B X

THE PRESIDENT'S SCIENCE ADVISORY COMMITTEE
EXECUTIVE OFFICE BUILDING
WASHINGTON, D.C.

March 13, 1959

REPORT OF THE EARLY WARNING PANEL

The Early Warning Panel of the President's Science Advisory Committee met on March 11 and 12, 1959, to review the status of the BMEWS program and to consider some of the most promising other means for providing warning of ballistic missile attacks. This Panel utilized the services of consultants from Bell Telephone Laboratories, Lincoln Laboratory, the Office of the Secretary of Defense, and Massachusetts Institute of Technology who have been associated with the ballistic missile warning problem over an extended period of time. The Panel examined the various programs, existing and proposed, with two objectives in mind:

1. Recognizing the existing and anticipated Soviet ICBM threat vis-a-vis the vulnerability of the U. S. deterrent force, we believe that, as a matter of national policy, it is imperative that some degree of early warning operational capability be achieved at the earliest possible date.

2. To achieve unequivocal warning of an actual attack, and at the same time avoid the danger of accidents and provide a degree of protection against counter-measures, it is most desirable that the warning system actually consist of a spectrum of systems, complementing one another in technique, space and time.

The currently planned warning system (BMEWS) employs UHF radar exclusively, and is not scheduled to achieve even initial operation until late 1960. We believe it both necessary and possible to have some warning capability in BMEWS as early as January 1960. In addition, we recommend the immediate procurement of a complementing airborne infra-red detection system which can first achieve limited capability in early 1960. The recommendations contained in this paper are based on our considered judgement that the immediate attainment of an early warning capability is vital to our national security and that this requirement alone justifies prompt, vigorous action.

BALLISTIC MISSILE EARLY WARNING SYSTEM

The current status and plans of the BMEWS program were reviewed with representatives of OSD, H. Q. USAF, ADSID, ARDC

BMEWS Project Office, G.E. Co., MITRE Corp., RADC and RCA. Technical, fiscal and scheduling aspects of the proposed installations were discussed in some detail.

It is our opinion that this program could have made substantially more progress in the past and that the possibility of further delay could be avoided by a clarification of the operational objectives and technical characteristics of the overall BMEWS program. In the hope that we might be of assistance in this situation, this Panel has made a number of detailed recommendations concerning the specific radar configurations and components to be employed at the various sites.

We believe that, with the adoption of these recommendations, the effective, early implemtation of BMEWS will depend primarily upon the management proficiency, vigor and determination of the contractor and Air Force personnel charged with the execution of the BMEWS installations.

We therefore recommend that:

(1) The Air Force proceed without delay to obtain a limited BMEWS capability at Site 1 (Thule, Greenland) as soon as feasible. In our opinion such a limited capability, consisting of a minimum of 2 to 4 scanning radar beams

at this site, a local; manual display and simple teletype or telephone communications to the ZI, could be achieved as early as January 1960.

(2) The Air Force proceed without delay to obtain at Site 2 (Clear, Alaska) a limited capability similar to that described above for Site 1 at a time that is substantially in advance of the presently programmed date.

(3) A third site in the U. K. become operational at the earliest possible date.

(4) The primary BMEWS warning capability at each of these three sites be achieved by the use of the AN/FPS-50 scanning radars.

(5) Klystron transmitters (AN/FPT-3) be utilized in all scanning radars.

(6) The development program of the AN/FPS-49 tracking radar be continued, but that no procurement of tracking radars for BMEWS site installation be undertaken.

(7) Steps be taken to simplify the display system proposed for installation at the ZI site.

From our examination of the conduct of the program to date, we feel that the OSD and the USAF should provide more effective management control of the program. The prime contractor should also initiate similar action within his own project organization to accomplish the primary objective of BMEWS, i.e., the early achievement of a capability to alert the U. S. in the event of an imminent mass attack.

U2 INFRA-RED WARNING SYSTEM

A ballistic-missile early-warning system using 50 -100 U2-type aircraft on station in the Artic and equipped with infra-red search equipment has been studied and proposed by the Lockheed Aircraft Corporation. Available infra-red equipment is sufficiently sensitive that its ability to detect missiles prior to burnout is primarily limited by line-of-sight. The proposed system could detect missiles at ranges up to about 1100 miles, i.e., launched from roughly the northern two-thirds of the USSR. The U2-IR system is particularly desirable as a complement to BMEWS because:

(a) An IR system provides an early-warning capability of an essentially different type than that provided by radar. It should, however, be considered a complement, not an

alternate or "back-stop", to BMEWS. IR is a passive system and inherently harder to evade, spoof, or jam. (There is, however, some uncertainty as to the extent to which an IR system can be made insensitive to "natural" confusion such as reflections from the sun, high-altitude jets, etc.)

(b) The U2-IR system could be operational earlier than other proposed IR systems. Lockheed is certain that the first IR-equipped aircraft can be placed in operation within approximately one year, and that the complete system could be operative within two years. Considering the experience which Lockheed has had with this aircraft and its relative simplicity, we believe that these dates are reasonable.

(c) The IR-equipped U2 aircraft is capable of extremely high altitudes (65,000 ft.). Compared with other available aircraft types, this permits a considerable reduction in the number of vehicles required and increases the depth of coverage and freedom from atmospheric difficulties.

(d) The U2-IR system should be relatively inexpensive, both in capital costs (approximately $200 million) and sustaining costs (approximately $50 million/yr.).

