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AIR DEFENSE

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26 July 1954

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William J. Cain Jr.
WILLIAM J. CAIN, JR.
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The conclusions and recommendations set forth in the seminar solutions included in this study history file are those of the students and do not necessarily represent the official views of the Air War College.

FOR THE COMMANDANT:

John W. Garrett
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AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

CLASS 54

STUDY No. 6

AIR DEFENSE

CONTENTS

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Col. Kruzel
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SOLUTIONS SEMINAR NO. 1

A

Air University
AIR WAR COLLEGE
Maxwell Air Force Base
Alabama

9 August 1954
Date Submitted

STUDY NO. 1954-6

SEMINAR NO. 1

(Scheduled dates 4 Jan - 30 Jan 54**)**

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SEMINAR MEMBERS:

1. Colonel Kelly
2. Colonel Rockwood
3. Colonel Dunham
4. Colonel Nagle
5. Colonel Sullivan
6. Colonel W. T. Smith
7. W/Cmdr. Poole
8. Colonel Skeldon

Colonel Walker

STATEMENT OF THE PROBLEM:

In general terms, analyze the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

SPECIAL PROBLEM OF STUDY TREATED:

Instructor's Signature
SHANNON CHRISTIAN
Colonel, USAF
Study Director

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SEMINAR SOLUTION

STUDY NO. 6

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Col. Skeldon

MAXWELL AIR FORCE BASE, ALABAMA

25 January 1954

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AIR DEFENSE

PURPOSE

a. To analyze the development and deployment of Air Defense forces as programmed for 1957.

b. To identify the factors considered in this analysis.

c. To set forth specific changes in the program recommended and the justification therefor.

SCOPE

Evaluation of the forces available and their deployment for air defense of the United States in 1957 from the standpoint of the Air Defense Commander and <u>within</u> the limits of national policy, national strategy, budgetary authorizations and technological capabilities.

BACKGROUND INFORMATION

Historically, the geographical position of the United States has permitted homeland immunity to rest securely in the isolation provided by two great oceans and the domination of these oceans by, first the British and then our own, Navies.

Although the growing range of airpower decreased somewhat, this security, the Allied victory in World War II, our atomic monopoly and the prostration of our enemies seemed to more than compensate for this diminished isolation.

In the face of this and our hasty and indiscriminate demobilization of the greatest military force the world has ever known, little, if any, consideration was given to the necessity of continental defense. What we could consider an air defense force was merely an element of the Tactical

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Air Force, designed primarily for the protection of ground forces and air bases in a theater of operations.

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The aggressive development of the Soviet Union's foreign policy along a course directly inimical to our national interests, a gradual realization of all, the unexpectedly prompt attainment by the Soviet Union of atomic capability, quickly convinced our leaders that more consideration must be given to continental US defenses.

This was not a reversal of Air Force concept that the role of air power is primarily offensive. However, it was realized that even though we had the capability to destroy an enemy's war-making ability, our national policy of not striking first might result in our receiving a fatal blow before we could mount our own attack. Moreover, with the enemy having the advantage of surprise and knowing our offensive capability, it was probable that immobilization or destruction of our striking force would be the first priority objective.

These basic considerations led to the constitution of the Air Defense Command as a major command charged with the mission of defending the US from hostile action. The current defense concept evolved as a result of several factors.

Strategically it became necessary to determine those targets and combinations of targets, the protection of which was imperative. From the tactical standpoint the functions of the defense force could be divided into four elements; namely: detection, identification, interception and destruction. This division is an arbitrary one and since the functions are not mutually exclusive, force deployment must be based on the interrelationship of target disposition and the achievement of greatest effectiveness of the defense functions within the limitations of available weapons.

While greater emphasis has been placed on Air Defense than in the early post World War II days, the Air Force has consistently held to its basic doctrine that only the offensive power of Air is decisive in modern warfare. There is general agreement, within the Air Force at least, that additional defense, purchased at the expense of offensive striking power may be suicidal in this era of thermonuclear warfare. In the absence of a perfect defense and with the possibility that a comparatively few successfully delivered weapons could, conceivably, destroy our war-making capability and will to resist, the major deterrent to enemy action lies in the offensive might of the strategic air arm.

ANALYSIS OF ADC CONCEPT AND DEPLOYMENT

With the foregoing considerations underlying the developmental pattern, ADC, today, is a system based on an island and area type of defense as opposed to a "wall" or perimeter concept. Moreover it is geared for action on the premise that the first warning of impending attack will be generated within the system itself.

The following factors govern the deployment of air defense forces according to Major General F. H. Smith, in his AU Quarterly articles:

1. The basic consideration is the ability to destroy the enemy bombers before they reach their bomb release line.
2. Forces should be disposed so that initial interception is as far out as possible and attacking interceptors may fight the enemy all the way to the target.
3. Forces should be concentrated along enemy approach lines, if possible.
4. The importance of the defended target complex will affect allocation of fighters and anti-aircraft dispositions.
5. Effective use must be made of the various types of equipments available.
6. The relative kill effectiveness of fighters vs. bombers determines the size of the fighter forces required.

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General Chidlaw, in his address to the Air War College on 11 January 1954, added two factors which he enumerated as follows:

1. The economic facts of life prevent an entire perimeter defense of the 3,000,000 square miles of the continental US.
2. Control of the air battle must be decentralized to permit rapid threat evaluation and dispatch of defense forces.

This seminar understands the problems of an Air Defense Commander faced with the limitation imposed by "first warning of impending attack" being generated by the Air defense system itself, and no issue is taken with the factors listed by the Commander and Deputy Commander of ADC. However we are of the opinion that at least two other factors merit consideration and emphasis; namely

1. The nature of the threat; that is enemy capability, and
2. The location of augmentation forces within the US.

In its study, "Cost and Effectiveness....." ADC credits the enemy with an air delivery capability in 1957 which exceeds USAF Intelligence estimates and our judgment based on the reported strength of the Soviet Long Range Air Forces today. For example, ADC credits the Soviet Union with 1150 medium and heavy jet bombers in 1957 while according to best available estimates their present strength does not exceed some 30 medium jets of the B-47 type. In the light of experience, an achievement of these proportions would be far in excess of US capability. Even acknowledging the ability of the USSR to concentrate all productive efforts on items of top priority, and, for the sake of the argument, crediting the Soviet with technological skill, experience and an industrial base equal to our own, an advance of this magnitude is not credible. For this reason, we believe that a Soviet attack would be predominantly TU-4 type aircraft with smaller numbers of Type 31 and medium jet bombers. On the other hand, the seminar

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accepts the general development of the active Air Defense Forces but retains a mental reservation that portions of it seem to be optimistic; i.e, inclusion of 12 full squadrons of combat-ready F-102's by July '57, completely armed with Falcon missiles and two Bomarc squadrons.

In other respects the hypothetical attack plan as established by ADC is accepted. Based upon these considerations, the following criticisms of the proposed ADC deployment are offered:

A. ADC assumes that in 1957 radar coverage will be adequate to prevent tactical surprise and that the enemy attack will be aimed primarily at industrial and population centers rather than against the SAC striking force and the personnel of the ADC installations. No redeployment of ADC active forces is made on the basis of this assumption. In our opinion, if this assumption is valid, defensive forces within the resources of ADC could be allocated to the industrial and population target complexes of the Northeast, Northwest and Southwest.

B. The current and contemplated geographic locations of augmentation forces, with their aircraft inventory in excess of ADC itself, apparently has not been taken into consideration by ADC in its own force deployment. These forces which are stationed predominantly in the south central portion of the US could be considered available for area defense even though they would be, to great extent, of the day fighter category. On the premise of the reduced range capability which we believe valid, enemy bombers could not enter from south to north through our southern flank. In effect, then, the augmentation forces charged with the defense of this area would be a "backup" to the coastal and Northern boundary ADC forces.

C. ADC continues to consider four fighters per enemy bomber the optimum ratio despite the increased kill probability which may reasonably be expected of FALCON armed fighters. While this 4:1 ratio was reasonable by World War II standards, it is now considered unrealistically high. No weight has been placed by ADC on the possible advent of atomic explosives for accomplishment of the Air Defense mission. Given the proper priority, it would appear that the atomic stockpile would support the development of a capability to deliver atomic explosives against bomber formations by 1957. Further, the fighter kill effectiveness would be increased by the development of a lightweight, high yield weapon which would permit a load of two per interceptor. This would permit each interceptor to launch two strikes per sortie. Giving the defense force an atomic capability, in addition to improving its kill effectiveness, has the additional merit of spreading enemy formations, thereby decreasing the possibilities of saturating the functions of defense.

D. ADC violates its own principle of "most effective use of various types of equipment" in stationing F-89D fighters on the northern boundary while leaving a number of squadrons of F-86D aircraft in southern locations, since the former are not effective against bombers of the 50,000 feet - 500 knot class. Again as in B above, if the reduced range capability and reduced number of enemy jets assumed by the seminar is valid, it would appear reasonable to move the F-86D aircraft to the north and replace them in the southern locations with the less effective F-89D.

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CONCLUSIONS AND RECOMMENDATIONS CONFIDENTIAL

1. The kill probability achieved by ADC in its hypothetical attacks is unacceptable. Even assuming less enemy capability and greater defense effectiveness on the basis of the points on which we have taken issue with ADC, we feel that an acceptable kill probability would not be obtained. Moreover it is our opinion that if the US continues to accept the premise of not striking first, we have reached or are approaching a point of diminishing returns beyond which even greater expenditures of resources and skills will not obtain proportionately greater results. We recommend continued exploration of all possible avenues that may offer a more effective defense of the North American continent.

2. It is recommended that high priority be given to the development of atomic weapons capable of delivery against bomber formations by interceptors and missiles.

3. For the purpose of extending the area of interception and destruction beyond the boundaries of the US and the populated areas of Canada, we recommended that the EW (MacGill) line be augmented by appropriately positioned fighter aircraft and/or guided missiles.

4. No recommendation has been made by ADC for a unified North American Defense Command. It is our opinion that the over-all effectiveness of the entire system would be enhanced considerably if the defense forces of AAC, NEAC, Canada and ADC were placed under the control of a single commander and that commander was charged with the over-all defense mission. Despite the political implications of this proposal, we consider it of such importance that we recommend that all necessary action to achieve this goal be taken without further delay.

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5. In our opinion implementation of the DEW (Lincoln) line should at least be delayed until after completion and evaluation of the MacGill line and its seaward extensions. The small increase in kill probability acquired (2%) together with the inherent logistical difficulties of supporting this DEW line warrant further feasibility studies. In the meanwhile we feel that more positive long range results can be obtained from diverting the programmed $247,000,000 initial outlay to research and development on improvement of Early Warning Radar, better IFF equipment and improved ECM equipment and techniques.

While the following recommendations are outside the scope of the problem presented, in view of the unanimity of opinion of the seminar, their inclusion herein is not considered inappropriate.

a. Maximum emphasis should be placed upon expanding and improving existing intelligence collection and processing facilities for the purpose of obtaining more, better and more timely intelligence in order to provide the earliest possible warning of enemy intentions and capabilities as well as of attack.

b. There is an apparent conviction on the part of many of our responsible government officials that the American public will never support a policy that would permit us to strike first. Therefore we must resign ourselves to receiving and hoping to absorb the first blow without irretrievable damage. This attitude should be reviewed realistically. Coupled with the preceding recommendation relative to achieving reasonably reliable and timely intelligence of impending attack it is our belief that the US citizenry and probably the free world would dynamically support a national policy of striking the enemy first when all our indicators point to early enemy aggression. As an interim measure we should at least cease to proclaim on any and all occasions that our head is on the chopping block and that we hope that our turn will come later. This possible denial to the Soviet of the initiative, together with our ever mounting offensive capability, might introduce an additional variable into the mathematics of aggression against the United States.

SOLUTIONS SEMINAR NO. 2

AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
Date Submitted

STUDY NO. 1954-6 SEMINAR NO. 2

(Scheduled dates 4 Jan - 30 Jan 54)

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SEMINAR MEMBERS:

1. Col Arnold
2. Col Dougan
3. Col Lay
4. Col McNickle
5. Col Rehmann
6. Col Spicer
7. Col A. H. Wilson
8. Mr. Graham

Col Wallace

STATEMENT OF THE PROBLEM:

In general terms, analyze the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

SPECIAL PROBLEM OF STUDY TREATED:

Instructor's Signature
SHANNON CHRISTIAN
Colonel, USAF
Study Director

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SEMINAR SOLUTION

STUDY NO. 6

SEMINAR NO. 2

SEMINAR CHAIRMAN: Col. Greening

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MAXWELL AIR FORCE BASE, ALABAMA

25 January 1954

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I. OBJECTIVE

The objective of this study is to analyze development and deployment of the United States Air Defense forces as programmed for 1957 with the view towards making recommendations for improvement.

II. INTRODUCTION

The contents of this study have been necessarily confined by several limitations, primarily that the analysis has been conducted in general terms to provide general recommendations for improved U. S. military defense in keeping with technological developments of the recognizable future. These recommendations are intended for an effectiveness date of 1957. Canada, Alaska, NEAC and the sea approaches to the United States provide limitations geographically. It must be assumed the economic conditions within the United States dictate limitations of a nature that will not allow resources in excess of those utilized for the planning period up to 1957 as found in current documents. Inasmuch as the problem of resources will be limited to the United States, recommendations for forces will likewise be limited to those of the active United States forces.

In discussing factors affecting these recommendations, four questions are introduced upon which the logic depends. If all questions could be answered accurately and in detail, the course of action for the United States to follow would be much easier to determine. The first question that arises is. "What are the intentions of the Soviets?" Admittedly, this question is the most difficult to answer and one that

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would provide guidance of the highest possible value. The answer must necessarily be assumed with as much weight given to favor the USSR as possible in order to avoid underestimating them. The second question is: "What are the Soviet capabilities with regard to military conquest of the United States and the free world?" Where capabilities can be measured in hardware and "know how" again we must assume the Russians possess the highest amounts and degrees published in our intelligence estimates. Even these are not to be relied upon due to the high degree of security employed by the USSR and the free world inability to penetrate their security defenses. It is well recognized that accurate determination of the adversary's capabilities often provides excellent indications of intentions. Likewise, intentions affect a national effort towards capabilities.

The third question concerns the "U. S. national defense policies." The fourth question concerns our "U. S. capabilities." Where these two questions are closely related and are inter-supporting, they must be answered accurately for the purposes of understanding. Following this understanding, recommendations become more apparent. The four functions of active air defense must be constantly examined in light of making recommendations. These functions are. (1) detection; (2) identification; (3) interception; and (4) destruction.

III. SOVIET INTENTIONS

A. Russia hostile

We see no evidence that the ideological dynamism of the Soviet leadership is diminishing and we believe that Communist rulers still

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believe that permanent hostility exists between the Communists and the free world. Their basic objectives, therefore, continue to be an expansion of their own sphere of power and the eventual domination of the non-Communist world. We believe these basic objectives will remain unchanged, at least through 1957.

B. Communist Principles

Basic Communist principles, reaffirmed at the 19th Party Congress in October 1952 and since Stalin's death, hold that the struggle will continue through a whole historical epoch, with historical forces working inevitably to favor the increase of Communist and the decline of "capitalist" powers. Another Communist principle is that the form of the global struggle is not necessarily military, except possibly in its final and cataclysmic stage. Communist strategy has been, therefore, to increase its own economic and military potential while simultaneously attempting to reduce non-Communist power by political warfare against non-Communist states.

C. USSR Conditions for Starting War with U. S.

From these considerations it appears the Kremlin would not deliberately initiate general war or launch a surprise attack on the U. S. unless it became convinced that. (a) Soviet bloc forces had a decisive superiority, insuring an early and decisive victory; (b) war was in any case imminent and it wished to have the advantage of the initial assault; or (c) the Western powers were so growing in strength as to eventually place the USSR in a position where it would have to

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retreat from vital positions or accept general war under extremely disadvantageous conditions.

D. <u>Possibility of War to 1957</u>

We do not believe that the Kremlin will reach any of these conclusions between the present and 1957. The Soviet strategic air capability is increasing and may soon reach the theoretical capability of destroying the will and ability of the U. S. to resist in a single surprise attack. However, we believe that through 1957 at least, Soviet leaders will continue to consider an attack on the U. S. a hazardous gamble, involving the possibility of early detection, operational failures, strong retaliation and the possible destruction of the Soviet system itself. We therefore believe it unlikely that the Kremlin will deliberately initiate general war, at least through 1957.

E. <u>War by Accident</u>

It is always possible, however, that the Kremlin, through miscalculation, might adopt some course of action which would force a strong Western counter-action. This strong Western counter-action might lead the USSR to feel general war was inevitable within a short time as hostilities spread from the initial point. In this case, they might decide that a direct, surprise attack on the U. S. was preferable to retreat and settlement of the local action.

F. <u>How Soviet Intentions Bear on U. S. Air Defense Problem</u>

On the basis of the above discussion of Soviet intentions, we have derived the following considerations bearing on the U. S. Air Defense program.

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1. A surprise attack on the U. S. is unlikely through 1957, but only if U. S. military strength, including Air Defense, is maintained at a level to make Soviet leaders feel a surprise attack would be hazardous or uncertain in its results.

2. If the U. S. intends to pursue a "strong" foreign policy involving political-military pressures on the Soviet bloc of a nature which might threaten control over vital areas of the Soviet bloc, the danger of a surprise attack on the U. S. would increase. As a corollary to this view, we believe a strong air defense is an essential element of U. S. power in the pursuit of a strong foreign policy. Unless our air defense is capable of insuring the survival of our strategic air power and in protecting vital industrial centers, our government will be subject to Soviet atomic bluff or threats.

