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13 NOV 1961

Dear Senator Stennis:

The enclosed paper responds to your letter of 5 October 1961 on the subject of our warning and detection systems. I am sure you will realize that some of the information contained in the enclosure is quite sensitive.

I trust that this information will be helpful in the deliberations of your Preparedness Subcommittee and that you will not hesitate to request any additional information or data which you feel we will be able to provide.

Sincerely,

SIGNED

Robert S. McNamara

Honorable John Stennis
Chairman
Preparedness Investigating
Subcommittee
Committee on Armed Services
United States Senate

Enclosure

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WHEN WITH ATTACHMENTS

SecDef Cont. No. S-1254

FIRST REQUIREMENT (U)

"A description of all existing and proposed detection and warning systems, including the weapons against which they are effective, the amount of warning, expressed both in distance and in time, which they are expected to afford, and other details of their operational capabilities."

RESPONSE (S)

1. Manned bomber detection and warning

a. Existing systems

(1) The Distant Early Warning (DEW) Line was designed to provide warning of potential hostile air breathing vehicles in multiples rather than single penetration.

The DEW Line is composed of three segments: DEW East, DEW Main, and DEW West. DEW East extends approximately 1200 miles eastward from Cape Dyer, Baffin Island, Canada, across Greenland to a communications facility at Keflavik, Iceland. This segment has been in operation since 1 August 1961. The reliability of this segment is approximately 94%. Because of technical unscheduled outages airborne early warning (AEW) aircraft are being employed to fill any gaps that might occur.

DEW Main extends from Cape Lisburne in Northwestern Alaska some 3,000 miles to Cape Dyer, Baffin Island, Canada. It

consists of six main stations, 24 auxiliary stations, and 28 intermediate stations. The intermediate stations serve as transmitters for the aircraft alarm system. DEW Main has exceeded its design capabilities.

DEW West extends westward for 600 miles from King Salmon, Alaska to Nikolski near the middle of the Aleutian Chain. It consists of five auxiliary stations and one main station. There are no intermediate stations in this portion of the line. The capability of this segment is the same as for the DEW Main Section.

The connecting link between the DEW West portion and DEW Main are radars of the Alaskan Aircraft Control and Warning System (AC&W). Data gathered by surveillance radars is forwarded to data centers where it is displayed and processed. A data center performs the function of collecting, displaying, filtering and identifying all airborne objects within its sector. These data centers then transmit the filtered data to user organizations such as NORAD, SAC, the Alaskan Air Command and the Royal Canadian Air Force Air Defence Command.

Warning times in terms of time and distance will vary dependent on the place of penetration and intended target. Assuming penetration of the DEW East portion and target at Dow AFB, Maine, the distance, assuming a direct line of flight, is approximately 1220 nautical miles (NM) which would result in approximately 2 hours of warning. However, if the target is Offutt, AFB, Nebraska, the distance in this

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case is approximately 2280 NM with warning time approximately 3 hours and 50 minutes. Assuming penetration of DEW Main and the target Offutt AFB, the distance would be approximately 1600 NM with a warning time of about 2 hours and 40 minutes. Considering processing, filtering and transmittal times required to effect decision, the above figures must be scaled down and will be slightly less in each case.

(2) The Mid-Canada Line is mentioned here because it is now considered to backup or provide confirmation of DEW Line penetrations. It is Canadian funded and operated.

(3) The Seaward Extensions of the DEW Line extend our coverage in the Pacific to Midway Island, and in the Atlantic to the United Kingdom. In the Atlantic, one Constellation type airborne early warning aircraft, WV-2 is constantly on station between Greenland and Iceland. One destroyer escort radar (DER) is constantly on station between Iceland and United Kingdom. One WV-2 is also on station at random 50% of the time between Iceland and United Kingdom. Plans provide for full time manning of this station during periods of international tension. These stations tie in with shore based radars on Greenland, Iceland, and the United Kingdom.

In the Pacific, an average of 4.5 WV-2's are on station at all times. They fly a race track pattern 1,500 miles long and 100 miles wide. Two DER search and rescue stations are manned at all times. Although not actually part of the system, they participate fully.

