June 11, 1959

MEMORANDUM FOR RECORD:

Dr. Killian and Dr. Wiesner saw the President on June 3rd. They summarized conclusions reached in three related reviews by panels of the Science Advisory Committee: one on ballistic missile warning systems, a second on the national response to warning, and a third on defense against ballistic missile attack.

The memo which was the basis for the informal report to the President is attached.

A. J. Goodpaster
Brigadier General, USA

~~TOP SECRET~~ ATTACHMENT

J. B. Wiesner/6-3-59

Warning and Defense in the Missile Age

The anticipated inclusion of long-range missiles in the Soviet arsenal will greatly alter the warning and active defense requirements of the United States.

The P.S.A.C. has carried out comprehensive studies of the National needs in these areas and also attempted to judge the potentiality of the various existing programs for satisfying requirements.

We have recently completed three related reviews; one on Ballistic Missile warning systems; one on the National response to warning; and one on the defense against ballistic missile attack.

I would like to anticipate a more complete discussion of the active defense systems with a few remarks which will establish a setting for the discussion of missile warning systems and of associated problem of response to warning.

We do not believe that an active anti-ballistic missile system can be made effective enough against a determined attack to provide significant protection for the civilian population. I will discuss the basis of our position later. We believe that the most significant contribution of active anti-missile defense will be the additional protection it might provide to hardened sites such as missile or bomber bases. It is unlikely that active defenses, even for this purpose, will become available before 1964-65, some time after Soviet intercontinental missiles will have become a very serious threat.

Because of the uncertainty regarding the ultimate capability of active defense systems and their late availability, we must take other measures to insure our security.

A number of things must be done to insure the survival of our deterrent forces, or as a minimum, to permit them to be launched prior to an attack, so that they are not destroyed on the ground.

A number of methods may be employed to protect the retaliatory forces. Among the choices available to us are hardening, dispersal, mobility and rapid response to warning. We believe that these are more certainly effective than active defenses for protection of the retaliatory force. These "passive" tactics are now available, can be implemented to an effective degree relatively soon and can, unless precluded by redundant operational requirements, be more inexpensively effective than active defenses. The Panel believes that these "passive" tactics should be considered as the basic anti-missile defenses for both the aircraft and the missiles of the U.S. retaliatory force. We urge, in the strongest terms, that they be exploited more fully and more rapidly than called for in present plans.

One of the measures for passively defending the retaliatory force -- hardening -- progressively decreases in effectiveness as the aiming accuracy of the attacking ICBM is improved. Therefore, in the long run, active defense, if possible, will become more effective relative to hardening, although not in an absolute sense.

Though our studies have shown the importance of hardening of the retaliatory forces, we will not give attention to the details of this subject in the present report. Our purpose is to review the problems of warning and response to warning. Our recent review has covered both tactical and strategic warning of missile attack. We also examined the response mechanisms to warning and will have some remarks to make about this subject.

First, on tactical warning of an actual ballistic missile attack. We believe that reliable detection of a missile attack can be obtained by a radar system. We are confident that a properly designed electronic warning system can detect any significant attack with sufficiently low probability of false alarm to be a most important component of our deterrent force. The BMEW System, when implemented, will provide this capability. Unfortunately, the BMEW's system was overly elaborate as first planned and was not going to have any capability until late 1960 or early 1961, some time after its need appears to become critical. The Air Force is now re-examining their schedules. We believe that a limited but useful capability could exist early in 1960 if the system were simplified, and furthermore, that the necessary simplifications would not impair the effectiveness of the system. Information from BMEW's not integrated into warning system.

An alternate type of missile warning system using airborne heat detectors appears quite promising and should, if practicable, be used to augment the radar warning system. This system would observe Soviet missiles during their launch phase and consequently will provide a longer warning time than

will the radar system which observes the mid-course of a missile trajectory. It should also be noted that it is practically impossible to spoof this system because it observes the energy radiated during the launch phase of a missile flight and this will be very difficult to imitate.

The usefulness of such warning is often questioned for it is so short, ranging from 10 to 15 minutes to slightly more than half an hour. We believe such warning is vital and when backed with a bomb-alarm system is adequate if proper procedures exist to insure prompt reaction.

A bomb-alarm system which instantaneously and certainly passes the word that a nuclear detonation has occurred is an essential part of any deterrent system which is to have a quick response. Such a system is now being studied by SAC. We believe that the implementation of an effective bomb-alarm system is deserving of high priority.

The bomb-alarm system will function, for it is very unlikely that a major attack employing missiles can be launched in such a manner that most of the targets are hit simultaneously. In fact, it is our judgment that a spread in arrival times of a half-an-hour or more is to be expected. The electronic early warning will provide the information to alert our forces, get SAC alert aircraft into the air, ready missiles, wake up government officials who must authorize a response, etc. The bomb-alarm system, reporting the occurrence of the first explosion will provide the information upon which the decision to respond will have to be based. We shall have more to say about the problems of response to warning later on.