3. Since the threat of a surprise Soviet attack does not appear imminent, and since Soviet capabilities to knock out the U. S. in a single surprise blow will remain limited through 1957, the U. S. appears justified in planning its air defense on the basis of future maximum effectiveness and not on a "crash" basis with currently available equipment and systems. However, this consideration might be outweighed by policy decisions discussed in 'B' above.

IV. SOVIET CAPABILITIES 1954-57

A. Aircraft

Aircraft with which the USSR can launch an air offensive against the U. S. homeland are in being and will increase in both

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quality and quantity during the period 1954-57. As time advances, she will also secure an increasing capability to more successfully launch an air attack due to extending range, increasing speeds and improving combat crew quality by virtue of additional training. The primary type of long-range aircraft available to her will be the TU-4. The current Soviet inventory is estimated to be 915 TU-4s in active units with an estimated TO&E authorized strength of approximately 1,220 toward which she is building her long-range aviation force. By an extensive maintenance stand-down, she is credited with having an operational capability of 90 per cent in active units or 825 aircraft available for a maximum effort for one strike. With little more than routine operational maintenance she could probably provide a force of 50 per cent of these aircraft or approximately 455. As time goes on she will no doubt increase her TU-4 force nearer to authorized strength and augment this force with small numbers of heavy bombers of the Type 31 turboprop category. Further, it is estimated that she will also add small numbers of medium turbojet bombers, although intelligence on this type is seriously lacking.

B. Ranges

At present, the Soviet long-range bomber aircraft and missile ranges are sufficient under average conditions to constitute a serious threat to bombing all major target areas in the continental U. S. During the 1954-57 time period, these ranges will no doubt be further extended by refinements in refueling, cruise control, crew training, etc., to provide greater flexibility of operation. In addition, various other refinements will probably be made to permit operation at higher altitudes, greater speeds and an increased ECM capability to reduce kill probability and to permit more foolproof bombing techniques and greater accuracy. USSR bomber aircraft NM ranges at present are estimated to be approximately:

Type	Normal No/IFR	Normal w/one IFR	Optimum Flt. Profile (no/IFR)	Optimum Flt. Profile (w/one IFR)
TU-4	3300 NM	4400 NM	3900 NM	5200 NM
Type 31	6000 NM	10,000 NM	-	-
Med.Jet	3400 NM	**4150 NM**	-	-

The optimum flight profiles referred to for the TU-4 incorporate removal of all turrets except in the tail position and adding 10,000 pounds of fuel. It is further estimated that a completely modified configuration could provide a range of 5,000 NM without IFR and with one IFR a range of 6,800 NM. This complete modification will include stripping of excess equipment, installation of torque meters on all engines, engine cylinder modification, installation of special bomb bay tanks, use of extremely accurate fuel metering and recording equipment. In addition, all crews would require training to the level of lead crews. Further, although no intelligence is available to indicate an IFR capability, the Soviets have had access to knowledge of the refueling techniques and equipment. Therefore, it would be serious to overlook or discount that potential capability. The only estimated serious two-way threat is the Type 31; however, it is believed to be limited in numbers during the period of 1954-57.

Soviet submarine-launched missiles and airplanes are estimated to be theoretically capable of the following ranges.

Type	Range
V-1	200 NM
Turbojet missile	500 NM
Jet airplane	1000 NM
V-2	190-280 NM

C. Bases

It appears feasible that Soviet bomber strikes could be launched without serious problems from the presently available bases. The areas for effective launching of missiles from submarines are anywhere off the coastal and gulf areas of the U. S. within range of the missile being launched. Here the main problem is in properly positioning the submarine to prevent detection by U. S. defenses and ocean going vessels.

D. Routes

Probable approach routes of Soviet bombers are generally of three types. It is estimated that they will approach directly over Canada, passing near to the polar region, via dog-leg courses for the majority of the distance over water to avoid detection until the last possible moment, or a combination of both of the above. As stated earlier, they are estimated to have range capability for either type of approach, particularly if they are able to conduct successful refueling operations. Approaches directly over northern North America, while lending the advantage of shorter distances, are characterized by earlier penetrations of our EW system, thus permitting longer periods of surveillance by our

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defenses prior to BRL. The approaches over water would be considerably greater in distance flown prior to reaching the BRL but would have the distinct advantage of avoiding detection until approaching the target areas, particularly those adjacent to the coastal areas. Approach routes for submarines with missile-launching capabilities would be from the Murmansk, Baltic Sea and Eastern Siberian coastal areas across the Atlantic and Pacific Oceans, respectively, to waters adjacent to our east and west coasts and Gulf of Mexico. Their main difficulty here would be moving and positioning a sizeable number of these carriers without being detected.

a. Armament

The air-delivered weapons which can be expected to be available to the Soviets by 1957 include all World War II types, fission and fusion bombs, bacteriological agents, chemical agents of the G-series, and possibly radiological contaminants. Current Soviet research and technology demonstrate an ability to package any of the mass-destruction items into cases whose gross weight and dimensions will be compatible with the capabilities of aircraft available. Estimates of current production of fissionable material indicate that stockpiles of mass-destruction weapons will be sufficient from 1954 on to exceed that necessary to produce critical destruction of the military and industrial capability and recuperability of the U. S. In essence, the Soviet problem of weapons (aside from the ability to deliver them on target) to defeat the U. S. has been solved as of 1954.

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F. Other Weapons

Supplementary to the above capability, the USSR is known to be developing a submarine-launched missile of the V-1 type. Here also intelligence is seriously lacking, but the capability cannot be discounted entirely as she has been receiving help from German scientists and Soviet submarines have been sighted with a deck capsule. The submarine itself is not a threat to the air defense of the U. S. However, when it is the launching platform for a surface-to-surface missile which can strike coastal target areas it becomes a definite and serious threat. Forty-one major targets out of the Summer Studies Group listing of targets for the first 100 enemy nuclear weapons lie within current ranges of V-1 type missiles launched from submarines which have penetrated the ASW screens at sea. The submarine-launched V-2, the turbojet missile, and the jet airplane are all possibilities of a threat; however, they are considered quite remote in the near future when compared to the V-1 type missile, which is indicated to be in a more advanced stage of development. Information as to the number of submarine-launched missiles and jet airplanes is very sparse. Recent estimates state that the Soviet will have a potential capability of between 25-100 during the time period 1954-57. The primary limiting factor in this area is the number of submarines equipped for launching these devices.

Intercontinental ballistic missiles will not be a threat within the period under consideration.

Clandestine introduction of nuclear weapons, BW agents, and CW agents is not considered as being a problem peculiar to Air Defense, but one cutting across the responsibilities of all commands and agencies.

6. Electronics

Our knowledge of Soviet capabilities in the field of electronics is limited. We do know that they have been able to duplicate the electronic equipment aboard our B-29 aircraft, our AN/CPS 6 type radar and our various forms of chaff. It therefore should be assumed that they can continue research and development in the electronics field and progress at about the same rate as we.

Aboard their aircraft which might be used in an attack against the U. S. we may expect:

1. Radar bombing and navigation equipment similar to our APQ 13 or APS 15.

2. Electronic computers giving essentially the capability of our AN/APQ 23 with range of 120 miles at 35,000 feet, with range accuracy of 1 per cent and azimuth accuracy of 2 degrees.

3. Loran.

4. High and low altitude electronic altimeters.

5. Localizer.

6. IFF.

7. Tail warning and gun laying radars.

Since the present and programmed air defense system of the U.S. is heavily reliant on electronic devices in all of its phases -- detection, identification, interception and destruction -- it is appropriate that we examine the electronics countermeasures which the Soviets may employ against us.

1. Rear Burst Chaff Against Tracking Radar. This method employs chaff bursts not more than 200 feet behind the A/C with a burst about 10 times as large as the A/C. It is effective against AI radars, missile seekers and Nike target tracking radar. Soviets will have this capability in the period 1955-1956.

2. Forward Chaff Screening Against Tracking Radars. Because of certain counter-countermeasures which we might employ against Rear Burst Chaff, this method provides an additional method of jamming AI radars, missile seekers and Nike target tracking radars. Soviets will have this capability in the period 1955-1957.

3. Area Chaff Sowing. This method involves the sowing of chaff by drones or unmanned aircraft 1/2 to 2 hours ahead of the bombers and is "refreshed" periodically. Dense sowing clutters radar scopes of GCI and local acquisition radars to where A/C cannot be detected. Causes needless employment of missiles and interceptors. Soviets will have this capability in the period 1955-1958.

4. Random Chaff Against the Acquisition Phase of AI Radars and Missile Seekers. This method involves the periodic scattering of chaff by bombers and escort fighters so as to affect AI radars and missile seekers. Soviets will have this capability in 1956.

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5. Blinkers. This method uses corner reflectors and repeaters on A/C to produce rapid, erratic motions of the apparent centers of echoes on radar screens. Effective against missile seekers, Nike tracking radar and AI tracking radar. Soviets will have the capability in 1956-1957.

6. Towed Corner Reflectors, Repeaters and Noise Jammers. This method employs the same principle as Blinkers except that maneuverable aerodynamic containers are used containing repeaters or reflectors which produce larger radar echoes than A/C. They are towed 100-200 feet above or below and 300-500 feet behind the bombers and are effective against most surface-to-air missiles. Soviets will have this capability in 1955-1956.

7. Decoy Missiles. This method employs drones equipped with repeaters and reflectors, launched from bombers before entering radar screens. By "looking like" more bombers, these decoys saturate the defenses and dilute the effort of defense. Soviets are not expected to have this capability prior to 1958.

8. Jamming AEW (Picket) to Ground Communications. Intelligence gathered by AEW and pickets must be transmitted to shore by HF or VHF which are highly vulnerable to jamming. Soviets now have this capability.

H. Scale and Nature of a Soviet Attack on the U. S.

Although we believe a surprise attack unlikely in the next few years, it is necessary as a basis for Air Defense planning to

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consider the scale and nature of a possible Soviet attack against the U. S. We have no information on current Soviet concepts of the employment of strategic air power and in attempting to anticipate the scale and nature of Soviet attack we can only assume that the Kremlin would follow a rational plan designed to maximize the effect of its attack. In planning the attack, the Kremlin would have to take into account the number and range of bombers available, the range and efficiency of the U. S. early warning system and the nature and types of air defense equipment available in the U. S. All of these factors are undergoing constant change. Moreover, we cannot know how the Kremlin evaluates such factors as the effectiveness of our early warning, of our ground-to-air missiles, or the possibility of atomic warheads being employed in air-to-air missiles against large bomber formations. Therefore, we cannot draw up a possible plan of attack for the Soviets and place much confidence in it as an example of what we can expect to face.

I. <u>Plan of Attack.</u>

Almost by definition, the Soviet attack which concerns us will involve an attempt at surprise. So long, at least, as our overseas SAC bases do not have a retaliatory capability in terms of a few hours, the Soviet attack can afford to pass up these targets until the initial penetration of the continental early warning system has been made. We should not expect, therefore, to receive warning in the form of an attack on our overseas bases. Neither do we believe that the Kremlin would compromise the surprise attack on the U. S. by preparations for ground action in Europe. Such action would be unnecessary because of the defensive strength of the Soviet forces in Europe.

The Soviet attack will be directed at two main targets in the U. S. -- SAC facilities and population centers. On a purely mathmatical basis, the Communists will have sufficient bombs and delivery vehicles to assign bombs to all SAC facilities and to a large number of population and industrial centers. Whether or not they expect SAC to receive sufficient early warning to evacuate, we believe they would attempt to hit SAC facilities in the expectation of limiting and disorganizing our retaliatory capacity. They must appreciate that simply to destroy a large number of cities would be an uncertain means of preventing a heavy counter-blow by an undamaged SAC.

Soviet tactics would be governed by the nature of our defense capabilities and would probably employ a variety of techniques. Low level and high level flights, saturation and single flights would probably be employed. Feints, chaff and jamming all would be employed.

V. <u>U. S. NATIONAL DEFENSE POLICY</u>

a. <u>Economic and Military</u>

Although the danger of Soviet aggression, either premeditated or accidental, is the fundamental motivation of our national military policies, the spectre of economic bankruptcy or depression looms large in establishing another national policy of equal importance but opposite effect. Thus, it is the view of the present Eisenhower administration that the nation must develop programs and policies to defend against war

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on two fronts, economic and military. So long as the techniques of fighting the economic war consist of budget reductions -- largely in military programs -- it is apparent that military forces will be reduced or delayed from previously planned expansion.

B. Birth of Policy and Program

The intervention of United Nations forces against Communist aggression in Korea stirred U. S. military policy from its lethargy after World War II into positive, expanded programs for both offensive and defensive war. Initially, after Korean operations began, the Air Force expansion was limited more by the physical availability of air bases, aircraft, etc., than by the budget and it was directed more toward the tactical type war then being fought than by long-range policy or positive objectives.

C. Counter to Atomic Threat

However, even as the 95 Wing Program was being developed in mid-1952, the NSC and the Joint Chiefs were establishing new and larger objectives to counter the threat of the Soviet possession of atomic weapons.

D. Force Levels

From the viewpoint of the Air Force and writers like Charles Murphy of Fortune magazine, the military forces approved by the Joint Chiefs represented a curious balance between conventional and atomic strategy. Thus, the Army and Navy emerged with approved programs and budgets for 21 divisions and 408 combatant ships, respectively -- both forces designed "pre-atom" around a deployment and strategy something like World War II. The Air Force, on the other hand, was given the go-ahead on its 143 Wing Program (it had asked for 155 Wings) designed around atomic warfare under the "Survival Concept."

This concept, to which the Joint Chiefs implied approval, was simply that the possession of atomic weapons by the Soviets gave them the strength to strike a surprise, catastrophic blow on the United States -- a blow of such devastating nature that we might be unable to employ our other forces in any succeeding conventional phase of war. Toward this concept the Air Force program provided, and up to the time of the Eisenhower Administration was funded, for 37 Wings of strategic bombers and 31 Wings of air defense fighters; of the latter, 25 Wings were for ZI defense and the balance for overseas areas.

e. Taxes Versus Defense

Much as Vannevar Bush in his book Modern Arms and Free Men frequently expressed concern over the high costs of modern weapons systems and the potential dangers of national bankruptcy, so the new Eisenhower Administration believed government expenditures must be reduced. Since the preponderance of controllable funds lay in the military budget -- other governmental costs, like interest on the debt, could hardly be cut -- it became apparent that military programs would be cut. They were -- and in the amount of seven and one-half billion dollars in the fiscal year 1954 budget. There is, at this time, indication that an additional five billion dollars will be lopped from the fiscal year 1955 budget to meet the insatiable demand for tax relief and the administration's estimate of fiscal and economic safety. Due to the long lead time in the Air Force program -- for example, in aircraft and air bases -- the preponderance of the cut, five billion dollars, was applied to the Air Force in FY 1954. A smaller proportion is expected to apply in FY 1955 due to the cessation of the Korean War, reductions in Army personnel, and some cut in the active fleet.

Throughout these program reductions from 143 Wings to 120 Wings (which incidentally may be restored to about 127 Wings) the high priority of air defense under current national policy has protected this force and weapons system from significant reduction. The few aircraft cut from the interceptor program last year were dropped for technical reasons, not budgetary limitations.

The brunt of the reductions was borne by tactical forces, including some NATO units, and by both fighters and bombers of the strategic force. This would further confirm the high priority of the air defense concept and system -- both from the viewpoint of the Air Force as well as the Secretary of Defense, the Joint Chiefs, and Congress.

F. <u>The Philosophy of Defense</u>

There is a general consensus that possession by a nation of an absolute weapon or overwhelming military power could protect that nation from aggression and attack. The one hundred years of Pax Britannica would surely be an example and history may some day show that only the atomic bomb stood between the disarmed U. S. and Soviet attack during the decade following World War II. Nevertheless, as Soviet atomic strength increases toward a level which could neutralize all major U. S. targets the more lucrative course of action would become a surprise attack. From the Soviet view, this might at best destroy the U. S. strategic retaliation force and at least make certain the ultimate outcome of the war.

Thus the need is clear for an air defense system which can parry even a surprise attack, secure the strategic force for its counter-attack, and prevent the annihilation of major industrial and population targets. A one hundred per cent defense would be obviously desirable, especially when fusion bombs may be available and used by the enemy, but is equally obviously impossible when budget limitations are set, in the face of swift technical change and progress, and when the enemy has a potentially infinite variety of surprise and deception tactics.

Within these limitations and unknowns, then, the U. S. plans to develop the highest "kill" potential possible by means of a general air defense system composed of warning equipment, data handling networks, and finally a combination of manned interceptors and unmanned missiles and projectiles. There is a general concept of keeping the system in balance; however, the uneven rate of progress in basic research as well as weapons development has resulted in system bottlenecks -- for example, data handling -- which seriously limit the kill potential.

By 1957 it is hoped that warning may be available from a mid-Canadian (McGill) line augmented by airborne and picket ship early warning on the ocean flanks. Coupled to this will be high speed computers and data transmission systems which will permit high capacity, accurate interception tactics from the point of early warning to the target area. Finally, the plan for actual weapons envisages subjecting an attacking force to continuous attack through the use of long-range interceptors (or carrier forces at sea), long-range missiles such as Bomarc, shorter range fighters, along with Nike type missiles near the target area.

G. Deficiencies

Difficulties in meeting these objectives lie in technical, fiscal and intelligence fields. The national policy of restricted military budgets has already been pointed out. Before discussing the technical aspects it would be well to look at a related problem of intelligence and security which seriously depreciates the potential capability of our air defense system and tactics.