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The amount of warning provided by the Atlantic extension expressed in time is approximately 3 hours 20 minutes maximum and 2 hours minimum; for the Pacific extension, this time is approximately 5 hours maximum and 2 hours 50 minutes minimum. The amount of warning expressed in distance is approximately 2,000 NM maximum and 1200 NM minimum for the Atlantic extension; for the Pacific extension this distance is approximately 3,000 NM maximum and 1700 NM minimum. Maximum and minimum times and distances were figured approximately from the farthest and nearest points on the respective extensions to the closest Continental US area and assuming a target speed of 600 knots.

(4) The Contiguous Radar Coverage System provides both early warning and a weapons control capability. This system consists of a series of radars across the entire width of Southern Canada known as the Pinetree Line and the Seaward Extensions. The Seaward Extensions consist of a series of radar ships operated in both the Atlantic and the Pacific to provide a warning of approximately 400-500 miles in distance and 45-55 minutes in time. Airborne early warning aircraft are operated in conjunction with the Seaward Extensions. There are two Texas Tower radars located off the Northeastern Coast of the United States operating as part of the Atlantic Extension.

b. Proposed systems

(1) There is no system proposed or required to replace the manned bomber early warning systems. Air defense studies over

the past several years have indicated that only product improvements of the present warning systems are required.

(2) Continued evaluations to determine the necessity and extent of improvement of the DEW Line are in progress.

2. Missile and space detection and warning

a. Existing systems

(1) Ballistic Missile Early Warning System (BMEWS) consists of a combination of high power long range surveillance and tracking radars designed to detect a mass ballistic missile attack launched on northern approaches to the U.S. and Canada from the USSR.

BMEWS at present will provide from 15 to 25 minutes warning time under the type of attack conditions considered most probable through the 1963 time period. Varying degrees of warning time below these figures are possible as USSR guidance and thrust capability increases.

(2) Space Detection and Tracking System (SPADATS) with its control center located at NORAD is a nontactical system utilizing existing sensors (optical and radar) that are currently in operation in support of other programs. SPADATS consists of the Space Tracking System (SPACE TRACK) and the Space Surveillance System (SPASUR). SPACE TRACK is a combination of strategically located radar and optical sensors. SPASUR is an electronic "fence" stretching from the East to West Coasts. It is capable of detecting earth satellite vehicles passing over the United States and accurately predicting their orbits in real time.

b. Proposed systems

(1) Missile Detection Alarm System (MIDAS) is an infrared detection system with the detection media located in eight satellites on Polar orthogonal orbits 2,000 miles from the earth's surface. The information detected by the satellites is relayed to ground readout stations and then to the tracking and control center where it is processed and supplied to the appropriate users. The initial MIDAS System is being designed to detect missiles with a thrust capability comparable to ICBM. Follow-on improvements may provide a detection capability against intermediate range ballistic missiles (IRBM s) and submarine launched ballistic missiles (SLBM s).

The MIDAS System is now planned to be implemented in July 1964, and would provide warning of a northern approach missile attack from 3 to 5 minutes earlier than BMEWS of the type of a raid considered most probable through 1964. It will work in conjunction with BMEWS thereby increasing not only the period of warning but also the reliability and certainty of warning. Beyond the 1965 time period the MIDAS System should provide warning time varying with the re-entry angle (trajectory) of the missile from minimum time of 12 minutes up to more than one hour for missiles fired over the Southern Hemisphere.

(2) An improved SPADATS is expected to grow into a world-wide surveillance system with real time detection of all space objects presenting a threat to the U.S. The warning time available from the SPADATS System cannot be defined in simple terms.

SECOND REQUIREMENT (U)

"The geographical coverage afforded by each of the systems and, conversely, the areas or directions in which we are without adequate detection coverage. In other words, we desire to develop accurate information regarding the coverage which we have of possible attacks of enemy planes or missiles and any gaps which now exist and which will continue to exist. Obviously, this information should be presented separately with respect to manned bombers and unmanned strategic missiles. It should also include a discussion of the present capability of BMEWS compared with the capability which will exist when the station in England is completed."

