions now scheduled for the 1958 program in order to complete them by 1 September 1957 if practicable.

SIGNED
C. E. WILSON

CAR/ab

CONFIDENTIAL

SecDef Cont. No. C-0609

22 May 1956

MEMORANDUM FOR SECRETARY THOMAS

Subject: Conversions to Radar Pickets

1. Admiral Mumma has furnished the following information on the above subject:

There are 16 conversions---4 in the fiscal 1957 program are being converted now and will be completed in March 1957.

There are 8 already completed.

There are 4 in the 1958 program.

The conversion of the 4 in the '57 program and the 4 in the '58 program could be speeded up, but not all to the same degree. Believe all 16 could be completed by 1 September 1957 with a maximum speed up.

The critical part is that some electrical equipment, which would have to be ordered early before the '58 program, would have to have advance authority to start early from the President and the Committees of Congress---pre-committment of '58 program.

Very respectfully,

W. F. BRINGLE
Captain, USN
Naval Aide

3,13,24

25 June 56

SECRET

R&D

DEPARTMENT OF THE AIR FORCE
WASHINGTON

OFFICE OF THE SECRETARY

JUN 6 1956

MEMORANDUM FOR THE SECRETARY OF DEFENSE

SUBJECT: Supplemental Killian Report

We have considered the Supplemental Report which Dr. Killian filed recently, on behalf of his Committee, with Dr. Flemming and have studied our programs with a view to improving them along the lines proposed by Dr. Killian. The points made in the Supplemental Report that are pertinent to the Air Force and our comments are as follows:

1. "Expedite improvements in our radar warning and other components of air defense with special emphasis on performance against high-altitude attack."

The principal points involved are:

a. The improvement of the high altitude capability of our early warning radar.

b. The modernization of our interceptor force with Century series planes of the F-102, F-101B, and F-104 types and new weapons for these interceptors.

c. The completion of our Distant Early Warning system.

As to a, we have re-examined the program for increasing the altitude coverage of the early warning radar in our continental defense system from 45,000 to at least 60,000 feet. This is a complicated program limited in part by technical problems. It would be practicable to authorize a step-up in production, with some increase in costs, to advance the date for the completion of this conversion from October '58 to April '58. We believe that this situation is not as unfavorable as the numbers might imply and that acceleration beyond that indicated would entail costs that are disproportionate to the improvements that could be expected.

SecDef Cont. No. 0759

SECRET

DS 56-2401-A1

334 SAC

P.L. Lyon 14 August

As to b, the acceleration of Century series interceptors, we have recently made moves in this direction which we believe are as far as we should go, particularly in the light of certain technical difficulties that we are now encountering, as for example with the F-101 plane. Except for the possibility of a one-way Bison mission, which we feel is very improbable, our present (pre-Century series) interceptors have the altitude capability to cope with the threat. Our new planes and the missile equipment for them have high-priority and we believe all practicable and justifiable measures for improving the situation are already in the program.

As to c, we are proceeding with all practicable speed with the initial increment of DEW Line and still expect it to be in operation by July 1957. It will be equipped with modern early warning radar with proper altitude coverage. No further acceleration is practicable. The Mid-Canada Line will be completed and in operation by the Canadians probably no later than our DEW Line. It will have adequate although not the best radar coverage.

2. "Decrease vulnerability of SAC bases by local defenses and by dispersion."

As for local defenses, we are considering the alternatives of installing NIKE or TALOS. TALOS is presently programmed for such installation beginning in 1958. This date could be improved time-wise by switching to NIKE but only at the expense of other installations of NIKE. Further consideration should be given to this point.

As for SAC base dispersal, our FY '57 program now provides authorization and funding for the preparation of 11 additional dispersal bases for SAC heavy bombers. This includes 5 provided for in the supplemental budget. We are also asking Congress to authorize 4 more than the 11 so that design work and perhaps some construction may be undertaken during Fiscal Year 1957. We are also proceeding at once with this SAC dispersal base program, seeking in this way to save several months as compared with waiting for the Fiscal Year '57 appropriations. We believe that the above measures provide maximum practicable acceleration of this program.

3. "Alertness."

Alertness is already a cardinal principle in both our Strategic Air Command and our Continental Air Defense Command.

This could, however, be improved by provision of certain additional facilities and other special arrangements. We are now studying these possibilities but have no immediate proposals.

In line with our discussions, we are proceeding with the specific actions to improve the high altitude coverage of our early warning radars and to accelerate the preparation of SAC dispersal bases indicated above. We will also be alert to other possibilities for speed-up along the lines of the Supplemental Report to the extent that further studies may indicate feasibility.

Donald A. Quarles