An accepted weakness of democracies, in the past, has been an absence of security concerning vital policies of the national government, including defense. In the future this weakness must be corrected for otherwise air defense of the nation may be fatally compromised through failure to retain in secret the latest technological advances as well as advances in military procedure gained by test and maneuvers.

1. Press. The single worst offender is the press. Despite censorship and a self-imposed code, journalist phobia in connection with freedom of speech and press is apparent whenever the question of security is raised by the military. This was endurable by the nation when effects

of security breach were buried in slight increases of casualty figures in Korea. It is not endurable in terms of advantage given to enemy aircraft capable of reaching any city of the U. S. The press also champions economy of government expenditure and therefore justifies support of columnists whose forte is "smoking out" by conjecture or criticism news stories of developments of national defense. These columnists "protect" the taxpayer and "drive" the military to greater efficiency. They also simplify enemy plans for collection of information by pointing the way.

2. Government. The press depends upon government releases as well as military for the bulk of its news. Yet nine years into the atomic age the national government has still failed to bring out a security program to meet the requirements of a period of what may be preparation for atomic war. Neither Congressional Committee, FBI, nor President Eisenhower's warning to his Cabinet have settled this issue. What agency of government is responsible for clearing the mass of publications, abstracts, bulletins, departmental histories, which make enemy intelligence gathering easy?

It is possible that a tougher military policy of maintaining security would in itself be the largest contributor to a national awareness of the danger. Certainly lapses of security traceable to service rivalry and to bids for public support should be eliminated. While each command could under policy directive police its own personnel, there are possible gains from creating a special military corps of inspectors in the field of security with back-up of discipline to be applied to all military agencies stationed in the ZI.

The basis for an improved military policy should be prepared by ADC in the form of a counter-intelligence plan. This plan should cover the area between a passive defense program and the counter espionage activity of the FBI. Its aim should be to hinder or obscure the sources of information now openly and legally available to enemy intelligence activity. Its scope should include military and governmental press releases and advertizing by military hardware manufacturers as well as measures to safeguard essential data of vital military installations. Both passive measures and active measures of deception should be prescribed not only for ADC and SAC, but for all agencies of Civil Defense.

VI. U. S. DEFENSE CAPABILITIES

A. Functional Criteria

Having determined the intentions and capabilities of our potential enemy, the USSR, it behooves us to consider the defensive capabilities of the U.S. to meet the threat envisioned by these factors. It is essential that any defense proposed must meet the primary requisites of detection, identification, interception and destruction. We must have detection sufficiently remote from the bomb release line, identification so thorough and rapid that friendly forces are clearly defined from enemy attackers. These two initial phases must be accomplished as remotely and rapidly as possible to provide interception and destruction of the largest numbers at the greatest possible distance from the critical NE industrial complex, West Coast and NW area. It is believed that this coverage must take precedence over interior ADC, AEC, and SAC bases in the light of our inability to provide complete radar and AA coverage for these areas. The potential threat cannot be envisioned in a singular sense but must be considered as possibly coming from two or more directions simultaneously.

b. Initial Covert Assault

It is quite improbable that any enemy assault will be a simultaneous effort including submarine launching of missiles, covert action against vital installations, biological or chemical warfare as well as aerial attack. The degree of timing required to affect such a mass assault is not impossible, but appears to be definitely not worthy of the risk of the failure of one to expose the entire method of operation, particularly in the light of the intolerance of failure in part or total by the inherent theory of Soviet conquest. Accordingly, we must assume that the most likely and probable effort to achieve this end will be aerial assault.

c. Radar Detection Capabilities

The presently planned U. S. Air Defense system, when fully implemented in 1957, will give radar cover into Canada about 600-700 miles north of our important cities and 400 miles to sea from our coastal cities. The MacGill Line which the Canadians are planning is a simple alert line along the 54th parallel and will give approximately 3-1/2 hours warning on TU-4 type aircraft, and approximately 2-1/2 hours of warning on B-47 type aircraft and approximately 1-1/2 hours on Snark type missiles. This radar coverage is believed to give adequate warning of an attack with weapons of the time period involved. Because of exorbitant costs and the possibility of break-through in R&D by U. S.

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scientists, additional lines such as the DEW line should not be constructed. All present radars will be vulnerable, however, to spot jamming by the attackers using chaff and other electronic countermeasures.

The present alert plans of SAC require two hours warning and ADC availability per squadron is as follows:

Runway alert	2 a/c
5 Min "	2 a/c
30 Min "	4 a/c
1 Hr "	4 a/c
3 Hr "	5 a/c

With the radar coverage indicated above, both the runway alert and the 5 minute alert aircraft can easily reach a 200 mile forward line for the battle.

D. Identification

Identification should take place as soon as possible after detection. During the time period involved, identification will be limited to visual means, homing beacons, multiple corridors, flying maneuvers and possible modification of the compromised Mark X, IFF. Electronic countermeasures available to the enemy make identification much more complex. Our electronic counter-countermeasures will be limited during this time period.

E. Aircraft Deployment

The deployment of programmed aircraft does not seem consistent with the goal of providing the maximum defense to the critical targets. It stands to reason that the limited funds can be better

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utilized at the most critical targets rather than to disperse to southern areas which are at extreme range for Soviet aircraft.

The interception equipment for both a/c and missiles is as equally vulnerable to chaff as that used for detection. In addition, the equipment becomes extremely degraded for low or high altitude attack.

Sixty-one (61) squadrons of interceptors are programmed for ADC for 1957 and augmentation fighter availability is as follows:

Air National Guard	1,000
Air Force Reserve	500
Tactical Air Command	1,000
Navy	500 to 1,000
Strategic Air Command	500
Air Training Command	500

These aircraft are more than could be controlled except in VFR mass interception raids.

VII. CONCLUSIONS

A. The USSR's program for world domination does not appear to have been altered.

B. A surprise attack on the U. S. is unlikely through 1957 because Soviet leaders could not rationally be certain of decisive success against the present level of U. S. military strength, particularly SAC and ADC.

C. Unless the U. S. develops improved weapons and equipments by 1957, increasing Soviet capabilities by and after that date in delivery vehicles and weapons will greatly increase the danger of a successful surprise attack.

D. The present U. S. intelligence is inadequate to make an accurate assessment of the trend of the USSR capabilities in weapons and equipment.

E. The present U. S. security practices are inadequate to insure safeguarding our military defense program.

VIII. RECOMMENDATIONS

A. That the highest priority be given in terms of money, trained personnel, and modern intelligence techniques to improve our ability to collect and analyze information concerning the progress and intentions of Soviet research and development in the fields of strategic air warfare and air defense weapons and equipments.

B. That the U. S. reduce the availability of technical and military information of value to the Soviets which is now being released through the press and other news media. A common central plan at national level to classify and isolate this type of information from public release is essential. A planned security education of editors, writers, and industry, as well as deception and decoy schemes, should be a part of this program.

C. That the U. S. divert funds from Air Defense end item procurement to Research and Development for longer range detection, automatic data handling, faster and more positive identification, faster interception and more deadly weapons (subsequent to 1957).

D. That AW radars and fighters be redeployed so as to give the maximum protection to the three critical areas of the U. S.

SOLUTIONS SEMINAR NO. 3

C

AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
Date Submitted

STUDY NO. 1954-6 **SEMINAR NO.** 3

(Scheduled dates 4 Jan -30 Jan 54 **)**

INSTRUCTOR Col Shannon Christian **STUDENT CHAIRMAN** Col Gruber

SEMINAR MEMBERS:

1. Col Ascani
2. Col Brousseau
3. Col Arnett
4. Col Meals
5. Col Dimmock
6. Col Stewart
7. Col Bronson
8. Col Davis

Col White

STATEMENT OF THE PROBLEM:

In general terms, analyze the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

SPECIAL PROBLEM OF STUDY TREATED:

Instructor's Signature
SHANNON CHRISTIAN
Colonel, USAF
Study Director

(Use reverse side for remarks)

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SEMINAR SOLUTION

STUDY NO. 6

SEMINAR NO. 3

SEMINAR CHAIRMAN: Col. Gruber

SEMINAR RECORDER: Col. White

SEMINAR MEMBERS: Col. Ascani
Col. Brousseau
Col. Arnett
Col. Meals
Col. Dimmock
Col. Stewart
Col. Bronson
Col. Davis

MAXWELL AIR FORCE BASE, ALABAMA

27 January 1954

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AIR DEFENSE PROBLEM

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PART I

The problem is to analyze the development and deployment of ADC forces programmed for 1957.

Since the Air Defense System is dependent upon a closely knit well integrated organization consisting of three major components (1) Fighter Squadrons and support bases (2) Air Surveillance and Weapons Control System and (3) Army Antiaircraft forces, it was decided to discuss first the deployment of the entire system and then the development of the system.

DEPLOYMENT OF ADC FORCES

The fighter squadrons as deployed by ADC, provide the maximum protection within the limitations of the equipment. In general, they are so positioned as to protect the most sensitive target areas. Their location along the fringes of the heavily concentrated industrial areas of the northeast and northwest assure a reasonable degree of intercept of enemy bombers prior to bomb release line. Through coordination with GCI they are able to maximize their range limitation and increase their fighting time.

The antiaircraft forces are deployed to provide maximum protection to vital point targets without critical target area. Since the cost would be prohibitive if other than point target coverage were desired it appears that the target selected for protection by ADC will result in the greatest return.

We feel that a more efficient DEW system can be achieved. The present system does not provide the information for the effective operation of the defense system as a whole. We suggest the establishment of an AEW from Midway to Alaska thence to Thule terminating in Scotland. This

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system could be installed without additional cost by the elimination of East and Westward extensions of the McGill Line. It could provide the information, such as range, speed, direction of attack necessary to the defense commander. It could roll with the punch and follow the attacking forces providing up-to-the minute intelligence.

We feel that the GCI, as deployed by ADC, is proper. It provides maximum control within range limitations of fighters.

DEVELOPMENT OF ADC FORCES

The development of fighters as envisioned by ADC is generally in consonance with the technical capability of the aircraft industry. The F-86D's and F-89D's should be available as programmed.

There may, however, be appreciable lag in the development of the F-102. Since the first prototype F-102 was destroyed and development tests on the second have just begun, it may be rather optomistic to expect 12 combat equipped squadrons in 1957. Hence, it is necessary to place major emphasis on the development of this fighter to insure its availability as scheduled. With major emphasis on this program it may be possible to produce sufficient F-102's to equip 12 combat squadrons and at the same time provide replacement aircraft for the F-89D's, which in our opinion are unsatisfactory because of their ceiling and speed limitations. In addition, we feel that every effort should be made to develop the F-86D and the F-102 so that they will be capable of carrying small A Weapons. This would vastly increase the firepower of the fighter and in turn the effectiveness of the defense.

There are five characteristics which are essential to the proper functioning of any Air Surveillance and Weapons Control System. They are:

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1. Ability to detect the enemy.

2. Ability to identify him.

3. Ability to vector the interceptor to the target.

4. Ability to transmit accurate and timely intelligence to the combat center.

5. Ability to counteract electronic countermeasures.

We feel that the system is deficient in all five of these characteristics and that major emphasis should be directed towards improvements in these areas. General Chidlaw, General Lewis and General Berquist have all indicated the inadequacies of the system. While it is true that the Lincoln Transition System may solve some of the present day problems, it is doubtful whether this system could be operational by 1957. Even so, it would not provide the ultimate in early warning. The efficiency of the system would be increased through its ability of rapid transmission of radar intelligence to the combat center and its ability to integrate high and low radar for vectoring approximately 100 fighters to the target. It appears desirable therefore to emphasize the development of a long range radar system which could be integrated into the Lincoln Transition System.

While the foregoing reflect the characteristics common to all radar equipment, which require improvement, there are also other components within the system, that if properly developed would result in a savings.

The Navy has apparently reduced to some degree the cost of picket ship operations through the substitution of the Liberty ship for the Destroyer escort ships programmed in Cost vs Kill.

The "Blimp" which is being developed by the Navy for AEW shows

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promise of effecting further savings in the system. Weather conditions along both the East and the West Coast are such that the "Blimp" could be used for approximately substantial portion of the missions. If the "Blimp" were used in conjunction with AEW aircraft complete contiguous coverage at a reduced cost would be assured.

In the opinion of this seminar the development of the Nike "B" should be discontinued. The Navy Talos has approximately the same characteristics as the Nike "B". The Talos has been test flown and with minor modifications could be substituted for the Nike "B". This would result in a substantial savings and would provide an operational weapons much sooner than if development were continued on the Nike "B".

CONCLUSION

As set forth above, it is the opinion of this seminar that a more efficient defense can be achieved without increased cost.

RECOMMENDATIONS

1. That a defense aircraft capable of carrying an atomic weapon be developed.
2. That use be made of both Blimp's and AEW aircraft for contiguous coverage on both the east and west coast.
3. That greater emphasis be placed on early warning radar development.
4. The development of Nike "B" be discontinued and that Talos be substituted therefore.
5. The AEW coverage be provided from Midway to Alaska thence to Thule and Scotland.

PART II

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FACTORS

The following factors were considered while analyzing the program of the Air Defense Command:

I. Enemy Capabilities. Since the only nation with the expressed objective of world domination is the U.S.S.R., we therefore assume that he will be our potential enemy for the time period under consideration. We accordingly limited our discussion to her known and/or expected capabilities. We accept the various intelligence documents made available for this study at face value. We also are of the opinion that present intelligence is not adequate and that our ability to defend ourselves increases in proportion to the amount, quality and timeliness of the intelligence made available to us. Since adequate enemy intelligence is so seriously lacking, the estimates of his capabilities are largely predicated upon our own for the period under consideration. These estimates are based upon the assumptions that:

1. His intelligence will keep him informed of our own inter-continental weapons development which they will quickly adopt if deemed expedient.

2. The laws of nature and available scientific knowledge makes the same technical areas available to both the U.S. and U.S.S.R.

3. We cannot afford to count heavily on the time factor in any technical advantage or development over the U.S.S.R. in view of his demonstrated ability to copy and produce in large scale in a few years such weapons as our B-29. She has the further capability of developing her own systems independently of us.

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By 1957, Russia can be expected to have a substantial stockpile of atomic weapons that can be delivered by the existing air vehicles of TU-4 size and smaller. Increasing the yield of the Soviet bomb could be expected to reduce the number required for a given level of destruction. Therefore a proportionately smaller fleet of bombers or other air carriers would be needed to accomplish the mission.

At the present time the U.S.S.R. has 1000 TU-4s, capable of 1 way raids against the U S. to a range of 4000 miles. If 2 way trips are contemplated, then refueling is required both ways and we believe the Russians are capable of developing this operation.

The IL-28 is capable of wing-tip coupling with the TU-4 which would effect a maximum range or one-way mission capability of 5150 miles. The IL-28 has a cruising speed of 400 kts. Two hundred IL-28s can be available by 1957.

Intelligence estimates gives the U.S.S.R. the capability of developing and equipping operational units with medium and heavy jet bombers by 1957 such as the T-31 and T-37.

The U-1 type guided missile of 200 mile range with a C.E.P. accuracy of 1 to 2 miles can be expected in the relatively near future. This missile may be submarine launched with a two to three thousand pound payload.

This missile can also be launched from a freighter in the same manner. Both the Submarine and Freighter type vessels can fire shells containing BW or CW type contents over our coastal cities. Using the missiles mentioned above this type of warfare can be carried much further inland.

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We do not intend to overlook the obvious capability to wage BW and CW by air.

II. Vulnerability of the U.S.

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The United States and, for that matter, the North American Continent is vulnerable to attack both from the air and from the sea. Our problem was narrowed in scope to that area concerned with attacks by air forces and guided missiles after they are airborne. Therefore, the attacks from the sea were considered in this frame of reference.

The lack of adequate early warning is one of the most significant factors in the vulnerability of the United States. Development in this field has not kept pace with Bomber, Fighter and Atomic development. This electronic problem will be discussed later. We mention it here as a factor contributing to the vulnerability of the United States.

The very size of the North American land mass makes it vulnerable from the standpoint of attempting to defend the whole area. Cost in manpower and materials when compared to value of mass thus protected is prohibitive. We therefore agree with the island concept of defense.

The general apathy or lack of sound understanding of the threat on the part of the general public is another factor contributing to our vulnerability. It has been a good long time since this country has been subjected to active hostile enemy action. It is natural, therefore, for a people who have lived for generations in freedom not to understand the meaning and ramifications of an enemy attack. Public opinion is not abreast of the scientific developments that have made a hitherto impossible task not only possible but a rapidly approaching probability. They are reluctant to spend large sums of tax money in the necessary

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developments that are needed to cope with modern methods of warfare. Also, because humans are reluctant to change and tend to revere tradition, we are slow to reconstitute our defense forces along realistic lines adjusted to the changing requirements of the manner of fighting. We have thereby lost time which is vital in any arms race.

Our method of economic development has made us vulnerable. The tendency to concentrate production near urban centers where other or allied production is already located creates lucrative targets. This is natural in a free nation since transportation facilities, labor market, materials and the economic support of the labor market is already established in these cities. However, with the advent of high yield weapons, this concentration makes our urban targets even more inviting.

1. Target Considerations. The selection of targets in the United States for a surprise attack by the U.S.S.R. would be influenced by three primary objectives.

a. Disruption of governmental control and weaken the will to resist.

b. Destruction of the industrial capability of the nation for war.

c. Reduction of U.S. ability for retaliation to acceptable limits.