RESPONSE (S)

1. The geographical coverage for detection and warning against manned bombers is listed below:

a. The DEW Line consists of a band of rotating radars whose coverage in depth varies from approximately 320 miles for the DEW Main and DEW West segments and 430 miles for DEW East at high altitudes down to approximately 60 miles at 200 feet. This band extends across the rim of the North American Continent from the Eastern part of Greenland to Nikolski on the Aleutian Chain.

b. The Seaward Extension of the DEW Line extends in the Atlantic from Greenland to Iceland to United Kingdom. In the Pacific it extends

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from Umnak, Alaska to Midway Island. The coverage provided by this system averages approximately 300 miles in depth along the extension.

c. The Mid-Canada Line extends completely across Canada generally along the 55 degree parallel, but only provides a coverage of narrow width.

d. The Contiguous Radar Coverage extends around the periphery of the United States. It extends northward through the Pinetree Line into Southern Canada. Coverage from 500 - 90,000 feet exists over flyable terrain. The Seaward Extensions extend this coverage 400-500 miles seaward from south of San Francisco to Vancouver Island in the west and from Boston to Cape Hatteras in the east. One picket ship and one AEW Station are located off the coast of Florida.

2. The geographical coverage for warning and detection against missile and space systems is listed below:

a. Present capability

(1) BMEWS

Site II at Clear, Alaska attained full operational capability as a system in the automatic mode on 30 September. Site I at Thule, Greenland has been in operation more than a year. Site III in England is under construction. The coverage of Sites I and II will provide warning against a mass missile raid launched from estimated Soviet launch areas. This capability is based upon our estimate of Soviet threat which includes operational 6500 NM missiles with entry angles of from 17° through 23°

with the launch sites located in the Central USSR. In January 1962, additional coverage will be provided in the deficient Site III area by the installation of a tracking radar at Thule. This will afford protection of the U.S. for missiles launched above 23° and protection of all Western 2/3 of the U.S. for missiles launched from 15° to 23°.

(2) SPADATS

This system detects, tracks, and maintains and updates a catalog of orbital elements of satellites in orbit. The sensors providing inputs to SPADATS have an overall capability of tracking satellites at ranges of 90 to 2500 miles altitude above 32 degree latitude.

b. Future capability (BMEWS/MIDAS/SPADATS)

In April of 1963, Site III at Fylingdale, England will become operational, thus providing complete coverage of all missiles launched on Northern approaches, from the USSR to the U.S. with re-entry angles between 15° and 60°. It would be possible to penetrate the system below 15° or above 60° or from the south. At present we are looking to MIDAS to provide warning of such attacks; however, should MIDAS prove ineffective, additions to the BMEWS system will be required. Improved SPADATS could possess a world-wide surveillance capability by 1967/68 by the addition of new sensors (radar and optical) and the integration of existing sensors. This program will provide a real time detection capability against all space objects threatening the

continental U.S. Both MIDAS and the improvements to SPADATS are in the development stage. Our detection capability against space objects during the 1963-68 time period will depend upon their degree of success and program approval to achieve a tactical operational capability. In the event the MIDAS development is unsuccessful, alternate action will be required in the BMEWS program to provide for gap fillers and additional sites to provide a detection capability against the southern approach missile.

3. The subject of gaps must be viewed in the light of probable enemy directions of attack. Quite obviously from the foregoing discussion of geographical coverage, we have not covered attacks from the south with an early warning capability. Of the systems discussed, however, we do have solid coverage for the areas specified.

The DEW Line coverage is without gaps against the expected threat. Even at relatively low altitudes, there is sufficient overlap coverage, with due consideration to probable Soviet tactics, to detect an attack. Although it is possible to develop a gap by a number of adjacent stations becoming inoperative, such a situation is not probable. In addition, and should such a situation develop, the Mid-Canada Line would give warning prior to the attack reaching the continental contiguous radar coverage.

A gap in our present posture is the lack of a capability to detect submarine launched ballistic missiles. This gap could continue to exist until about 1965 when follow-on MIDAS improvements or other systems may provide coverage.

THIRD REQUIREMENT (U)

"The fallibility or infallibility of the detection systems, including their susceptibility to being 'spooked' by natural phenomena or jammed by electronic countermeasures."

RESPONSE (S)

1. DEW LINE

The DEW Line was designed to detect a raid, not a single aircraft. In January 1961, an analysis of all tests was made. The analysis pointed out that a raid of ten or more Mach 3 aircraft of a B-70 type at 85,000 feet would produce a raid alarm from the DEW Line. An attack containing approximately one half this many aircraft at 4,000 feet and speed of about Mach 1.0 would also produce an alarm. The analysis also concluded that the DEW Line capability at altitudes up to 120,000 feet is likely to be little different than at 4,000 feet.