We recommend that procurement and installation of the U2-IR system be initiated immediately. Specifically, we suggest that:

(a) In the interests of cost, early installation, and reliability as an early warning system, the equipment should be kept as simple as possible. We do not believe that either a tracking capability, a high-precision navigation system, or a re-entry prediction capability are essential to the early-warning function. Communications equipment should be made as reliable as possible, but development of improved communications equipment should not be permitted to delay an early capability.

(b) Development and test programs should be intensified, particularly with respect to solar difficulties and spectral studies.

(c) Interconnections with BMEWS should be carefully studied, and the installation of the U2-IR system should be planned to complement BMEWS both in coverage and in timing.

BALLISTIC MISSILE EARLY WARNING SYSTEM BY IONOSPHERIC PROPAGATION TECHNIQUES

Utilization of ionospheric propagation techniques for the detection of ballistic missile launchings appears to be of immediate value for intelligence purposes and, with further experience and development, for the warning function. Experimental results, although still incompletely understood, confirm that radio reflections from the ionization columns produced during the launch phase can be obtained through single and multi-hop ionospheric propagation paths. The latter paths are of great interest because they may permit detection at extremely long ground ranges with moderate levels of radiated power.

Together with IR detection methods, the ionospheric propagation techniques offer promise to extend the amount of warning time obtainable in a missile attack to nearly the full flight time of the missiles. However, ionospheric detection techniques can only supplement, not supplant, conventional radar because of the vagaries of ionospheric propagation and the "noisy" nature

of the frequency spectrum involved.

The current level of technical development of the ionospheric propagation detection techniques is about as follows. Observations have been obtained on a considerable number of missile firings. These observations correlate well in time with the firings, although markedly different signal characteristics are found for different detection geometry. The amount of experimental data obtained and the analyses of the conditions of those detections have not been adequate to delineate the full capabilities and limitations of the techniques, nor to adequately explain the basic physical phenomena. There is no doubt, however, that the techniques do work, and that information interpretable as a missile launching can be extracted from the signals received.

Clearly, to make these techniques useful for early warning, intensive work must be done on data processing and signal interpretation, with the objective of attaining an automatic, real-time operation. Until this is achieved, the techniques are limited to intelligence uses where some a-priori information is likely to be available and where the real-time function is not so important.

Much more detection experience is needed in order to answer many questions concerning detection geometry, signal

characteristics, etc. To this end, the establishment of an experimental test facility operating around-the-clock is considered an important next step in developing the prototype equipment for use in a warning net. It appears that it will require about a year of additional experimental and developmental effort before the system engineering of an operational net of stations could be carried out.

MIDAS PROGRAM

ARPA is currently studying an Air Force-Lockheed proposal for the development of a satellite-borne infra-red system to provide warning against ballistic missile attack. Calculations indicate that such infra-red detection systems can detect burning rocket motors at great ranges. There still remain, however, many unanswered questions concerning the effects of cloud cover and atmospheric absorption, the discrimination of high-altitude jet-aircraft targets, electronic reliability, performance of the proposed stabilizing equipment, the design of orbital control equipment, etc., which require further research and development.

It was stated by ARPA that if funds and authorization for the procurement of an operational system were provided now, it could begin to come into operation in the last half of 1960 and be fully completed during the last half of 1962. Such a system would require

at least 20 satellites, randomly disposed in polar orbits, to provide continuous coverage and would cost between $200,000,000 and $600,000,000 per year, depending on the lifetime of the satellites.

The Panel feels that there is insufficient evidence concerning the effective implementation of such a system to justify its construction at this time. Even if the proposed system could become operational on the specified dates, it is not considered a satisfactory substitute for the other measures which we believe must be undertaken at this time. For these reasons, we recommend that the contemplated Phase 1 research and development program be carried out, but that any decision to implement an operational system be deferred for at least one year.

ADDITIONAL CONCEPTS

The Panel also reviewed the proposed concepts of the Sylvania-EDL Project David and concluded that these techniques could not make an appreciable contribution to the early warning program.

Dr. Jerome B. Wiesner, Chairman
Dr. Hans A. Bethe
Dr. William E. Bradley
Dr. Albert G. Hill
Dr. Edward M. Purcell
Dr. Herbert Scoville, Jr.
Early Warning Panel

In addition, the Panel utilized the services of the following consultants:

Dr. Daniel E. Dustin, Lincoln Laboratory
Dr. Brockway McMillan, Bell Telephone Laboratories
Dr. William M. Siebert, Massachusetts Inst. of Technology
Dr. Hector R. Skifter, Department of Defense
Dr. Herbert G. Weiss, Lincoln Laboratory

Committee met on March 11 and 12, 1959, to review the status of the BMEWS program and to consider some of the most promising other means for providing warning of ballistic missile attacks. This Panel utilized the services of consultants from Bell Telephone Laboratories, Lincoln Laboratory, the Office of the Secretary of Defense, and Massachusetts Institute of Technology who have been associated with the ballistic missile warning problem over an extended period of time. The Panel examined the various programs, existing and proposed, with two objectives in mind:

1. Recognizing the existing and anticipated Soviet ICBM threat vis-a-vis the vulnerability of the U. S. deterrent force, we believe that, as a matter of national policy, it is imperative that some degree of early warning operational capability be achieved at the earliest possible date.