Air attack on Washington, D.C. might well seriously impair our ability to maintain control and necessary direction of the war effort. Its attack for political and psychological reasons seems highly probable. The terrorizing effect of the instant destruction of this city, as with other important populace centers may have a strong demoralizing effect on

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public will to pursue the war.

The great predominance of our industrial activity and of our heavy populations coincide. To prevent our full conversion to a war production in industry and to create maximum personnel casualties the industrial North-East, the extreme North-West and South-West constitute attractive Soviet targets and are areas we must defend.

The Strategic Air Command and certain ADC installations represent important and apparently most vulnerable major components of the military forces. SAC constitutes the threat of retaliation together with the atomic weapons it would carry. Warning of a Soviet attack being launched would cause SAC forces to disperse minimizing U.S.S.R. damage to a retaliatory capability of the U.S. Subversion rather than air attack would seem less expensive and more assured of success in several SAC and ADC key installations. However, in order to assure neutralization of those forces not susceptible to subversion, an air attack would be justified.

2. Prediction of Routes - 1957

The exact routes of approach which U.S.S.R. forces will take on any airborne attack on the Continental U.S. in 1957 are not, nor will they likely be, known to the ADC. However, it appears that those envisaged by ADC would probably be the most advantageous for the attacking Soviet forces to follow and the most difficult for the U.S. defenses to monitor. The factors which determined the choice of those routes are:

a. Capabilities of delivery vehicles. The U.S.S.R. should possess a wide variety of aircraft-and possibly missiles launched from submarines- capable of reaching a large percentage of the most vital and sensitive targets in the U.S.

b. Location of departure bases in U.S.S.R. It is known that Russia bases capable of handling large aircraft are located in the areas of East Germany, Alakurtte and Markova. These areas are on the northern flanks of the U.S.S.R.

c. Location and coverage of U.S. and allied early warning and GCI radars. These areas will be avoided as long as possible to prevent detection and later interception. The effectiveness of their ECM on our facilities will also affect their choice of routes.

d. Location, strength and capabilities of U.S. ground and air defenses would certainly be considered and might influence the selection of routes.

e. Presence of navigational check points prior to and within defended zones might also bear on the determination of routes if long over water flights or radar navigation and bombing are to be used.

We feel that we must push our early warning line north as far as possible. This is because we own a piece of property on the northwesternmost point of land in this continent. Alaska is also our closest point of contact, physically speaking, with the U.S.S.R. The two islands in the Bering Straight being approximately two miles apart, one owned by Russia and the other by the U.S. Alaska then represents the left flank. The Northeast Command the right flank and Canada the center line. It may seem that we are spreading our forces too thinly over too wide an area. We believe this is necessary however for the following reasons:

a. The advantage of early warning with the eventual capability to bring the enemy under fire earlier and for a longer sustained period.

b. To give SAC more advanced sites from which strike attacks can be launched and aircraft recovered.

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c. Our control of this area denies its possible use to the enemy as launching and recovery sites against us. This is most likely with the launching of ballistic missiles.

d. We have an obligation to protect our Alaskan interests.

e. By controlling this area and extending our warning lines seaward from both flanks we force the enemy to take circuitous routes to avoid detection while attacking.

III. U.S. Counter Capability.

We will discuss the factors of active defense in the four functions of detection, identification, interception and destruction.

1. Detection.

In considering the first of the four functions of an air defense system it is our opinion that the most important principle is that of providing full radar coverage extending outward in all directions and for adequate distance from the defended area, and at both high and low altitudes. This principle should also provide for continuous tracking of targets after they enter the area, and thereby greatly facilitates the identification and interception functions. We note that the ADC projected program follows this principle for perimeter coverage of the three most vital areas of the Continental U.S.

We believe that the seaward coverage planned is inadequate in that it does not extend outward far enough to assure maximum utilization of the air defense fighters. Thus we recommend that ADC place greater emphasis on the eastern and western sea approaches, and if necessary, do

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this at the expense of radar coverage planned for the southern portion of the country. Coverage planned for the California coast, while not entirely adequate, is substantially better than that further north, and is not as critical as the northeast area. The sea areas of primary concern are those lying off the northwest coast outward from Seattle and the northeast coastline as far south as Norfolk. AEW & C aircraft seem to us to provide the best means for this extension, the depth of which should be at least 700 miles outward from the vital areas.

With respect to early warning lines, we feel that the McGill Line across Canada is of great importance, and thus should be installed as soon as possible. We would prefer to see it equipped with tracking radar rather than the passive detection equipment now planned, but we recognize that the additional cost may not be justified for the period of time under consideration. The other early warning lines, which include the east and west seaward extensions of the McGill Line, the Lincoln Line, and the Navy-sponsored line from Kodiak to Hawaii do not impress us as being optimally planned. It appears that the principal advantage of distant early warnings lies in providing time for increasing the effectiveness of augmenting forces and for passive defense measures by SAC, Navy forces, civil defense agencies, etc. If this is the case, then distant early warning should be as near Soviet territory as may be practicable. We suggest that the two proposed AEW & C aircraft lines over the Pacific (from Canada to Hawaii, and from Kodiak to Hawaii) be changed to provide a warning line extending generally from a point north of Thule, thence over the Pole, and on to Nome, Adak, and finally terminating at Midway.

Since the distances are comparable, there should be little, if any, increase in capital cost. We would extend this distant line eastward from the point north of Thule, along the northern edge of Greenland, and thence to Iceland and Scotland. Funds for this latter portion of the distance line could come from savings accrued in eliminating the eastward extension of the McGill Line.

We recognize that the far north poses certain operational problems for aircraft, but believe that the greater warning time would justify acceptance of the difficulties. It seems logical to consider the use of B-36 type aircraft for all or portions of the distant line. By 1957, the B-36's will be essentially obsolete as strategic bombers. Costs of using them in the air defense system would need to be compared with costs involved in obtaining and operating the C-121 type. AEW & C aircraft represents the best choice of equipment from the point of view of flexibility. If a line is equipped with aircraft it can be redeployed wherever the Commander desires. This capability we believe is a valuable factor in enabling a Commander to deploy his forces to meet a changing situation. The mobility and versatility of this arrangement cannot be matched by any presently known system.

It may be argued that enemy spoofing can destroy the value of the distant line. Spoofing with a few aircraft or small flights of aircraft could be recognized for what it is, and could be tolerated. A hostile act directed at the line itself would be the signal for an impending assault. By using AEW we could have the advantage of the Judo principle of flexibility. The AEW not only could drop back keeping the enemy under surveillance but also has the advantage of being able to direct an air battle using long range interceptors. When the battle comes within proper range control can be passed to the appropriate GCI. In other words we recommend that the tactics used with any AEW line be based on the flexible principle where the whole line gives with an attack to keep the enemy under surveillance once you have him. Bring fire to bear as soon as possible and keep him under fire the rest of the way in and out from target.

2. Identification.

Identification is one of the weakest spots of our Air Defense system. Its importance has increased in direct proportion to the development of high yield weapons and their air carriers. With present day speeds and altitudes we can no longer be satisfied with visual identification. Other means of positive identification must be developed and soon. This seminar feels that the present system of matching flight plans etc. can be improved by decreasing some of the human element and by shortening the time required for this operation. We feel that light planes are no problem because of their inherent signature of speed and altitude. Commercial airlines, however, should be furnished IFF and required to maintain it. There is no excuse for the preponderance of military flight plans being in error or pilots not following the plan filed. This should be corrected at once starting at the top in the Department of Defense and working down through the entire department. The figures of 95% military error as against 5% civil error is intolerable.

When the air battle gets within range of Nike and other artillery weapons, electrical identification of friendly aircraft is a

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must. Development in this field and in the area of air to air identification must be accelerated to the utmost and must take in all of the ramification of ECM.

3. <u>Interception</u>.

Interception is of course dependent upon the efficient performance of the first two factors detection and identification. Our ability to vector aircraft and missiles to an intercept of an enemy force is greatly enhanced by the improvement of the equipment used in the first two factors since a lot of this equipment is also used in the vectoring problem.

The primary long range intercept machine as programmed for 1957 is the manned-fighter aircraft comprising the F-102, F-89D and F-86D all equipped with some form of intercept radar. Before the interceptor can be utilized obviously it must close with the enemy. If the defender must remain within his immediate defense area his versatility is greatly reduced. If on the other hand these aircraft can be deployed, their utility would be greatly increased.

In the case of one of these aircraft types, the F-89D it is felt that another longer range, faster and more modern aircraft such as the F-102 should be utilized. The F-89D is primarily scheduled to be used within the interior defense area, and were it to remain within that area it could probably accomplish its mission. There is however a need for force mobility which would allow immediate deployment of aircraft to meet major threats at perimeter locations. Aircraft should be capable of reaching the attack area and performing intercept without any unnecessary delays for refueling.

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The problems of electronic countermeasure action on the part of the prospective enemy are probably more applicable to the actual intercept mission than to any other phase of air defense. Regardless of the accuracy of either the detection or the identification portion of Air Defense, unless the kill aircraft or missile is able to close with the enemy the possibility of kill is denied. As has been demonstrated by "Operation Tailwind", under weather or instrument conditions no more than three AI fighter aircraft can be held on G.C.I. at any one time, without ECM activity. With positive kill requirements dictation a minimum of four and in most cases five fighters it is mandatory that adequate intercept systems be devised which will be relatively immune to ECM and will obviate the present G.C.I. deficiencies. This principle also applies to the missile and artillery intercept problem.

4. Destruction.

Using as a departure point, the thesis that the predicted degree of effectiveness of the U.S. air defense system will not be adequate to prevent the delivery of 120-200 A-bombs on U.S. targets in the 55-57 period, the major consideration in the destruction phase should then revolve around a program for increasing the destructive capability of whatever weapon is fortunate enough to engage the target. In this respect, the employment of A-explosives shows the greatest promise.

In the cost-kill report compiled by the ADC, a fighter/bomber ratio of 4 to 1 is quoted as a requirement for a reasonably high probability of kill even with the best types of interceptors. Factors such as aborts, missed interceptions, failure of armament system to fire and near misses undoubtedly were evaluated in arriving at this figure. Almost all of these factors can be attributed to field degradation.

Since an increase in firepower has almost always created a correspondingly large variation in tactics, it is this seminar's opinion that the utilization of A-explosives in the Air Defense system is the single major factor which can increase the destructiveness of the weapons found in the system. This application includes the manned interceptor, surface-to-air and air-to-air missiles.

Again, quoting from the cost-kill study the best ratio obtainable by ADC in the 57 period is 1.21 fighters to every bomber. Employing conventional weapons, this ratio falls far short of the desired 4 to 1. To provide the 1.21 to 1 ratio system with a much higher degree of lethality, the use of A-explosives provides most promise for the immediate future.

A reliable authority points out that a modest capability for interceptor delivery of presently stockpiled A-bombs could be achieved by 55-56 with special effort. By 56-57, the period under discussion, large numbers of A-weapons could be in operational air defense units if desired.

Only one important aspect of the air defense A-explosive program remains to be resolved. The question to allocate fissile material to this channel must be determined at the national policy level. Such a decision should not be prolonged beyond the immediate future.

In the examination of the destruction phase of the air defense mission, no other single consideration guarantees the bonuses which can be derived from the introduction of A-explosives into the weapons system. An unexpected bonus of such a program is the near elimination of the margin of error usually designed into such a weapons system.

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In an attempt to unharness ourselves from past military theory and conventional thinking we in seminar 3 strongly feel that the use of A-explosives in the role of air defense will create as radical a change in air defense thinking as did the employment of this same munition in strategic bombing operations.

IV. U.S. Countercapability - Civil Defense

In analyzing the effectiveness of the defense of the United States against atomic attack, it is essential that an assessment be made of the reaction of the American people to such attacks in the event of war. Not only are we concerned with what inhabitants of a given city will do if attacked with atomic weapons but more importantly, what will be the reaction of the inhabitants of other cities not actually bombed but considered likely targets?

Since there is no actual experience factor upon which to make such an assessment, one can only predict what he believes would happen, basing his prediction upon two types of evidence; first, the evidence furnished by past situations which are similar to what is expected to prevail in the event of atomic attacks upon our cities; and second, that of known principles of individual and group behavior which can be foreseen to apply.

We have of course a wealth of information as to how people and nations react to conventional bombing, but we have only two examples of cities being subjected to atomic bombing. Exhaustive studies have been made of these latter two examples. But at best these studies are only retrospective accounts and may or may not be indicative of how people of an oriental culture as opposed to an occidental one would react in similar circumstances. Many factors make it extremely difficult to equate the reaction of the citizens of Hiroshima to what those of the City of New York would be if they were subjected to an atomic attack.

The second type of evidence is equally inconclusive as a basis for drawing valid conclusions in the field with which we are concerned. The floods, earthquakes, fires, epidemics, and similar disasters which we have experienced have, relatively speaking, been too miniature in scope to serve as suitable criteria. In addition, these disasters have been localized and generally have resulted from impersonal forces rather than from the deliberate act of a human enemy. Hence the psychological conditions encountered do not duplicate those to be expected in the event of an atomic attack.

As a matter of fact, unpalatable though it may be, a discussion of the probable psychological reactions of the inhabitants of a city which has been subjected to an atomic attack with modern high yield weapons is an academic exercise only. The unpleasant truth is that the overwhelming majority of such inhabitants will be dead and will have no reactions, psychological or otherwise. Hence, the question of whether the American people will have the will to continue the war following an atomic attack depends on the psychological reaction of those not bombed. It is the opinion of this seminar that the American people will have the fortitude to sustain an atomic attack and the will to mount and support decisive retaliatory strikes. It would be dangerously naive, however, not to recognize that at the present time the American people are not wholly prepared psychologically to cope with atomic warfare. This fact is amply demonstrated by public opinion surveys and reports from the Federal Civil Defense Administration which indicate that a very substantial percentage of the American people do not believe that there is any likelihood of an atomic attack on American cities in the event of another war. Obviously, a people cannot be considered well prepared psychologically to meet a threat that they do not believe exists. It is essential, therefore, that prompt and positive measures be taken to educate the American people how to meet such emergency conditions. It is recommended that in addition to the normal precautionary measures such as fire control, first aid, etc. it is of primary importance that a plan be devised which will insure that the temporary vacuum of personal information and direction that would be an inevitable aftermath of a disaster of the magnitude of an atomic attack is filled with a source of information and authoritative direction. This source must be able to provide information not only concerning enemy strikes on the United States but full accounts of the retaliatory strikes being made against the enemy's homeland. As previously stated, this seminar is convinced that the American people can take the enemy's atomic punch, and, if necessary, rise from the floor and deliver a knockout blow. We qualify that opinion only to the extent that we consider it essential that the American people must be informed of the nature of the threat and trained to meet it.

From the above it can be seen that we must have as much warning time as possible in order not only to bring fire on the enemy quickly, but also to be able to evacuate as many persons as possible from the target areas. The more warning time the better we are able to evacuate and set in motion mutual aid agreements without interference with the accomplishment of the military mission of active defense and quick retaliation. We can bring to bear other augmentation forces made available to us from the sister services.

V. General

REDEPLOYMENT OF ADC WEAPONS SYSTEMS AFTER "D" DAY

Consideration must be given to the redeployment of ADC weapons systems after "D" day. The potential of the ADC must be programmed for in order not to waste valuable equipment and trained manpower after the primary mission requirements have been met.

This redeployment must be governed by the type of initial and subsequent enemy attacks. Careful evaluation of the remaining enemy potential for attack will dictate the phasing of this redeployment. The type of anticipated use of ADC facilities in its secondary or tiertiary roles is also a factor, as reversion to their primary mission must be kept in mind.

An examination of the initial attack and subsequent potential of the enemy is a primary factor in redeployment of ADC facilities. Several courses of action are indicated:

1. An all-out air attack predicated on a "Sunday punch" concept. In this case most of ADC aircraft assigned to intercept of enemy aircraft or missiles could be redeployed very soon after "D" day.

2. An infiltration or continued attrition type of attack. This would dictate ADC remaining at a high state of readiness in their primary role. In fact there would be no change until intelligence indicated the enemy potential had been definitely attrited. ADC redeployment

would then occur at a considerable time after "D" day and then only in small increments.

3. An attack along the "suitcase" type. This would require ADC to continue to retain all of its facilities for the possible air attack that still exists.

4. A combination of percentage of any of the above.

In all instances the prime consideration must be the enemy potential remaining after "D" day insofar as air attack is concerned, whether it be in aircraft or guided missiles. After the determination of the enemy's fall off in air potential the phasing of redeployment can begin.

Without attempting to re-energize the age-worn argument of general purpose aircraft versus the highly specialized type, it can be safely stated, in general terms, that a considerable portion of the Air Defense equipment is capable of supporting other missions assigned to the USAF..

Assuming the enemy offensive threat is successfully countered and removed as an active force, a large amount of the Air Defense force can then be made available for other purposes.

Considering aircraft first, of the three types presently programmed for air defense, the F-86D, F-89D and F-102, all but the F-89D can be utilized for air-to-air fighter combat. The F-89D is obsolete by present day standards of performance and maneuverability as a day fighter. In the case of the F-86D and F-102, an impressive contribution can be made to the active combat role in overseas or domestic theaters. With minor technical modifications to fire control systems and utilization of existing armaments (rockets or AAM) these two aircraft can make the switch with little or no difficulty.

With the trend towards increased firepower through the use of rockets in all future fighters, the F-86D and F-102 possess a high potential degree of compatability with planned day fighters.