The warning system discussed above will have a different role as time passes In the immediate future it will provide the warning necessary to get the SAC alert force off of the ground; without warning the 15 minute alert concept has little meaning. At a later date it will provide the time necessary to ready our missiles so that they can be fired before they are destroyed. Later when we have hardened, or mobile, quick response missiles of the Polaris or Minuteman type, it will only provide some decision time if that is, in fact, needed.

To summarize:

(1) Electronic warning can be obtained.

(2) It is necessary.

(3) Bomb-Alarm System is also needed.

(4) Both should be speeded up.

As I inferred earlier, the PSAC does not believe that the warning response mechanisms have properly evolved to meet the needs of the missile age. We have recently reviewed the organization and functioning of the National Indicators Center and examined those plans which exist within the Air Force for the use of the warning information discussed earlier, and we believe that the present system and future plans are inadequate in several ways.

The National Indicators Center has the task of watching strategic indicators for information which would alert us of an impending attack prior to an actual penetration of the tactical warning system. The indicators which provide the most useful information at the present time are associated with the Soviet

strategic forces and their air defense system. As time goes on, such information will become harder to get and have less meaning. There are many other kinds of information, now not exploited, which we believe could be obtained.

Other comments regarding the NIC include the following points:

(1) The center does not enjoy adequate priority in the intelligence community to always obtain information it desires, or even to insure its prompt transmission home in competition with administrative communications traffic. Many times information obtained by a particular service or agency is processed and evaluated before it is made available to the NIC.

(2) The Center does not have adequate data processing facilities to insure getting full value from information now collected. The system seems to depend primarily upon the memories of men having area responsibilities.

(3) The functioning of the Center and doctrine for the use of information generated are not adequate to insure any response to a missile attack. We believe that it is necessary to study this problem in detail and to formulate a response doctrine adequate for the missile age and providing alternate procedures for the various conditions which might be encountered. This need exists to insure the effectiveness of both strategic and tactical warning.

Recommendations in Regard to Warning and Response:

(1) Improvements should be made in the handling of strategic indicators including improved communications and data handling. The possibility of getting useful information from a wider range of indicators should be explored.

(2) Steps should be taken to insure that information from the BMEWS is made available to users as fast as electrical communications permit. In particular, direct circuits from the BMEWS installations to SAC strategic government centers should be provided.

(3) A bomb-alarm system should be installed as rapidly as possible. This should be regarded as a matter of highest national urgency.

(4) National policy must be established to insure the prompt and effective utilization of warning information in the missile era.

(5) A primer on warning and response should be prepared to inter-relate types of warning and types of response. Special attention should be given to developing a response doctrine to include various levels and types of response to various kinds of warning information.

The Nike-Zeus system (as are all AICBM systems) is appallingly complex in concept and in required performance criteria. No system which can approach such performance requirements has yet been demonstrated in test or practice. Nevertheless, the Nike Zeus system is founded on sound technological concepts and the Panel has a high regard for the competence of the technical staff developing the Nike-Zeus equipment. The system appears to have been well designed from a data processing point of view, and the discrimination radar has a very good range resolution capability. It appears that the presently conceived Nike-Zeus system can be made to function satisfactorily, in a technical sense, against simple attacks involving no more than very elementary tactics of confusion by an enemy.

Unfortunately sophisticated decoys appear to be quite easy to make and should be anticipated in any estimate of AICBM performance projected for 1964-65, the earliest time when the Nike-Zeus system can be available.

Our own ICBM offensive plans presently include the use of much more sophisticated measures of confusion, multiple warheads and decoy than the Nike-Zeus can cope with in its present concept. We must reasonably expect that the Soviets will employ similar offensive tactics.

In fact, the defense against ICBM's with high yield multiple warheads, employing tactics of confusion and decoy, is a problem which must be faced continuously from now on.

Recent research work appears to offer some hope of providing means for the development of more effective decoy discrimination. It appears possible by radar and optical means to examine the characteristics of the ionization cloud produced when the objects enter the atmosphere and distinguish the lighter ones from those that are heavier. This may make it possible to distinguish real warheads from decoys but obviously will not help against multiple warheads.

The discussions concerning decoy discrimination highlighted the urgency and importance of a well-planned program to examine Soviet nose cones during the re-entry phase. Adequate knowledge of the characteristics of Soviet nose cones and of any Soviet decoys which might be developed may be a decisive factor in our ability to confront the enemy with a potentially effective system. The Panel believes that an observation program, carefully planned to obtain as much useful data as possible, is deserving of a major effort. While conventional radar observations and infra-red photographs are useful, they are insufficient for this purpose. Special instrumentation is required to get much of the information believed to be available during re-entry; however, it appears that such instrumentation can be assembled from components which are now available.

High Altitude Effects

The problems of attenuation and refraction which may result from high altitude nuclear detonations, including those of the Nike-Zeus warhead itself, was considered a serious problem prior to the Hardtack tests. It now appears that the principal effect will be a temporary reduction in the range capability of the 500 mc acquisition radar in the direction of the detonation. The Panel believes that the problems associated with beam refraction and radar clutter, resulting from high altitude nuclear detonation, should receive further study in terms of their effect on the overall system capability.