It is quite clear that the DEW Line in actual operationexceeds the original design criteria.

Since all radars in the DEW system, except the four in DEW EAST, operate above 1000 megacycles, auroral or solar noise is not considered a problem. However, a fix to counter these natural phenomena for DEW EAST is under consideration. There are no anti-jam fixes on the DEW radars and none contemplated. Jamming would, in itself, provide early warning and would be treated as such in the evaluation.

While it is not impossible for the enemy to end run the DEW Line or the sea extensions, any attempt to do so would impose significant penalties on the enemy.

2. DEW Line Extension

The Seaward Extension of the DEW Line can be alerted by "spooking"* aircraft. It is true that the system can be degraded by electronic countermeasures, but this in itself provides warning as would the sinking of a radar ship. The Atlantic Extension has a raid recognition probability of 99% and the Pacific Extension a probability of 95%.

3. Contiguous Radar

Since the Mid-Canada Line and the Pinetree Line portion of the contiguous radar coverage back up the DEW Line, their relative infallibility should not be considered alone. Quite obviously when added to the coverage of our Northern approaches provided by the DEW Line the relative infallibility of the system increases markedly. The ship-borne radar of the contiguous coverage can be under flown; however, the probability of being undetected is low, for airborne early warning aircraft operated in conjunction with this system provide low altitude cover. The

* "Spooking" is defined as a technique used by forces to make a penetration of an enemy warning screen, and then return without making an attack. The purpose of "spooking" is to degrade the warning system.

Seaward Extensions can be "spooked," but an enemy aircraft within range of the Seaward Extensions would obviously have an attack mission. This contiguous system can be degraded by electronic countermeasures; here again, however, the jamming would in itself provide warning.

4. BMEWS/MIDAS/SPADATS

For BMEWS/MIDAS/SPADATS, we should note that any warning system using radiating sensors can be "spoofed"* or jammed. The general statement can be made, however, that "spoofing" or jamming of the system to the degree necessary to provide the element of surprise by the enemy is extremely difficult. Various methods of jamming can be employed to insert false reports into the system quite easily. These false reports, however, will never get into the alarm level generation cycle unless very sophisticated techniques are used which would create false vectors and activate the alarms. If this were accomplished on a regular schedule, the confidence in the warning data would be degraded severely. During the present time period, we consider it improbable that the Soviets could or would employ these techniques against BMEWS to the extent required to hide a mass attack. We consider them a serious possibility for future use in 1964-65 time period and at present are undertaking

* "Spoofing" is defined as any technique designed to provide misleading information to an electronic system.

improvement programs and ECCM fixes to correct these deficiencies in the BMEWS programs. The complementary role of BMEWS, MIDAS and SPADATS in providing warning of a missile attack further increases the problems for the Soviets to completely negate our warning system by jamming techniques. The existence of jamming of these systems is in itself an indication of possible aggressive intent particularly if applied to all systems simultaneously, the condition which would be required to mask a mass raid.

FOURTH REQUIREMENT (U)

"The prospects of the survival of the systems, including matters relating to hardness, dispersion and redundancy."

RESPONSE (S)

1. DEW Line/Mid-Canada Line

The DEW System and the Mid-Canada Line are not hardened nor are there provisions for protecting operating personnel against fallout. Normal security measures to afford protection against sabotage or other action of this type are in force. In the case of the DEW System, there is overlap radar cover at altitudes of 30,000 and above, so that in the event one radar is rendered inoperative for any reason, there will be only a small gap. The Mid-Canada Line is a double fence of doppler radars, each fence capable of providing warning. The dual fence system

provides redundancy thereby enhancing the detection capability. At each DEW Main and auxiliary station emergency radio facilities are provided, and at all stations disaster radio equipment is located.

Early warning systems are considered dispersed to the degree possible commensurate with their capability to perform the early warning mission. Even though the enemy has the capability to bomb early warning lines, it is considered that he would not choose to reveal his intentions, since it would be construed as a possible attack and much of the element of surprise would be lost.

Should the enemy initiate a surprise attack against the U.S. with nuclear missiles constituting the first strike, only BMEWS type warning would be provided. Under conditions postulated above, analysis indicates that sufficient early warning and communications remain to provide a sound warning system against follow-on manned bomber attacks. The DEW Line and extensions, AEW, gap fillers, and picket vessels of the contiguous cover would survive. This capability should provide a reasonably sound warning system against manned bombers for passive defense measures as well as alert for Continental U.S. defense systems.