Considering the large stocks of munitions which must be accumulated for the air defense of the U.S., little imagination is required to visualize the usefulness of these munitions for missions other than air defense. Equipments such as Nike, Talos, Falcon, 2" or 2.75" rockets, and also A-explosive weapons can be readily converted to offensive use. Tactically, all of these weapons may be used in support of ground or naval forces. Conversion of the previously mentioned SAM to SSM is relatively easy. The rockets and A-explosives may also be delivered via missiles or tactical aircraft. As previously mentioned, the airborne munitions may be employed in air to air combat.

It must be assumed that the fixed radar installations will lose considerable value as a military instrument once the air defense battle has been successfully terminated. This deficiency need not apply, however, to the mobile units being procured to fill in the fixed system. The latter can be very effectively used in overseas areas to support the tactical mission by providing guidance during night or inclement weather operations. In addition they may be used to augment the GCI system already planned for air-to-air engagements.

The fixed radar installation within the continental U.S. offers great promise for peacetime use. Radar surveillance under all conditions of weather can do much to improve the operation of commercial air transportation both for the purposes of safety and greater density. Automatic direction finding may even be geared to the radar system someday thus providing the U.S. and Canada with a new complete airways complex. (Monitor of off course parallel flights and implementation of the block-traffic system).

One last factor of sufficient magnitude is the personnel presently assigned to air defense. Since the destruction phase of the air defense mission corresponds so closely to the offensive role of combat units, little difficulty should be encountered in the integration of the bulk of these personnel into other combat missions. For the greater part, the pilot personnel should have no difficulty adapting themselves to the tactical or day fighter missions. The other major portion of this personnel group, the maintenance people, are universally useful in any category of missions providing they work with the same equipment.

When examined even in its broadest scope, it appears that the air defense system possesses sufficient versatility to make the amortization costs far less painful to bear than the cost of battleships or atomic cannons.

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SOLUTIONS SEMINAR NO. 4

D

AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
Date Submitted

STUDY NO. 1954-6 **SEMINAR NO.** 4

(Scheduled dates 4 Jan - 30 Jan 54 **)**

INSTRUCTOR

STUDENT CHAIRMAN Col Hall

SEMINAR MEMBERS:

1. Col Bailey
2. Col Campbell
3. Col Newton
4. Col Merrell
5. Col F A Rogers
6. Col Stinson
7. Col Dickerson
8. Col Galer

Col Wilcox

STATEMENT OF THE PROBLEM:

In general terms, analyse the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

SPECIAL PROBLEM OF STUDY TREATED:

Instructor's Signature
SHANNON CHRISTIAN
Colonel, USAF
Study Director

(Use reverse side for remarks)

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SEMINAR SOLUTION

STUDY NO. 6

AIR DEFENSE

SEMINAR NO. 4

SEMINAR CHAIRMAN: Colonel Hall

SEMINAR RECORDER: Colonel Wilcox

SEMINAR MEMBERS: Colonel Bailey
Colonel Campbell
Colonel Newton
Colonel Merrell
Colonel Rogers, F.A.
Colonel Stinson
Colonel Dickerson
Colonel Galer

MAXWELL AIR FORCE BASE, ALABAMA

22 January 1954

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I. INTRODUCTION

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Seminar 4's approach to Study [illegible] of "Air Defense," was interpreted as a requirement to study, evaluate, and offer constructive suggestions within the limits of the ADC plan itself. To have adopted any other approach would have involved factors beyond the scope of the problem. Therefore, we did not consider seriously a "new look" for the entire U.S. military structure but confined ourselves to consideration of an air defensive effort in the order of magnitude as that proposed by ADC itself.

We did not consider putting all our chips on the SAC retaliatory force, even though we cannot visualize a 100%-successful defensive effort. Whether or not there is merit in maintaining a 90% successful defensive effort, when the 10% failure may be sufficient to "kill" you, entails considerations beyond the scope of this study. We believe some defensive effort must be made, at least to the extent that the enemy cannot be absolutely guaranteed of successfully "killing" our retaliatory capability.

II. SUMMARY

Seminar 4's approach was to first consider in detail the second part of the problem as stated, i.e., to identify the factors ~~[illegible]~~ essential to a sound analysis of the development and employment of air defense forces as programmed for 1957. Once these factors were determined and agreed, a detailed study of each factor was undertaken, conclusions were formed,

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and justification given either for accepting the program as planned or for recommended changes thereto.

The entire study was conducted within the framework of the four agreed missions of the Air Defense Command, i.e., detection, identification, interception, and destruction.

Factors which were agreed as essential to any such analysis of the subject of air defense were as follows:

a. Capability of the enemy, or character of threat.

b. Concept of what is to be defended and manner.

c. The air weapon system.

d. Control and warning in support of the air weapons system.

e. Organization and command.

The seminar agreed that the enemy threat as envisioned by the ADC, in the time period under consideration, was essentially of the magnitude and capacity indicated. It was further agreed that improved intelligence coverage of the recognized enemy, i.e., the USSR, was of near vital importance and no other lone factor so affects our entire air defense efforts. Lacking reliable USSR intelligence, our defense must be based upon our own capabilities for conducting offensive warfare. Such a blind approach creates a viciously sky-rocketing cycle which, if not managed within the economic limits of the country, might seriously undermine our entire air defense effort.

Seminar 4 agreed in general with ADC concept of what is to be defended but took exceptions with certain phases of the manner in which the defense was programmed for employment.

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The first broad exception stems from the agreed conclusion that the enemy is capable of reaching vital target areas within the United States (to include SAC bases) within two hours after passing the McGill Line (if he attacks via the northern route). Seminar 4 not only feels that such a small amount of warning time is intolerable but can be improved to give some four to six hours warning to the same complex of targets. This improvement can be accomplished within the limits of the established criteria.

In broad terms, the following changes were recommended to improve the probability of accomplishment of the four phases of air defense:

a. Delete certain south and central United States air defense forces and reinvest equivalent resources northward to the 70° parallel between Alaska and Greenland. This reinvestment would consist primarily of the establishment of two additional air defense bases at Port Radium, District of Mackenzie, and Coral Harbour, Southampton Island, Hudson Bay. This defense force is visualized to consist of airborne early warning and control (AEW-C) units and a limited amount of fighter type aircraft. This will provide a mobile defense force utilizing the techniques and tactics similar to the hunter-killer packs. We believe this transfer and redeployment of available resources represents an over-all gain for our air defense.

b. The weapon system programmed for the defense line running from Newfoundland ~~Greenland~~ to the Azores should be shifted north and east to extend from Greenland to Iceland to Scotland. This redeployment will improve and

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extend radar detection and control in the areas most likely to be penetrated.

c. In order to increase the kill potential of the defensive fighter force it was concluded that a proportional amount of day fighters (preferably with all-weather pods when available) be programmed to augment the present system quantitatively. A review of the maintenance complexities of the day fighter against the all-weather fighter indicates that aircraft-in-commission rates will be materially increased and at the same time the logistics, training, and personnel problems will be reduced. A detailed study of such factors as probable weather conditions, AOCP's and ROCP's, indicates that this action will not negate the overall all-weather capability and will greatly enhance the cumulative operating potential, i.e., the kill potential.

d. In the interest of securing more air defense per dollar spent, the seminar next reviewed the 1957 ADC program for seaward extension of contiguous radar coverage employing a combination of picket ships and AEW&C aircraft. In the light of known airship (blimp) test results in a similar role, it was agreed that serious consideration should be given to the possibility for programming airships to replace a majority of picket ships and AEW&C aircraft in the 1957 ADC program. Our investigation revealed that the operating cost of airships over picket ships and/or AEW aircraft is approximately one to three, while providing the more effective platform for AEW&C. Airship weather restrictions proved to be minor in nature.

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e. Data handling and processing techniques should be exploited using equipments already commercially available or within the present technological developments. This action will permit immediate flow of radar search data, range and azimuth from any number of radars to a composite collection point over existing medias of communications; provide a means to project this data on a ~~horizontal~~ vertical screen for evaluation and action. These actions will increase the traffic handling capabilities of the system by a factor of 4 or 6, dependent on type of radar; reduce the plot-tell time from two or three minutes to one-eighth of a second from distant radars; and provide, because of tube characteristics, a two-minute history of all tracks which is not presently possible. This equipment can, since it is of the building block type, be used in NEAC, AAC, TAC, and overseas sites upon the advent of the Lincoln project.

The factors of ECM and IFF were recognized as serious deficiencies within the complex of the over-all system, including ground and air. No specific recommendations are offered, except to denote the vital criticality of the absence of same and restress the need for a high degree of emphasis on these subject.

A cursory review of the current organization and command of air defense force resulted in the recommendation that a unified command for the aerial defense of the United States and Canada be considered. Certain revisions for the internal organization of the ADC were also suggested.

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In conclusion, our evaluation of the ADC problem has led us to make specific recommendations. We realize the need for further detailed and precise study before these several recommendations could be adopted. We submit that such study should be performed without delay in order that maximum kill potential per dollar invested can be accrued to the United States.

III. DISCUSSION

A. Capability of the Enemy or Character of Threat.

An obvious weakness of the air defense of the United States is the limited amount of available intelligence information. Intelligence information is meager upon which to base predictions of Soviet capabilities in 1957. It is to be hoped that increased information will permit accurate and timely assessment of Soviet capabilities and specific intentions. As it is not certain that such information will be available, intelligence sources cannot be relied upon to furnish warning of imminent attack.

Clearly, under these conditions, the United States has no alternative but to construct and maintain an air defense at least capable of preventing an attack against our own retaliatory capability from being a certainty of success. To this end improvement in our knowledge of the Soviets would pay enormous dividends in that we could design our own defensive effort to counter best a specific threat. Logically, then, improvement in the amount and quality of our intelligence information is the course that United States efforts must pursue if we are to bring into sharp focus our military structure. Seminar 4 is not able to do more than recognize the vital necessity of this requirement as knowledge of the United States effort in the intelligence field is not available. The scale of intelligence effort, the talents available for its direction and implementation, and the expected degree of success are not known. We believe, however, that success is vital and should be accomplished as the priority requirement.

In our opinion, the estimated Soviet capability upon which ADC's 1957 plan is based represents a maximum Soviet capability. This, we have concluded, is sound. It is noted, however, that the Soviet could be developing his force along entirely different lines other than manned aircraft - that is, he could be concentrating on inter-continental ballistic missiles which could negate all or most of our defensive measures. We conclude, therefore, that our air defense structure, while designed primarily against the most probable Soviet threat (TU-4's, Type 31's) must maintain flexibility to meet eventualities.

In brief, the Soviet is estimated to be capable of attacking the United States in the 1957 period with:

a. Manned conventional aircraft - TU-4's, Type 31's, IL-28's - and high performance subsonic bombers.

b. Submarine-launched guided missiles of V-1 and V-2 types. This weapons system gives the enemy a capability of reaching vital target areas in the United States to include SAC bases within two

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hours after passing the McGill line, if he takes a [illegible] northern route.

B. <u>Concept of What is to be Defended, and Manner:</u>

We of seminar 4 are in substantial agreement with the ADC concept of the "vulnerability" of the United States as a target for air attack. There is apparently little, if any, improvement that can be made of the ADC method in the determination of the United States "vitals" that must be protected. We agree that these "vitals" are:

a. The United States retaliatory force (SAC).

b. The United States war industry.

c. The United States population centers.

d. AEC installations.

e. Government control centers.

Because of the many imponderables and the complex interrelations of the several components listed above, we do not consider it feasible to establish a priority listing. There is little merit in preserving our AEC installations, for example, if in so doing we expose our civilians and industry. Happily, however, protection of these several components are not mutually exclusive and not, in all cases, competitors for the same <u>means</u> of air defense.

We believe in and endorse the ADC proposal to provide:

a. "Double perimeter" defense around the vital northeast and far western sections of the United States.

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b. Island defensive points for isolated, but strategically important points scattered throughout the remainder of the country.

In brief, we subscribe to and believe in the concept of defense of the United States retaliatory capability.

Under such a concept defense of the bomb carriers themselves becomes of prime importance. Most effective of the defensive means available to accomplish this vital defense is to provide adequate early warning to permit realistic evacuation of these carriers from their home bases. A warning time of four to six hours is required to provide for the implementation of such a plan.

We are concerned with the vulnerability of the ADC warning and control system because of its heavy reliance upon civilian-run communications. Similarly, we suspect that SAC's vulnerability to sabotage damage represents a high risk.

C. The Air Weapons System:

Present:

Today's air defense system has a limited effectiveness against high altitude TU-4 attack and almost no capability against low altitude night attack. Estimated kill potential against the former is 30%, versus 2% to 5% against the low altitude night threat.

The weapons system itself is in the process of converting to an all-weather force and expanding from its 1952 force of forty squadrons to a total of fifty-seven squadrons by 1955. AAA forces consist of approximately sixty battalions of AA guns of various types and

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one Nike battalion deployed around 15 to 18 potential targets. By 1955 the low and high altitude kill potential will have improved considerably. Forces will consist of the following:

39 squadrons F-86D's
2 squadrons F-94C's
16 squadrons F-89D's

30 90mm. battalions
28 Nike battalions
8 Skysweeper battalions

Programmed: (Tentative)

In 1957 it has been estimated by Air Defense Command that air defense forces will consist of the following:

61 Fighter-Interceptor squadrons:
12 of F-102's
15 of F-89D's
34 of F-86D's
Plus 2 Bomarc squadrons.

60 Nike battalions
8 Skysweeper battalions

The interceptor aircraft are all programmed to be equipped with Falcon, a guided aircraft rocket. F-86D's and F-89D's will have only a limited capability against newer type Soviet jet and turbojet bombers. Estimated performance of various USAF interceptors is shown on the attached chart (Tab A).

The F-102, MX-1179, and Bomarc have had several production slippages and may slip further. If the above program can be met, which is doubtful, ADC has estimated that this force will have a kill capability of:

40% against high altitude day attacks.
45% against low altitude night attacks.

It can be seen that the low altitude capability has been considerably improved by the completion of the low altitude coverage

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system prior to 1957. In this period the curve of high altitude effectiveness will have flattened off in the above ratio because of limits on F-86 and F-89 performance and because the quantity of the force has failed to keep pace with the increased numbers of enemy bombers (and A-bombs) available to the USSR in the 1955-57 period. Given sufficient warning time of six to eight hours, which will not be available, this kill percentage could be improved about 10% by the use of augmentation forces from ATRC, TAC, SAC, ANG, and Navy. However, additional interceptor aircraft on hand are still needed to <u>insure</u> the obtaining of any substantial improvement in air defense effectiveness.

Yet the total cost of the air defense system by 1957 will have reached $15.5 billion, and annual operating costs will continue at the rate of $1.5 to $2 billion per year. It will cost an additional $2 billion or more in initial costs alone to completely equip the system with F-102's, Bomarc, and Nike B.

The high initial and operating costs of the completely all-weather system, plus the other troubles expected in its operation and maintenance, suggest a re-examination of the basic requirement for such a system.

The weather in the United States is seldom, if ever, bad over more than one-third of the country, and it would not be possible for the USSR to attack all areas from all altitudes in bad weather, or even to do so against 50% of their targets. An examination of weather conditions in the United States shows that (1) weather over the

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southwestern United States has clear to scattered cloud conditions approximately 90% of the time, (2) samplings from other areas show that clear to scattered conditions exist over other sections of the country according to the following percentage averages per year. Recorded data covers a five to fifteen year average.

Northeast:

Mitchel AFB, N.Y. - 46.5% of year (low 40% in May; high 54.2% October)
Washington, D.C. - 46% of year (low 38% Jan.; high 54.7% October)
Pittsburgh, Pa. - 40% of year (low 28% Jan.; high 51% Aug.)

Mid-west:

Minneapolis, Minn. - 45% of year (low 32% Dec.; high 59.9% July)
Chanute AFB, Ill. - 45% of year (low 36% Dec.; high 58.5% October)
Omaha, Nebraska - 55% of year (low 39% Nov.; high 75% Sep.)

West:

Seattle, Wash. - 33% of year (low 19% Jan.; high 57% July)
San Francisco, Calif. - 52% of year (low 38% Feb.; high 62% September)

To sum up, over the areas of the worst weather, CAVU conditions exist at least one-third of the year, and in many areas of the country the percentage is 50% or better. In the case of enemy bombers flying at high or minimum altitudes, the possibility of intercepting above or below the overcast greatly increases the percentage of time that visual interceptions could be made. Brigadier General Bennett, Commanding General 25th Air Division located in the northwestern United States, advised that the day fighters, until recently assigned to his command - made successful contacts between [illegible] of the time when scrambled.

The initial cost of an all-weather interceptor is over one million dollars, at least $2\frac{1}{2}$ times the cost of a $300,000 day fighter (see Tab B). Higher operating and maintenance costs for the all-weather type are in about the same ratio. Skill levels required to operate and maintain the increasingly complex all-weather interceptor will be high. The Air Proving Ground estimated the F-86D will be seven times as hard to maintain as the F-86E or F, and the F-102 - MX-1179 combination is far more complicated. The in-commission rate of F-86D's averages 30% to 40% today as compared to 85% to 90% for the day fighter. The requirement for skilled personnel is steadily increasing throughout the entire USAF, yet there is every indication that skilled personnel will be more critical in the future than they are today.

The all-weather interceptor and its fire control system are extremely weak against a maneuvering target, and its electronic gear is subject to enemy jamming. The day fighter, with a 7.33 load factor, using guns or a large number of small rockets (1"), would have an approximate two-to-one advantage over the all-weather type against a maneuvering bomber in clear weather.