It is apparent that the effects of large nuclear explosions (1 MT), at very high altitudes (100-1000 km), have not received sufficient study. There is serious concern that the effects of such an explosion might persist for rather long times and could adversely affect the Zeus system performance over an extensive region of space. This problem should receive further theoretical study.

The Panel believes that present efforts to provide a higher frequency transmitter and antenna for the acquisition radar are totally inadequate. Furthermore, we feel that it is within the present state of the art to provide the components for higher frequency operation and that their development should be carried out in parallel with the present 500 mc development. This work should receive sufficient support to permit incorporation of the new,

high-frequency components into the initial Zeus deployment rather than permit the less desirable, low-frequency equipment to go into large-scale production.

Hardening

Although one of the publicized advantages of the Nike-Zeus system is the protection of population centers, as I have already said, the Panel feels that any protection which can be achieved in this way will remain far from adequate to influence, in any serious way, the military policy of a potential attacker. We believe that the effective contribution of Nike-Zeus is to be looked for in the problem of protection of the retaliatory force. Whatever the merit of other possible applications, the presently conceived Nike-Zeus system is of doubtful value for the protection of hardened missile bases. This results largely from the vulnerability of major system components to the effects of near-miss nuclear detonations. It is now estimated that the present Nike-Zeus system can only withstand overpressures of the order of 2 psi. By using multiple antenna installations, this weakness can be overcome to some extent and at considerably additional expense; however, this is a glaring weakness in the system. There is, at the present time, no known way to obtain a really hard antenna system, but this problem is one of sufficient importance to warrant much more attention than it is now receiving. (These comments apply to all of the antennae of the Nike-Zeus, and not to the lens alone.)

The Panel therefore believes it highly desirable to explore all possibilities which may permit the hardening of major Nike-Zeus system components.

We have a somewhat uneasy feeling that there is not enough planning for the future needs in this system. The Panel feels quite strongly that the research programs should be continued and that every effort should be continued to get an experimental system into operation at the earliest possible date. This system should be sufficiently flexible to permit perfection without substantial replacement. At the same time, we urge the initiation of a parallel R&D effort to perfect measures for system hardening, a higher frequency capability for the acquisition radars and an effective capability in the presence of advanced confusion techniques.

We often hear criticism of the Zeus system concept and the proposal that some other arrangement of components would be better. So far there has been no proposal that would not require the development of the very large radars, though possibly in other forms; or the large, high-speed maneuverable missiles planned for Zeus, nor has there appeared a proposal for a system capable of really adequate decoy discrimination.

With the high degree of pessimism the panel shares about the possibility of a highly effective AICBM system based upon the present concepts it is necessary to explain why we believe that the development work should be continued at the present high rate of expenditure, and in fact allowed to increase as planned. Among the most important reasons which, taken together, convince us that the (Nike-Zeus) development must be carried forward are:

(1) The system will be capable of providing some additional protection for hardened sites. For this use it is obviously necessary to provide

antennas and other components much harder than those presently planned.

(2) Active defenses appear to be the only means of achieving some protection for cities against attack by missiles. Without challenging the over-riding importance of protection for the retaliatory force, the Panel notes two circumstances in which protection for cities has value:

(a) The condition in which the Soviets have a superiority in missiles great enough that they can direct up to a few hundred, but not as many as a thousand, missiles at cities in addition to those directed at our retaliatory forces. In this case, active defenses would not contribute to preventing attack, but could nonetheless save many lives.

(b) A situation in which offensive forces were limited by an agreement which is politically and technically enforceable. In this case it is possible to consider building even an active defense system which could not be overwhelmed within the limits of agreed forces.

None of the above circumstances can be ruled out as possibilities for the future.

(3) The components being developed for the Nike-Zeus system could provide the radar intelligence required for a quite different intercept system if new ideas should occur. Furthermore the only hope of solving the extremely difficult problems of ballistic missile interception is to

work at them. In spite of our pessimism we must admit the possibility of a new idea which could change our viewpoint completely. This has certainly happened in the past.

SPECIFIC RECOMMENDATIONS

As a result of our study of the current status of the U.S. anti-ICBM capability, the Panel feels obligated to set down the following General Recommendations:

1. The pursuit of an aggressive program to exploit the tactics of dispersal, hardening, concealment through mobility and quick reaction upon early warning as the basic anti-missile defense of the U.S. retaliatory force.

2. The early initiation of well-designed program to observe Soviet re-entry bodies.

Based upon our examination of the Nike-Zeus program we recommend the following:

1. Continuation of the present research and development program in an effort to get an experimental system into operation at the earliest possible date. (This experimental system should be sufficiently flexible to permit perfection without substantial replacement.)

2. The expenditure of a modest sum (150-200 million dollars) if this sum is, in fact, required for developmental production to retain the presently programmed development schedules.

3. The initiation of a vigorous, parallel research and development effort to achieve: (a) a higher frequency capability for the acquisition radars, (b) an effective means for system hardening, and (c) an

effective system capability in the presence of advanced confusion techniques.

4. Further theoretical investigation of the effects of the very-high-altitude detonation (100-1000 km) of high-yield (greater than 1 MT) nuclear devices on the Nike-Zeus system.