2. DEW Line Extension

The prospects of survival of the Seaward Extensions of the DEW Line are extremely high. The aircraft and ships are out of range of

Soviet fighters. The radar ships in the system are vulnerable to enemy submarines. However, backup aircraft are available for the system and could readily replace a destroyed radar ship until the standby ship arrives.

3. Contiguous Radar

The Pinetree Line portion of the contiguous radar coverage is not hardened. The system, however, is considered dispersed to the degree possible commensurate with its capability to perform its mission. The greatest threat, by far, to the survivability of the Seaward Extensions of the contiguous radar coverage is enemy submarines. Here again, airborne early warning aircraft and backup radar ships are readily available as replacements for any destroyed ship.

4. BMEWS

The configuration of BMEWS is such that survivability of the system cannot be guaranteed. Hardening of the BMEW System including communication is impractical. The system is vulnerable to both direct and covert acts which could prevent its detecting a missile attack. A situation of this nature, however, would indicate possible aggressive action and thus provide a degree of warning which combined with other intelligence information could alert our retaliatory forces.

5. MIDAS

The proposed initial MIDAS readout stations will fall in the same survivability category as BMEWS; however, possible expansion

of the system to provide multiple readout stations and satellite to satellite relay of the warning data would increase the survivability. Further, when implemented, MIDAS will enhance and complement BMEWS warning and make the enemy's problem extremely difficult if he desires to negate the capability of both systems to mask a mass raid. The extent of the action required to accomplish this would most certainly indicate aggressive intent.

6. SPADATS

The present SPADAT system is vulnerable. Since it is presently non-tactical, no hardening provisions are incorporated.

FIFTH REQUIREMENT (U)

"The channels through which the warning would have to be forwarded before the order to launch our weapons could be given and executed in the field, and information as to whether the assumed 15 minute warning time would be sufficient for the warning to be transmitted, the command to be given and communicated, and our weapons actually launched before enemy missiles or bombs impact in our territory. Again, this information should be given separately for both enemy bombers and missiles and our own bombers and missiles."

RESPONSE (S)

1. Warning Channels

a. Manned Bomber. The depth of the DEW Line, its seaward extensions, contiguous radars and constant check on operational status give a high probability that an enemy manned bomber force cannot attack our bases with less than 2 to 4 hours warning. This length of time will permit the generation of additional alert forces, the orderly launch of our strategic weapons systems under positive control (with the exception of missiles) and other measures designed to blunt the attack and decrease its effect.

Information on unknown aircraft or targets detected by the BMEWS, DEW Line, its seaward extensions and contiguous radar is fed by teletype to a computer at NORAD/CONAD, which in turn transmits the information simultaneously over teletype data links to the Automatic system displays at NORAD, SAC, the Joint War Room and the Headquarters USAF Command Post, thereby providing a simultaneous visual display of the air defense picture. As the air defense picture develops to indicate an impending threat, NORAD will make appropriate warning declarations to the Joint Chiefs of Staff and all other interested agencies over existing voice circuits and the special purpose teletype alert net.

b. Missile Attack. 15 minutes of warning time of missile attack provided to SAC will permit CINCSAC to launch SAC's ground

alert force under positive control. BMEWS warning is read out directly at SAC and is not dependent upon information from the Joint Chiefs of Staff and/or NORAD.

2. Assumed 15 Minute Warning Time

The time required for decision is the governing factor in a judgment as to whether the assumed 15 minute warning time would be sufficient for the warning to be transmitted, the command to be given and communicated, and our weapons actually launched before enemy missiles or bombs impact in our territory. The receipt by CINCNORAD of unequivocal warning that an attack is taking place on the United States will trigger a declaration of an Air Defense Emergency. This declaration in turn will cause the convening of an emergency telephone conference among the President, the Secretary of Defense, the Joint Chiefs of Staff and the commanders of unified and specified commands. Procedures have been established which enable the President to authorize the launch of our strategic forces and the implementation of war plans by voice notification. The Joint War Room upon direction of the President, the Secretary of Defense or the Joint Chiefs of Staff is prepared to authenticate such instructions by the dispatch of pre-cut messages both by voice and teletype. The voice channels terminating in the Joint War Room are wire circuits, with the exception of the radio link to CINCARIB, and are triplicated. The teletype messages are transmitted through