The day fighter can be equipped with a removable electronic pod now under development. Such a pod will provide a search and track A/I capability with about a 25 mile search range. This would be suitable for night operations or limited day bad weather attacks. The pod, unlike built-in A/I, would not ground the aircraft when the electronic fire control system is out of commission, as it could be removed for maintenance, or in CAVU weather.

Day fighters, such as the F-104, will have better performance than the F-102 (Tab A), and could be procured and operated at the previously mentioned cost ratio of $2\frac{1}{2}$ for each F-102. To obtain operational articles in the 1957-59 time period requires that procurement be initiated during 1954.

Considering the above facts it appears that a change in force composition and deployment, as shown on the attached chart (Tab C), would increase the over-all air defense kill capability by as much as 20%. The suggested force would be manned by an approximate combination on an order of magnitude of:

40 squadrons of all-weather interceptors and
40 squadrons of day fighters (with a night capability).

Such a force could be procured and operated for the same money as is now programmed, and with less skilled personnel than is now required. To determine the exact composition of forces required, war gaming of a variety of situations must be done!

In addition to decreasing the susceptibility of the force to electronic countermeasures, it would greatly lessen the training problem of the operational commander. New pilots and mechanics could be given six months to a year in the day fighter before progressing to the more sophisticated all-weather types, and be better prepared in that type in a shorter time period with the additional experience gained. The in-commission rate of the day fighter will be as much as 20% to 30% higher than the all-weather type, thus permitting more aircraft to get in the air.

In an additional effort to reduce complexity, decrease the effectiveness of jamming the F-102, Nike and Bomarc, and correct the deficiency of the F-102 and Bomarc at low altitudes, a cheaper missile is also suggested in lieu of some Nike's or Bomarc's. A missile such as that suggested in RAND study RM 1081 with a Mach .9 performance from 0 to 45,000 feet has sufficient capability to meet the expected threat from subsonic bombers during 1957-1960. With an estimated effectiveness of three to four kills per million dollars, it would be five to ten times better than interceptors or local defense missiles. It could be vectored by GCI, and the simplified guidance system proposed made it easier and cheaper to produce and operate. Again, more could be put in the air for less money than our present costly and complex systems require!

Long Range Aircraft:

The other major air defense deficiency is the lack of a suitable aircraft to adequately cover the seaward extension of radar coverage and the proposed northern early warning line. The F-89 offers a limited capability, but will be phasing out by 1957. It is understood that a long range interceptor is being considered for the 1958-1960 time period, and a modified F-101 is under consideration.

The present F-101, unmodified, is considered suitable for the task, and suitable quantities should be procured. Its present armament and fire control system provide an adequate kill potential. The F-101 radius of approximately 1500 nautical miles on an interceptor mission would furnish this aircraft with an excellent capability for tracking enemy bombers when first detected - its primary mission - and destroying some enemy aircraft. Further details of this concept will be explained later.

Atomic Warheads:

The use of atomic warheads in surface-to-air or air-to-air missiles might be effective against certain Soviet tactics. If any formation or close concentration of aircraft is used by the enemy in an attempt to saturate our defenses, such a weapon would be effective. The chief value of having such a munition is the threat it imposes. This will force the enemy to spread out, thereby decreasing the possibility of saturation. For this reason a limited number of weapons should be made available for air defense use.

Modification and Development:

The F-86D and other aircraft have already been modified several times. The cost of such programs in dollars and time lost is often high and usually of marginal value when weighed against the questionable increase in operational efficiency.

The modification of the F-86D to provide a Falcon capability requires almost complete reworking of the aircraft. The expense is not considered worth the gain in efficiency for this type with its marginal capability during 1957 to 1950.

Some means must be found to get new equipment operational faster, without increasing the number of modifications later found necessary after the article has been properly tested. A system of building six or seven hand-made prototypes of two or more different manufacturers before selecting a production article appears desirable. This would provide more selectivity, additional test time, and should result in less cost in dollars and time than the present eighteen months slow build-up system.

D. Control and Warning:

An examination of the 1957 end position of ADC with respect to its aircraft control and warning investment reveals some weaknesses which we consider most serious. These weaknesses are discussed in the paragraphs which follow, together with our suggested courses of action which can be taken to remedy or minimize the effects of these weaknesses.

Outstanding among all weaknesses considered is the almost total neglect of the ECM problem and the inadequacies of present identification measures. When we consider the ECM possibilities open to the Soviet (especially enhanced by our proclivity for advertising our own weapons systems) it is readily apparent that he can, for a relatively modest expenditure of effort, completely negate our detection and weapons control system. Although the Air Force has, for seven years, spent fourteen per cent of its dollars and manpower on communications-electronics activities, scarcely a fraction of one per cent of our electronics investment has been dedicated to ECM. Of the minuscule efforts taken, nearly all of it has gone into our offensive weapons system (SAC).

Irrespective of the merits of our AC&W posture, including the outward extensions of our warning lines by either surface or airborne means, and irrespective of our Nike and interceptor developments, any or all of these instrumentalities can be neutralized or negated by means now available to the enemy - and at a cost to him of only a small fraction of his weapons-carrying force.

Identification, a cardinal factor in exploiting the air defense weapon and increasing the kill potential is far from satisfactory. Present methods of using flight plans, visual means and "ADIZ" procedures are far from satisfactory and impedes the progress in exploiting intercepts. Emphasis must be placed on this program to provide a satisfactory, rapid-secure means of identification for all aircraft including military, civilian, or commercial. In the interim every step should be taken to expedite the establishment of the multiple-corridor funnel approach system on the northern border and coast lines.

We recommend this problem receive the highest level attention; that the ECM program receive greatly increased efforts in the areas of: research, development, engineering and production, training (including pilot training), and operations. The anomaly of Army responsibility for ground ECM development of devices and techniques having so profound an influence upon the Air Force roles and functions must be corrected without delay. This is a problem not alone threatening the effectiveness of our air defenses but one of no less gravity in the employment of strategic and tactical air power.

Another weakness in the 1957 program appears in the highly questionable utility of the 79 "mobile" radars planned primarily for additional ZI employment. While it is conceivable that some of these radars can be justified in certain key approach areas to enable the employment of interceptors at greater ranges from vital targets, the majority of these radars are programmed for installations in areas far removed from either the vital targets or the possible direction of enemy approaches. It is our considered judgment that at least fifty of these 79 radars could be deleted from the 1957 program with no appreciable degradation of air defense for the areas considered vital to national survival. The dollar savings possible from this decision would be approximately as follows:

a. Capital investment of 50 radars (each 4.04 million) . . . . 202 million

b. Annual operating cost. . . . . 95 million

(Nearly 300 million dollars saved in first year of operation.)

An examination of our northern perimeter system - even based upon optimum effectiveness of the "McGill" line (which can afford only "warning" - no combat potential), reveals that fourteen SAC bases and the major share of our industrial complex (practically all the entire vital northeast) lie in an area less than two hours T-31 flight time from our earliest possible warning. Our intelligence estimates Soviet possession of T-31 aircraft in significant numbers by 1957.

In view of this serious situation the following plan is proposed:

PLAN FOR PROVIDING ADVANCED EARLY WARNING FROM NORTHERN APPROACHES INCLUDING A DEFENSE IN DEPTH CONCEPT--
(MOBILE AIR DEFENSE FORCE)

1. Situation

The ADC has stated that the defense system programmed for 1957, operating at its ultimate effectiveness, could only attain a 52% kill ratio against an attacking bomber force. It was pointed out that the forces allocated to the ADC were inadequate for countering the Soviet long range bomber threat. With the limited forces and resources available the system for air defense must be evaluated as to how the effort should be expended wherein the end result would provide the greatest deterrent to an all-out war in the atomic age. As brought out in the "Kelly Report," the greatest deterrent we have to an all-out atomic war with the Soviet Union is the capability of our retaliatory air arm to rain devastating destruction on them far in excess of their capability to hit the United States. In view of this relative position between the USSR and the U.S. it means we must have first a defensive system which will be capable of making our atomic offensive retaliatory air arm reasonably invulnerable to initial attack. The best known method for accomplishing this is by providing adequate advanced warning of an attack in order to allow SAC aircraft to be evacuated from the usual ZI bases. Considering the 1957 ADC program the advanced early warning provided is inadequate for a high percentage of SAC bases with relation to possible enemy routes of attack from the north and northeast.

2. Operational concept for providing adequate early warning of an impending Soviet Long Range Bomber Attack employing approach routes over the arctic circle and northern Canada.

The objective for this element of the defense system is to provide by 1957 at least four hours advanced early warning of an impending Soviet bomber attack employing aircraft comparable in speed to our B-47's. It was considered that four hours would provide sufficient time for SAC to effectively evacuate its bases with a minimum loss of its carriers. In addition, the advanced warning would increase the effectiveness of the inner "heartland" air defense system by (1) increasing the state of readiness of ADC interceptors, (2) permit SCATER and CONELRAD to be effectively implemented, (3) permit augmentation forces to be deployed, (4) change rules of engagement, and (5) alert civil defenses. The advanced early warning line must also have the capability to effectively deal with the problem of spoofing. To accomplish this the system must provide for a limited capability of interception and destruction. In consideration of the many tactics that the enemy could employ with relative freedom from surveillance and attack after penetration of the early warning line, there is a need for continued surveillance, interception, and destruction of the enemy force after penetration.

Concept for providing this capability is to employ the hunter-killer technique using a mobile defense force. This defense team will keep the enemy under surveillance and attack from the point of detection to the inner "heartland" defenses of the North American Continent. The objective is to provide defense in depth from the advanced early warning line to the border of the double perimeter defense system.

3. Operation plan for implementation of the defense concept.

To close the early warning gap presently existing along the northern approach over the arctic an early warning radar line will be established along the 70° parallel from the Alaskan air defense complex to the east coast of Greenland. The easterly termination of the line will tie into the distant early warning barrier to be established from the east coast of Greenland, across Iceland, and thence to Scotland. The establishment of this line will provide a minimum of four hours advanced warning of an enemy air attack to the perimeter of the inner "heartland" defense system.

To provide a dynamic and mobile early warning line the plan calls for the utilization of AEW aircraft over this land route. Two operational procedures are feasible for the employment of AEW aircraft. One procedure is to operate a continuous double line from Alaska to Thule. The other method is to place the aircraft on stations along the EW line. The latter procedure was selected because it provided the base complex which made it feasible for using the hunter-killer technique to keep the enemy under surveillance and attack from the point of detection. With this added capability of defense in depth it denies the enemy freedom of tactical employment over northern Canada, such as refueling, launching from TU-4's or T-31's wing coupled IL-28's or air-to-ground missiles of 500 mile range. The TU-4's and T-31's would be under attack before they could effectively employ the IL-28's or the guided missiles. This operational concept exploits the geography of the North American Continent and the mobility of the AEW aircraft.

Ten AEW stations are required to cover the 2,000 miles of the early warning line. Based on the analysis that it takes five AEW air-craft to man one station on a 24-hour commitment, a total of fifty AEW aircraft will be required for this phase of the system. The AEW air-craft will be equipped with a top mounted surveillance radar providing 200 miles range and up to 60,000 feet coverage (a B-47 type aircraft), a height finder radar (type to be similar to the gun laying radar), capability to couple fighters on wing tips or under fuselage using FICON technique, and upon development of the AMTI principle locate under the nose section a low level surveillance radar. AEW aircraft must have a capability of traveling 500 miles to station and provide eight hours endurance on station with two hours reserve. Cruising speed 320 miles per hour with an on station flying capability at around 200 mph or less.

The hunter-killer technique will be employed using the same AEW aircraft and jet all-weather fighter interceptors. Ten additional AEW aircraft will be required. The jet all **weathor** interceptors must have a combat radius of 400 miles, service ceiling of 50,000 feet, and

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modified for wing tip coupling or hooking under the fuselage of an AEW aircraft. Fighter aircraft must have the capability of employing FALCONS and rockets. Also, aircraft should have the capability of employing the "A" weapons. Minimum fighter aircraft required would be fifty.

To logistically support the AEW aircraft on station and provide an operational base for the hunter-killer teams, two bases are required in northern Canada. The locations in northern Canada that could meet the operational requirements are Coral Harbor in the Hudson Bay area and Port Radium on the shores of Great Bear Lake. The Hudson Bay area is open to shipping from the States and from the railhead at Churchill. Shipping by sea can be planned from March to late October. Equipment can be moved across the ice in winter from Churchill. The area around Port Radium using the Mackenzie River system can have equipment shipped in by using road, river, and lake from Edmonton to Port Radium. The river is open to traffic from the first of June to late October. Equipment can be stored at Mills Lake during the winter for transfer up the Mackenzie River during the summer.

The two bases would also provide the ground communications stations for relay of defense information back to Canada and the inner "heartland" defense system. The bases would be tied into the Alaskan communication system at Eilson and into the NEAC communications system at Thule, Goose Bay, and Newfoundland. For positive relay of detection and tracking information, airborne data relay aircraft are required.

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The AEW aircraft at the two bases can be used for the relay mission within their area by providing the first leg for keeping in contact with the hunter-killer teams as they move with the attacking force. However, as they move further south toward the U.S. and Canadian border there should be at least five data relay units along the 50° to 54° parallels to transmit information on the attacking force. Possible locations are Edmonton, Churchill, Goose Bay, Newfoundland, and Courvette Island. These units would relay the information from the hunter-killer teams to the base communication system for retransmission to the inner "heartland" defenses. Also, these bases could be used at a later date for employing additional hunter-killer teams. Relay aircraft would only become airborne after a raid was detected.

To aid the navigational capability of the AEW aircraft in this area there is a need for the establishment of a Hyperan system. The system is inexpensive and its operational characteristics can be compared with SHORAN. Its order of accuracy can be designed to meet the operational requirement of the defense system.

Tab has a chart showing the tentative layout of the defense system showing proposed location of the EW line with necessary stations, two bases, and data zone relay units.

4. . <u>Aircraft that could meet the operational requirements.</u>

Taking into consideration tactical aircraft in the Air Force inventory that would be phased out in the 1955 and 1956 period, the B-50 would make an excellent platform for the AEW aircraft to be employed along the EW line. This aircraft could be modified to meet all the requirements; however, as the basic aircraft for the hunter-killer team, it would only be an interim measure until aircraft of the B-47 type could be made available. The aircraft, radar wise, would have the top mounted, stabilized antenna, AN/APS/20B. This technique has been successfully employed by the Navy in recent tests using the B-17 aircraft. The radar system would not give low altitude coverage to any great extent below the level the AEW aircraft is flown. However, the radar operator using the technique of tilting the antenna can detect low level penetration below the altitude of the AEW aircraft by riding the bottom lobe just above the ground clutter return. To provide height-finder capability the AN/APS-45 radar would be installed in the nose of the aircraft. This would not give 360° coverage for aircraft blockage would cut out approximately 60°. This could be compensated when needed by turning the aircraft slightly. In the future a test could be made to determine if radar techniques inherent to the gun laying type would be more satisfactory as a height finder in AEW aircraft. Limited control and passive detection capability would be added.

As stated above, the B-50 could fit in the interim period as the basic aircraft for the hunter of the hunter-killer team. As the speed of the Soviet Long Range Air Force bombers reach around : ..9 mach there is a need for an AEW aircraft that would have comparable speed capabilities. The B-47 aircraft has the speed range and the basic platform to meet this requirement. It is doubtful if the aircraft could

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couple fighters on its wing tips but certain long range jet fighters could be used with it to provide the kill capability.

Considering again existing aircraft hardware that could be available for use in the killer part of the defense team, the F-94C could be modified to do the job. The aircraft has been scheduled to phase out of the program by 1957; therefore, it would not decrease all-weather fighter-interceptor capabilities in the inner "heartland" defense system. The F-94C would only be effective if employed with the B-50. If the hunter was the B-47 type, a different type of aircraft would be needed to meet the killer requirement. The B-47 could not carry aircraft coupled to its wing tips; therefore, the killer aircraft would have to have a comparable range with the B-47. One jet fighter aircraft under test and scheduled for early production that could meet this requirement would be the F-101.

It is realized that it does not sound logical to provide this means of defense in depth from the northern EW line and leave the sea approaches open after penetration of the barrier. The extent we have covered is limited by the problem presented that we had to stay within force commitments programmed in 1957. The concept is practical for providing defense in depth over the sea approaches, but at a higher cost. This phase of planning is to exploit the geographical advantages of the ground terrain available for our use in northern Canada. The second phase would be to provide the same type hunter-killer team coverage from the sea approaches. The problem would have to be approached from the

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viewpoint of providing long range high speed AEW aircraft surveillance from the barrier, to operate as trailer aircraft. It would provide vital information needed to have hunter-killer teams, based along the sea coast, intercept the attacking forces out to sea and perform the interception and destruction phase of the defense mission. This would extend our defense system 1,000 to 1,500 miles out from our coastline and provide surveillance from the point of detection by the EW barrier.

5. <u>Cost of a northern early warning barrier and mobile defense force</u>.

To attain an estimated over-all figure for costing of this increment of the defense system we covered (1) cost of air base construction, and (2) capital and operating costs for the AEW units.

a. Base construction cost.

Actual cost estimates for construction in the mid-Canada area were not available. To present an over-all cost figure a comparison was made between the type installation required at these bases to Thule. Since the bases are not as elaborate as Thule and the cost factor relationship between construction at Thule and mid-Canada is 4 to 2.5, it was estimated that the cost of each base would be around one hundred million dollars. Thule construction cost was slightly over two hundred million dollars.

b. Capital and operating cost for AEW squadrons.

Major equipment	
Mission acft ($200,000 ea; total 60)	12,000,000
Airborne Electronics (1 million per acft)	60,000,000
Minor equipment (two squadrons)	
Organizational equipment	10,136,000
Initial Stock level	10,136,000
Initial training cost & travel	15,060,000
Total Capital	107,332,000

Annual operating cost.

Personnel:	
Training	3,624,000
Pay and Allowances	15,348,000
Travel	348,000
Civilians	888,000
Maintenance:	
Mission aircraft	29,940,000
POL	11,664,000
Services and miscellaneous	328,000
Indirect Services	1,160,000
	63,300,000

Total cost for first year operation of AEW aircraft including capital investment equals - $170,632,000.

c. Total cost for establishing the advanced early warning line and mobile defense force including first year of operation:

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Cost of air base construction (2 bases)	200,000,000
Capital and first year operational cost for:	
Two AEW squadrons (30 a/c each)	170,532,000
	370,532,000

(Of the total $63,300,000 is for annual operating cost. Capital investment totals $307,332,000.)

(Cost of establishing the automatic data zone airborne relay units were not included. It is realized the cost for a unit of this type could be made very low since aircraft of the C-47 type could be employed. For the purpose of this problem the five relay units could be left out since the AEW aircraft of the base would trail a penetrating force to provide the relay back to the home base. No additional aircraft would be required.)

In consideration of this program as compared to the ADC 1957 program the cost of the two fighter interceptor squadrons would not be in addition. Two of the squadrons located in the CADF area, such as Tinker and Smoky Hill, would be transferred to operate at the two northern mobile defense force bases.

Another major weakness is seen in the Navy program to extend an early warning line from Newfoundland to the Azores. This plan is based upon assumptions so tenuous as to engender incredibility. An examination of our NEAC and Iceland air defenses, on the contrary, immediately suggests the minor effort required to interconnect these systems and bridge the gap into the UK. Such interconnection could easily be done with picket ships and/or AEW aircraft at a fraction of the cost underlying the Navy proposal. This suggestion additionally has at least the

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equivalent by-product value in submarine detection (the LOFAR system) and adequate early warning to the northeastern part of the United States.

In the interest of attaining more air defense per dollar spent the 1957 ADC program, for seaward extension of continuous radar coverage by employing a combination of picket ships and AEW&C aircraft, should be re-evaluated in light of known airship AEW&C test results. Recent Navy and Air Force tests of the ZPG airship as a platform for AEW&C have found that it was able to track B-47 aircraft at 30 to 40 thousand feet and down to lower altitudes. Even with test over the Florida mainland it was tracking low flying aircraft of the B-29 type 80 miles from the station. The APG state in their evaluation that results obtained were far better than anticipated and that the airship provided the most effective and economical platform for AEW&C.

The ZPG or MAN airship was constructed as an ocean airship. It can carry two crews and it is designed for 90 hours on patrol. The airship can carry sonar, MAD, infra-red, sonor buoys, radar, and ECM. It can control aircraft for intercept and relay radar information back to a central collecting point. In addition, it has the capability of in-flight refueling and could stay on station as long as desired. Of the many uses that the airship could be placed to, none exploit its over-all capability to such a degree as when employed as a radar platform. Operating cost is one-third that of either a picket ship or an AEW aircraft. Over water it can use different types of radars to gain optimum high and low altitude coverage.

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Weather limitations is the major problem that must be overcome in airship operation. The craft has limited operation under icing conditions and high winds. Along the east and west coast this type of weather has been recorded to exist about 5% of the time; however, it is easily forecasted.

To exploit the capability of the airship as an AEW&C platform, even considering the weather limitations, immediate steps should be taken to program airships to replace the picket and AEW&C aircraft in the 1957 ADC program for the extension seaward of the radar coverage. Planning for the same station locations as established for the picket ships and AEW&C aircraft, it will increase the effectiveness of the radar coverage and provide ASW coverage all at one-third the capital and operating cost. The AEW&C aircraft released from this assignment should then be developed as the hunter aircraft of the hunter-killer team to be deployed along our seacoast approaches. The secondary mission for these aircraft would be to replace the airships during the 5% weather period that is beyond their operational capability. The picket ships could be programmed for employment in the Greenland to Scotland EW line. In the 1957 ADC program the force requirement for AEW&C aircraft could be reduced one-third and the picket ships one-half.

System's Concept.

A general statement is made in the 1957 program that data handling and transmission in the northeast and western U.S. will be improved as a result of the introduction of semi-automatic data handling equipment. However, with the decision made in April 1953 that the ADIS system would not be used and instead the Lincoln transition system would be employed, it is doubted that adequate plans have been established to provide an interim system for semi-automatic data handling. The Lincoln system, although all automatic, does not employ the building block technique. The first tentative set is to be available in 1958 and then only one division will be converted. Actually, the program isn't scheduled for completion before the period 1960-64. The ADC has not stated what they have planned to do in the interim period. Detection, identification, assessment of the threat, assignment and direction of the weapon, and controlled return to operational base has been discussed but little has been mentioned relative to the following:

1. The present ADC system of electronic defense is based primarily on radar concepts developed and used during World War II. Radical changes to the system would include such modifications as moving target indicator components, increase of power, tuneable (within a restricted band width that is vulnerable to barrage jamming) magnetrons and display systems. Little has been accomplished in reducing the requirement of human functions within the system and it is here in the handling process that much can be accomplished. Errors should decrease in proportion to the reduction of the human chain that is required to process any information as relates to:

Data gathering	Evaluation and decision
Data processing	Weapons control

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The <u>data gathering</u> portion of the system must provide facilities for target sensing and target location. Provision must be made for receiving data from other sources such as weather service and Army units. The significance and validity of data obtained must be verified by human operators. Useless data must be discarded immediately and ambiguous data properly annotated. Useful data must be encoded properly for transmission to composite collection points or area processing centers.

<u>Data processing</u> involves integration and correlation of all useful data concerning friendly forces, enemy forces, weather and all related data, and suitable transformation and display of all these data in the forms most readily assimilated by personnel in the process of evaluation and decision.

<u>Decision</u> must necessarily be largely a human function placing heavy demands on mental analysis and comprehension.

<u>Weapons control</u> requires varying degrees of mechanization depending upon the type of the weapon to be controlled. Weapons involved include all-weather interceptors, bombers, fighters, reconnaissance aircraft, antiaircraft artillery, electronic warfare, etc. Adequate means must be provided in the weapons control portion of the system for exercising effective control of a weapon selected in the execution of the commanders decision.

<u>Data gathering seems to be the foremost of the functions</u> since it includes the acquisition or position, identity and characteristics

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of targets entering and/or within a system. The other factors, even as important, cannot be effective without a high target seeking resolution and the capacity to handle excessive traffic. This task can be accomplished by the medias, such as ground radars, beacons, IFF, airborne early warning-AEW, electronic warfare-passive measures, D/F principles, acoustics, ground observers, and similar measures.

2. A review of the air defense plan indicates that up to and including 1957, two major steps will be accomplished to obviate problems relating to the aforementioned roles. These include:

a. The Columbia command computer.

b. The other additional attribute to the system will be the incorporation of low altitude gap fill radars that will act as acquisition radars to GCI stations. This project is the radar data transmission and assembly (RADATA) system. Equipments and technique has not as yet been developed. This action falls in the spheres of the data gathering and processing which are of foremost importance.

Present information indicates that these two major steps are planned interim measures to compensate for the late arrival of the Lincoln system, which automatize all of the four roles listed.

Thus action should be taken, which does not require any efforts in the R&D field, to apply tested and available techniques that would materially assist in the conduct of these four roles. Action taken should be compatible to and complement the two approved interim measures that will be applied to ADC radar systems through 1956 to 1958.

c. Recommendations to improve the system are three in number:

(1) TPI, target projection indicator, for plan position indicator information.

(2) 16" PPI-P-19 phosphor (zinc activated magnesium flouride) vice present 7" and 12" PPI-P-7 phosphor scopes.

(3) Data transmission system using SDV (slowed down video) technique.

d. These three recommended actions will materially improve the data gathering and data processing techniques. The first steps by the use of optical measures will provide almost instant means of projection on a vertical translucent projection screen the over-all air situation. This is a simple mechanism for the derivation of a clear picture of the air situation from a number of radar PPI pictures.

The second action will, because of the tube characteristics, permit two-minute retention of information on the screen. The long persistence furnished by the magnesium flouride phosphor permits easy determination of targets and since this phosphor has a large dynamic range and long storage characteristics of light (output) it more than compensates for the extended storage characteristics in the face of ECM.

The third application would be the introduction of automatic data transmission equipment. This system would use the RAFAX band width compressor. It is electronic, optical system which uses as inputs the synchronizing pulse and video signal from a radar set. The equipment is designed for unattended operation and can withstand reasonable power line voltage fluctuations without deterioration of the operating efficiency. The resolution is about 1 mile in 150 miles. Traffic handling of GCI stations will be increased by the factor of 4. The lightweight early warning radars will be able to handle the approximate traffic now handled by the CPS type stations. All these systems are either available or easily produced without any development requirements. The cost would not exceed $27,000 for equipping one GCI and two lightweight radars which would act as the low level acquisition sets.

The information flowing to the GCI would be automatically relayed from the early warning radars and low level lightweight radars and be ready for processing for projection within 1/8 of a second after the antenna has received a signal. The present telephone system will handle the compressed video information.

This action in effect could reduce the need for expensive mobile radar stations by substituting lightweight radars. In each case of substitution at lease one to two million dollars can be saved by this action depending on the area or environment concerned. The mobile radars programmed could then be used to satisfy tactical and overseas requirements. Personnel requirements of 225 people per GCI station could be reduced approximately 50% when substituting lightweight equipments for semi-mobile stations.

Equipment can be used in tactical and overseas operations upon entry of the Lincoln transition system into the Air Defense structure.

E. Organization and Command:

The air defense commander is responsible for establishing a command organization which will accomplish the air defense objectives and mission. With this thought in mind one must look at the present air defense objectives and mission. Considering the ultimate system programmed and planned for 1957 it seems the objective of air defense is moving from the defense of just the United States to an integrated defense of the North American Continent. Looking further into the future, the ultimate defense goal will most likely be the establishment of an integrated air defense system for the NATO countries or possibly for the nations of the Free World.

Viewing the objective of air defense in the near future as being the defense of the North American Continent certainly requires a review of the present ADC organization. From the time the ADC was conceived and established in 1951, the primary mission of the organization has been to provide for the air defense of the United States. Under this mission the Air Defense Commander exercises full command and control of Air Force forces allocated and primarily assigned to the air defense system. The only other force presently integrated into the air defense system is the Army Antiaircraft Artillery Command. The defense commander has operation control of the AAA which includes the authority to determine the deployment and redeployment of these forces. All other forces in the United States, including Air Force units of other commands, which have an air defense capability presently are planned for integration into the defense system only when authorized by higher authority. The present working relationship with Canada for air defense matters is on a coordinating basis. Each nation has its own defense system. The same problem exists with reference to AAC and NEAC.

To provide a sound air defense system, considering the high speeds of present day and future bomber aircraft and the lethality of nuclear weapons, requires a closely integrated system under one defense commander. One commander must establish the rules which would provide for maximum engagement of enemy targets with all forces available. It is the belief of Seminar 4 that every step should be taken to establish a Combined Air Defense Command for the North American Continent. This would weld all present systems into one, provide the needed centralized direction, and exploit the geography of the North American Continent. If this is not done it is considered doubtful that the maximum defense results could be obtained from the 1957 ADC program.

As an initial step toward the attainment of the N.A. Defense Command, it seems logical for the ADC to reduce their organization of defense forces to two; namely, disbanding the CADF. All units below the defense force level should be streamlined to reduce present chain of command pattern. This could be accomplished by eliminating at least one headquarters below the Air Defense Division level.

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IV. CONCLUSIONS

1. Present intelligence concerning Soviet Russia is woefully inadequate.

2. Highest priority in the United States defense effort should be afforded the requirement to protect retaliatory force.

3. Current and projected (ADC program for 1957) deployment of ADC does not provide an adequate degree of defense for the retaliatory capability.

4. The effectiveness of ADC (current and projected) could be increased by including a certain percentage of day fighters in its complement of aircraft (as opposed to 0-100% complement of all-weather fighters) with no increase in cost.

5. Present radar installations and control facilities do not take full advantage of present technology.

6. Present equipment and methods for positive identification of all aircraft flying within sensitive zones are inadequate.

7. The defense of the southcentral United States (as proposed by ADC) can be reduced to provide for extending the northern defense line northward to 70°N., between Alaska and the east coast of Greenland, with an over-all increase in effectiveness resulting.

8. The AEW line from Newfoundland to the Azores should be relocated northward to extend from Greenland to Scotland.

9. The ECM program, as currently operated and proposed for the future, is inadequate.

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10. By substituting blimps for picket ships our contiguous early warning coverage could be extended seaward much more economically.

11. There should be a unified command established for aerial defense of the United States and Canada.

12. The internal organizational structure of ADC should be revised for greater efficiency.

13. Continued emphasis and effort will be required to educate the American public as to the threat we face and the part they will have to play in the event of attack.

V. RECOMMENDATIONS

1. That the northern defense and EW line as proposed in Tab E, Section III, be installed without delay in order to provide the requisite early warning to protect our retaliatory force.

2. That the ADC complement of fighter aircraft be revised to include a percentage of day fighters of the F-104 or similar type.

3. That the system to increase the capability for data handling and processing as proposed in the system's concept under Control and Warning Section be procured and installed without delay.

4. That increased effort be expended in producing an adequate system for electronic identification of aircraft operating within sensitive zones.

5. That increased effort be expended to perfect the radar equipped blimp to the point where it can substitute for the picket ships proposed for the off-shore early warning coverage.

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6. That a unified command be established to provide for the aerial defense of the United States and Canada, to include NEAC and AAC areas.

7. That the organizational structure of ADC be revised as follows:

a. Eliminate the Central Air Defense Force and reallocate its area to the Eastern and Western Air Defense Forces.

b. Eliminate one headquarters in the chain of command below Division level.

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TAB A

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INTERCEPTOR FIGHTER PERFORMANCE

	ALL WEATHER FIGHTERS				DAY FIGHTERS			
	F-86D	F-89D	F-94C	F-102A	F-102B	F-100	F-104	L/Wt Northrup Proposal
Combat Radius	202 n.m.	396 n.m.	347 n.m.	400 n.m.	458 n.m.	380 n.m.	365 n.m.	350 n.m.
Speed	524 Kn @50,000'	482 Kn @40,000'	481 Kn @50,000'	824 Kn @35,000'	1173 Kn @35,000'	747 Kn @35,000'	1200 Kn @35,000'	1100 Kn @35,000'
Rate of Climb	16,000 1/m @ S.L.	11,000 1/m @ S.L.	14,000 1/m @ S.L.	19,000 1/m @ S.L.	48,000 1/m @ S.L.	18,000 1/m @ S.L.	52,000 1/m @ S.L.	51,000 1/m @ S.L.
Ceiling	50,000'	46,000'	52,000'	55,000'	58,000'	54,000'	54,000'	57,000'

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ESTIMATED INITIAL AND OPERATING COSTS OF
ALL WEATHER AND DAY FIGHTER AIRCRAFT
(From RAND Report)

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A. COST OF 61 SQUADRONS IN 1955 PERIOD:

Initial Costs			Annual Operating Costs		
Total	Per Sqdn	Per A/C	Total	Per Sqdn	Per A/C
For 36 Sqdns of F-86D's					
828 million	23 million	1 million	494 million	13-2/3 million	1/2 million
For 10 Sqdns of F-89D's					
391 million	39.1 million	1.5 million	199 million	19.7 million	4/5 million
For 15 Sqdns of F-94C's					
316 million	21 million	750,000	240 million	16 million	3/5 million

B. F-102 COSTS:

Initial Costs			Annual Operating Costs		
Total	Per Sqdn	Per A/C	Total	Per Sqdn	Per A/C
		1.5 mil.± in quantities of 1000 a/c			± 1 mil. a/c
For 61 Sqdns of F-102's					
912 million	15 million	600,000	998 million	16-1/3 million	3/5 million

C. DAY FIGHTER COSTS - F-86F or F-104

Initial Costs			Annual Operating Costs		
Total	Per Sqdn	Per A/C	Total	Per Sqdn	Per A/C
		±300,000			±1/4 mil.

TAB B

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SOLUTIONS SEMINAR NO. 5

E

AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
Date Submitted

STUDY NO. 1954-6 **SEMINAR NO.** 5

(Scheduled dates 4 Jan - 30 Jan 54**)**

INSTRUCTOR Col Shannon Christian **STUDENT CHAIRMAN** Col Hughes

SEMINAR MEMBERS:

1. Col Ballard
2. Col Carpenter
3. Col Dreiman
4. Col Kirkland
5. Col McDavid
6. Col G W Rogers
7. Col Priest
8. Col Grable

Col D E Wilson

STATEMENT OF THE PROBLEM:

In general terms, analyze the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

SPECIAL PROBLEM OF STUDY TREATED:

Instructor's Signature
SHANNON CHRISTIAN
Colonel, USAF
Study Director

(Use reverse side for remarks)

USAF-GAFB, Ala. (831374) 1000

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SEMINAR SOLUTION

STUDY NO. 6

SEMINAR NO. 5

SEMINAR CHAIRMAN: Col. Hughes

SEMINAR RECORDER: Col. Wilson, D. E.