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the facilities of the Service communications centers which are linked to the Joint War Room by pneumatic tubes. Continual tests and exercise of the procedures for the convening of the emergency conference and the transmission of alerting and emergency messages are held. Assuming no decision delays, voice and teletype communications exist and procedures have been established to relay the execution order to commanders controlling strategic weapons systems in less than 3 minutes. The time remaining of the assumed 15 minute warning time is sufficient to permit launch of all SAC alert aircraft and ATLAS E ICBM's and one third of the ATLAS D ICBM's. This warning time is also sufficient to relay the execution signal to Polaris submarines.

SIXTH REQUIREMENT (U)

"Separately as to our strategic missiles and long-range aircraft, what damage before launch would result under conditions of (a) zero warning, (b) 5-minute warning, (c) 10 minute warning, and (d) 15-minute warning?"

RESPONSE (S)

1. There can be no question that this country must have in being a demonstrated detection capability that will provide the maximum amount of warning to the Strategic Forces in the event of an enemy attack. As you are aware, the present posture maintained by our strategic weapons

systems is based on the BMEWS system providing approximately 20 minutes warning against ICBM attack. Our CONUS based alert forces can react within this warning period. In addition, it is not considered today that the POLARIS submarines, due to their mobility, would be taken under attack in an initial enemy missile strike. It is clear that our second strike philosophy demands that our warning capabilities keep pace with the increasing enemy threat. It is also pointed out that the posture maintained by our strategic forces is not static and is modified to overcome deficiencies in our warning systems. For example, initiation of airborne alert would be indicated if at any time warning is degraded to an unacceptable extent.

2. With respect to your request to be provided specific damage before launch figures for various warning periods, valid estimates of this factor cannot be arrived at when one considers the many and varied assumptions that must be postulated before making damage computations and conclusions. Included among these would be the manner of initiation of war, the tactics and targeting philosophy of the enemy, the availability of strategic warning as a prelude to tactical warning and the enemy's ability and capability to achieve launch coordination which insure simultaneity of impact on all bomber and missile bases both CONUS and overseas, as well as the number of vehicles committed to the enemy initial attack.

SEVENTH REQUIREMENT (U)

"Detailed information as to any systems which are in the research or development stage and which are designed to replace supplement or enhance our present detection systems, including the status of such proposed systems, if any."

RESPONSE (S)

1. There is no system proposed to replace the manned bomber early warning systems. Air defense studies over the past several years have indicated that only product improvement of the present warning systems is required.

2. Continued evaluations to determine the necessity and extent of improvement of the DEW Line are in progress.

3. No future programs exist in the warning area that would replace the BMEWS, MIDAS and SPADATS programs. MIDAS is intended to enhance and complement the present capability inherent in BMEWS by adding confidence to our present missile warning capability. Improved SPADATS will provide greater capability for first pass detection of space objects.

4. Project MADRE, which is still in the research stage, is designed to enhance our present detection systems.

a. MADRE is an over-the-horizon radar. A high power developmental prototype was recently installed at the Chesapeake Bay

Annex of the Naval Research Laboratory and commenced operation in August 1961. Testing of MADRE will be conducted in CY 1962.

5. Studies and exploratory development of other warning systems have been conducted. Some of these offer promise and will be subject to further study.

EIGHTH REQUIREMENT (U)

"In order to be fully responsive to our needs, we should also be furnished with detailed information upon our ability to detect and track enemy submarines, including any systems now in the research and development stage to increase our capability along this line."

RESPONSE (S)

1. Warning of Soviet submarine deployment is derived from intelligence obtained on enemy submarine movements such as port departures, and operational naval intelligence which indicates departure from the normal pattern of enemy submarine operations. This information is obtained by:

a. Our own submarines, operating off submarine points of egress, through their passive detection capability.

b. Aircraft/submarine transit barrier when established in selected areas during periods of tension, and by periodic aircraft surveillance of ocean areas.

c. Anti-submarine Warfare (ASW) type fleet units, when in normal operations at sea (training, backup of SOSUS, investigating intelligence reports of submarine movement, etc.), have a detecting and tracking capability with unit equipment of widely varying degrees. The total detection and tracking capability of ASW forces acting in coordination is greater than the total capability of the units acting separately.

d. The Sound Surveillance System (SOSUS) including its associated investigative forces.

e. Canada and U.S. Communications Instructions for Reporting Vital Intelligence Sightings (CIRVIS) provides reports from commercial and military aircraft, merchant vessels, fishing vessels, government and civilian agencies and other civilian or military observers, land or water-borne.

2. Ocean area surveillance, of which the SOSUS is a major element, will constitute the principal means of detecting the presence of enemy submarines off the U.S. coasts. Through SOSUS alone, the cumulative probability of detection of a single Soviet snorkeling or nuclear powered submarine approaching the United States is relatively high and increases with multiple penetrations. Certain SOSUS modifications now completing research, development, test and evaluation are expected to improve detection ranges; increased detection sensitivity is expected to offset

any attainable quieting of existing Soviet submarines during the same period.

3. Description of SOSUS

a. SOSUS is presently active in the Atlantic and in the Pacific. Each station is the terminal point for bottom-mounted hydrophones on the continental shelf. Stations report targets to evaluation centers at Norfolk and San Francisco, where information from all stations in the net and other intelligence is evaluated and transmitted to CINCNORAD and Fleet commands for follow-up action.

b. Detection ranges vary widely depending on oceanographic conditions, the nature of the target, and its mode of operation. When a target is detected by two or more stations, a cross fix is achieved and the approximate position determined. The number and location of stations impose limitations on this capability.

c. SOSUS is effective against diesel-electric submarines and Soviet nuclear submarines operated in a normal mode. Preliminary estimates of the Soviet "H" class (SSBN type) and "N" class (SSN type) acoustic outputs indicate that these submarines will be liable to detection. No Soviet efforts to reduce underwater noise output are yet apparent.

d. As a passive surveillance system, effectiveness of SOSUS depends on the sound output of the target. As in any military system, accurate knowledge of that system's capability assists the enemy in countering it.

e. No fixed large-area underwater surveillance system other than the extended SOSUS will be operationally significant by 1967, and it is doubtful that any other such system will be effective by 1971.

f. Immediate technical improvements being incorporated into existing SOSUS include:

(1) Digital spectrum analyzing equipment to increase range approximately 50%.

(2) Array correlators to improve bearing accuracy, classification and effective sensitivity of arrays.

(3) Curved arrays to provide omni-directional coverage for all future installations.

g. Research and development in ocean surveillance is centered in Project Trident. The initial effort of Project Trident is to search for systems, or combinations of sub-systems (fixed, portable, mobile, active and passive acoustic; non-acoustic), which can best meet underwater surveillance requirements.

h. Project Artemis is an applied research program to determine the feasibility of very long range ocean surveillance by low frequency active acoustic means.

4. Other Detection and Tracking Systems

a. ASW type ships, surface and undersea, and aircraft in transit, training or in fleet exercises contribute to the overall

detection capability and, though substantial, this contribution cannot be estimated. The coordination of all ASW information at three Net Control Stations, Atlantic, Eastern Pacific and Western Pacific, permits the most effective use of available forces.

b. Aircraft, ships and submarines have limited range capability vis a vis SOSUS for detection of snorkeling and submerged submarines. Mobility of these forces permits selected areas to be placed under surveillance. U.S. Forces available for surveillance of ocean areas as well as tracking and containment, consist of the following:

9 ASW Carriers with 360 aircraft

306 Escorts (DD/DDE/DE)

102 Anti-Submarine Submarines

130 Short Range Land Based ASW Aircraft

308 Long Range Land Based ASW Aircraft

77 ASW Seaplanes

c. Active research and development programs can be expected to improve the detection and tracking capabilities of the mobile ASW forces. Among those programs are:

(1) AN/SQS-26, sonar for surface ships increases active detection range. Operational date CY 1962.

(2) AN/BQQ-2, integrated sonar for submarines which increases active/passive ranges. Operational date CY 1962.

(3) Continued investigation of non-acoustic phenomena is expected to lead to improvements in air surveillance techniques in the 1965-1970 period.

(4) The deep operating submarine will optimize detection for both active and passive sonars. Planned operational date is 1965.

(3) Continued investigation of non-acoustic phenomena is expected to lead to improvements in air surveillance techniques in the 1965-1970 period.

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