SEMINAR MEMBERS: Col. Ballard
Col. Carpenter
Col. Dreiman
Col. McDavid
Col. Rogers, C. W.
Col. Priest
Col. Crable

MAXWELL AIR FORCE BASE, ALABAMA

26 January 1954

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SEMINAR NO. CONFIDENTIAL

The most significant threat to the security of the United States in the post war period has resulted from two developments achieved by the Soviets. On September 23, 1949, the United States learned that its monopoly of the A-bomb was over. President Truman announced that the Soviet Union had set off an atomic explosion. This news, coming two years ahead of the predictions by our scientists, caused great alarm in this country.

The second major development endangering our security is the Soviet long range air forces that has come into being within recent years. This technological feat reflects the importance and role that the Russians attach to strategic air operations in their goal of world domination.

Confronted by a potential enemy possessing the world's second largest air force and a stockpile of atomic weapons second only to that of the United States, the problem of national security becomes one of increasing importance in the governmental and public discussions. There is practically universal acceptance of President Eisenhower's analysis of the world situation and the "cold war". Our people have come to the conclusion that the "cold war" is likely to be with us for a long time, and that the United States must maintain a "military posture" which will insure our security over the long pull. A corollary to this conclusions is that we must find a way to maintain a strong military force in-being, and, at the same time, not endanger the economy of our nation.

Recent announcements by the President and the Department of Defense have charged air power with the role of providing the primary offense

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and defensive forces for the security of this country. The traditional role of the British Royal Navy in providing the first line of Defense to the Commonwealth for better than two centuries has now been placed on the Air Force insofar as this country is concerned.

Primary emphasis has been placed on the development of a strategic air force as the main deterrent to Soviet aggression. The potential striking power of this force has unquestionably played the major part in thwarting Russian moves for world conquest. The power relationship between the free world and the communist bloc can best be summarized by a statement made by Prime Minister Churchill. In 1950 he said: "It is certain that Europe would have been communized and London under bombardment sometime ago but for the deterrent of the atomic bomb in the hands of the United States."

The strategic air forces are charged with the mission of destroying the industrial complexes and war making potential of an enemy. In addition, they are charged with conducting counter air operations against the atomic capability of a potential enemy. Providing the strategic air forces could destroy the long range striking force and the atomic stockpile of the Russians, there would be little necessity for building an elaborate air defense system in this country. This is, however, beyond our greatest expectations in view of the threat that is posed today. This country will undoubtedly find itself in a position of conducting retaliatory attacks. Further, we do not, nor can we expect to have, timely intelligence on the exact location of the Russian long range striking force that would permit its destruction on the ground. It therefore must be assumed that the main effort of the counter air operations will be conducted against the enemy long range force following its first strike against this country. Nor can we assume that such operations will achieve the degree of effectiveness that will deny the Russians any capability to launch a second attack.

Therefore, a system complimenting the strategic air force must be provided to further enhance the security of this country. The second major deterrent is an air defense system that will have the capability to inflict losses to the extent that an offensive action against this country has little assurance of success. As General Chidlaw has stated: "the best defense is to get them in the nest." That is the mission of the strategic air forces. For that portion of the Russian long-range force that escapes destruction in the nest, the air defense system must have the capability to destroy or neutralize to an acceptable degree.

In attempting to determine the degree of effectiveness that an air defense system should possess, there are many questions that arise for which there seems to be no available answer. Should the system have the capacity for destroying 50% or 100% of an attacking force. Should the system be equipped to cope with the maximum force that the Russians could launch without consideration of the effect that the strategic air campaign might accomplish? If a defense system with a 50% kill probability can be built for say 15 billion dollars would it be economically feasible to double the budget to increase the effectiveness by 10 to 20%? How many bombs can this country withstand and still maintain the will and war making capability for conducting a war to an acceptable victory.

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These and many other questions point to the conclusion that two major factors will determine the degree of effectiveness of a defense system. First, is the amount of funds that can be allocated. The national economy has an overwhelming influence on the size of the defense budget. This in turn must be portioned among the three services. Within the services, the offensive weapon system will probably always enjoy first priority. Certainly this is true within the air force since the Strategic Air Command has a higher priority than the Air Defense Command. Offensive capability continues to be recognized as the primary deterrent.

The second factor determining the degree of effectiveness is the technological capability to develop weapons system to cope with the offensive weapons. Defense has traditionally followed offensive in the production of systems. There is little likelihood that this situation will change in the foreseeable future.

For the purpose of analyzing the Air Defense programmed for 1957, a method of weapon system evaluation was devised. The factors used in the method are described below:

In evaluating any weapons system, the ultimate question which must be answered is: "Can the weapons system under consideration do the job required better and with more certainty of success than any other weapons system, with at least as small or smaller force requirements, and at a comparable or lesser cost?"

To answer this ultimate question for an Air Defense Weapons System we must examine the system in a bit more detail. First of all, What is the job required of our Air Defense Weapons System? In broad terms, this job is to provide for the air defense of the United States against the Soviet threat discussed in the subject report. Throughout this discussion, the term "air defense" will mean defense against air attack, beginning with the launching of the enemy carrier, manned or unmanned, against targets within the continental limits of the United States.

For purposes of analysis we shall submit the Air Defense System to the tests of SUITABILITY, FEASIBILITY, and ACCEPTABILITY against the objective of providing for the air defense of the United States against the threat of Soviet air attack.

1. SUITABILITY:

a. Will the system provide the immediate effect desired in terms of:

(1) Firepower and destructive capability?

(2) Flexibility?

(3) Its ability to cope with opposing forces, either by virtue of its invulnerability and/or its mobility?

b. Does it harmonize with future or more far reaching considerations?

(1) Does it duplicate the capability of other weapons systems?

(2) Is it dependent upon other weapons systems, the values of which are not established definitely?

(3) Is its maximum utilization limited by:

(a) National Policy?

(b) Public Opinion?

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2. FEASIBILITY:

a. Are physical resources available to put the weapons systems into operations?

(1) Is it produceable?

(2) Is it manageable?

(3) Is it reliable and durable?

b. Are the available resources adequate to oppose resources operating against it?

3. ACCEPTABILITY:

Can we accept the cost of developing, producing, operating, and maintaining the weapons system in terms of:

a. Material resources?

b. Human resources?

c. Time?

Because the area of evaluation within the framework of these three tests can and does run the full gamut from broadest abstraction to minute detail, we shall concentrate on five criteria within the framework better to establish a definitive evaluation of the Air Defense Weapons System.

Our <u>first criterion</u> is a consideration of the <u>degree of success</u> which can be expected from the Air Defense Weapons System under evaluation versus that which can be expected of any other system. How nearly will the full employment of the system provide for the air defense of the United States against the Soviet air attack threat? The <u>degree of success</u> for this system must be compared with the <u>degree of success</u> which can be expected of any other system evaluated against the same objective.

Our second criterion is a consideration of the degree of destruction which can be expected from the full impact of the system in the air defense of the United States against the Soviet air attack threat. Again, the degree of destruction must be compared with that which could be expected from any other system when evaluated against the same objective.

Our third criterion is a consideration of the degree of vulnerability of the Air Defense Weapons Systems in providing for the air defense of the United States against the Soviet air attack threat. This is an analysis of the system with respect to loss rates from enemy action and other attrition causes. Included herein is an analysis of the replacement rate necessary to maintain a sufficient force to impose the required pressure against the Soviet air attack threat until the purpose of the action is accomplished.

Our fourth criterion is time - time required to direct the full impact of Air Defense Weapons System against the Soviet air attack threat.

Our fifth criterion is cost. The initial, operating, maintenance, and replacement costs of the system must be considered in relation to their impact on the economy and on the technical and natural resources of the nation. Cost of the system must be weighed against the results which can be achieved through employment of the system.

The next step in analyzing the programmed force was to apply the above criteria to the four essential elements of an air defense system.

The first element for consideration is detection.

The objective of detection is to prevent an aircraft from entering the warning net without detection, and to do so at such a range that

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adequate warning time is provided to permit reasonable defensive action to be taken and to permit SAC to evaluate or implement retaliatory mission. This time should be such as to permit evacuation of our cities, and preferably time to identify, intercept and destroy the detected aircraft if enemy. It is also desirable that this system be able to detect missiles up to a reasonable altitude. At present we have no indication of a possible detection capability for weapons entering from the stratosphere.

The system must provide for detection at the maximum practicable range, give low and high as well as medium height coverage, and must extend on the flanks sufficiently to prevent circumvention.

The capability of the radar elements of the system will normally determine its effectiveness. However, weather conditions will alter coverage. Where coverage is from AEW, severe turbulence may put the system out. Further mechanical failures may occur. It is not practicable to provide for 100% back-up radar at all sights. In the case of AEW, engine failure or other aircraft trouble may mean a break in the system. Further, as long as it is man operated there are all the human weaknesses to be considered such as scope watchers dozing or a technician not being fully competent.

There is no one radar which is capable of providing spherical coverage of the line at right volume of air space surrounding the radar set. Some are capable of giving low altitude short range coverage, some are capable of giving long range medium altitude coverage, and, as of the present, none are capable of giving good high altitude coverage. The limitations of modern radar forces the requirement for civil air defense posts. This requires a loss of considerable manpower with very limited capability to accomplish the job.

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The civil defense observers provide more of a public service and assist in making the public aware of the danger, than they do as vital part of the warning system. Present and foreseeable technological development necessitates distant deployment of radars to provide the time element needed in the detections. This factor places several undesirable features in the system. The remote locations are difficult and expensive to maintain and are undesirable from a personnel viewpoint. Further heavy reliance must be placed on land communications which are easily sabotaged or on radio which can easily be jammed. The portion of the net which is over water further complicates the system and adds greatly to the expense. Further as the enemy's capability in speed and altitude increases the system rapidly becomes obsolete.

Subjecting the programmed detection system to the evaluation criteria we find it is not suitable. It cannot give us the required reliability nor sufficient warning in time in all cases. These weaknesses are acknowledged by the ADC but within the funds provided and the technological limitations the system is as good as is feasible within the time limits.

The system is feasible as it is within technological capabilities and it can be installed and operated.

The system is acceptable as it is within allowable costs, we have the resources, both material and human, to provide it and it can be operational within the time specified.

The second element for consideration is identification.

The objective of identification system is that of differentiating between friendly and hostile aircraft (and missiles) and maintaining identification for any period of time necessary to provide for interception and destruction of those identified as hostile.

Identification thus falls into two categories. First, perimeter identification, this is initial recognition at the edge of the defended area of radar cover. Second, internal identification, this is retention of identity after penetration of the defense perimeter.

Present techniques (and the future promises only modification of these) are:

1. Electronif IFF: (The Mark X being the latest) a combination of an electronic interrogator on the ground and an electronic identifier in the aircraft.

2. Operational Means: This includes Flight Plan matching, Multiple Corridor Approaches, Inflight Maneuvers, and Code Words.

3. Recognition of Characteristics or Natural Features: In this case the enemy must exhibit some characteristic peculiar to it and not to friendly aircraft. Example: Rand Report 1078 carefully explains that, if the target approaches at 15,000 knots at an angle of 14 degrees to the vertical it is reasonably safe to assume that it is an enemy surface to surface ballistic missile. Altitude, attitude, and speed are identifying characteristics.

4. Forced Landing for Inspection: This is the "Fail-Safe" technique.

5. Statistical Raid Recognition: This is more of an aid by which the posture of the Defense System may be improved. It depends primarily on monitoring the "day-to-day" trend of "unknowns" and analyzing critical changes in the unknown rate. Presence of a raid.

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It is unlikely that the preceding identification procedures will be successful in recognizing hostile aircraft as such. The system is designed primarily to identify friendly aircraft and label all others as "unknowns". The last and most important step in the process is identification by interception and/or visual observation. Rand mentions as a means of identification the recognition of characteristic "signature" in the acoustic spectrum or Doppler shift. Although research in this field is promising, field use is not very near. For the period under consideration (54-57) the system is almost totally dependent upon the interceptor for making any positive identification. The present "rules of engagement" are so inadequate that they almost completely invalidate preceding identification efforts and destroy the efficiency of the interceptor. There is no indication, other than wishful thinking, that the rules will change before 1957. Identification of hostile aircraft therefor boils down to the following:

1. The pilot's recognition of an overt hostile act.
2. Someone's determination of a "manifestly hostile intent."
3. Observation of USSR markings and appearance except for aircraft "in obvious distress".

It is apparent that identification of hostile aircraft is a weak if not the weakest link in the Air Defense System. Tremendous amounts of money and scientific effort are going into Air Defense. There is little indication that a proportionate share is going into the identification phase. Improvisation seems to be the order of the day and, as is usually the case, improvisation hampers operational efficiency.

In applying our weapons system evaluation process to the element of identification we get the following results: Under suitability it can be stated without question that (1) it does not provide the immediate effect desired: that of immediate and unquestionable identification of hostile aircraft; and (2) it does not harmonize with future and more far reaching considerations. It is open to serious criticism under the test of feasibility. It is certainly not feasible to use "horse and buggy" tactics in an age that is about to produce inter-continental ballistic missiles. The test of acceptability, if applied to the Air Defense Weapons System points up a high degree of non-acceptability of an expensive system that is practically "ham-strung" for the lack of an efficient integral part-identification.

The pay-off in any identification system must be quick and positive identification of hostile aircraft as near to the moment of detection as possible. The fleeting mention by Rand that research in the field of characteristic signatures in the accoustic spectrum or Doppler shift is promising lends some measure of comfort but appears to be dangerously far off. This is hardly understandable considering that the U. S. Navy is in the process of installing its LOPAR system off the Atlantic seaboard. This is a relatively simple and inexpensive system based on recognition of accoustic signatures. It is possible that the combination of highly dependable IFF plus a system employing accoustical recognition may be an answer to Air Defense Identification. But even this could only be an interim consideration. Inter-continental ballistic missiles provides an entirely new problem for Air Defense. At this stage identification becomes "passe". Supposedly, this lies beyond the time period in question.

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It can only be concluded that, (1) the Air Defense System is severely weakened by the lack of an appropriate means of identification and (2) little improvement is foreseeable in the next few years.

The third element is interception:

Interception, as another function of air defense, usually follows the identification phase and is normally conducted in a planned sequence consisting of the following operations:

1. Directing the intercept weapon into action through command communications channels;

2. Providing necessary guidance and control for the interception weapon to a point from which it can complete an attack on the intercepted vehicle;

3. Monitoring the engagement of the intercept weapon with the intercepted vehicle and monitoring the control, guidance, and recovery of the intercept weapon to a safe landing at a designated sight.

In order to attain maximum effectiveness or 100 percent interception capability by our interceptor forces we must have 100 percent detection and identification. The effectiveness of these functions has been discussed in the preceding sections of this paper. This discussion will be confined to each operation enumerated above.

Before discussion of the separate operations begin, it is necessary to define "interceptor forces". For the purpose of this paper "interceptor forces" consist of fighter squadrons programmed by the AirForce and the NIKE and Skysweeper battalions programmed by the Army for the period ending 1957.

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<u>Directing Interceptor Weapon into Action:</u> The soundness of a decision which sends interceptor weapons into action is primarily dependent upon the validity of the intelligence received by a commander. Much of our intelligence received today is questionable. Today there is no positive identification system which can automatically identify, by electronic means, enemy aircraft. The present system is based upon human intelligence and interpretation and permits many possible human errors and leave unnumerable avenues which can avoid detection and identification. Until such time as positive electronic identification and transmission of this data can be developed for use in the field, the act of directing an intercept weapon into action will have to be made by commanders after evaluating whatever intelligence is available.

This brings us to the question of, "where" and "how" does a commander receive that information which is available? Today, and for the period under consideration, this intelligence is destined to originate in the main, from volunteer observers, radar stations, and from the control centers through which most of the data filters. Herein exists the weakness of our present system. The identification, the decision to place interceptor forces into action, and the actual directing of the forces all rely upon the ability of the human being to form opinion, or decisions, and to transmit his decisions and data through telephone, teletype, or radio nets which are vulnerable and susceptible to sabotage and electronic counter measures. Hence, we see that the very first act of the interception phase is degraded in effectiveness by the same electronic deficiencies which limits the detection and identification phases.

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Control and Guidance: Today, and for the period under consideration, 55 to 70 percent of enemy airborne vehicles can penetrate our air defense and reach their bomb release line. Part of this system weakness is found in our inability to effectively control and guide our interceptor weapons into a kill position. For example, with the present and programmed equipment the accuracy with which one manned interceptor can be vectored to one bomber is a function of the accuracy with which the tracks are plotted and the accuracy of the method of calculating interceptor vectors. These tasks are both currently performed by the director, and the error in positioning the interceptor in a correct firing pass on the intercepted vehicle is estimated to have a standard deviation as large as 1.5 nautical miles for a large bomber at an altitude where a solid track is obtained. Small bombers at 40,000 feet will produce only spotty tracks at best, with a resultant of perhaps 2.5 to 3 NM if returns from the bomber are, in fact, adequate for vectoring at all. At 200 feet to 500 feet no electronic capability for vectoring is to be anticipated until the low-altitude radars are produced and installed which is not expected before 1955.

The present electronic tracking system becomes saturated with 25-30 tracks and is limited to from 6 to 12 interceptor controls. This condition is expected to remain unchanged through the 1957 period. In addition to the saturation limitations our present ground and airborne radar equipment is susceptible to electronic counter measures and the effects of chaff.

The present ground to air communications system is vulnerable to carefully planned spot jamming and will be to repeater jamming when it becomes available, and the use of ECM by the enemy in an attack will

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virtually nullify the effectiveness of our interception phase [illegible] by airborne or missile type weapons.

In way of summing up the capability of the control and guidance phase of interception we might relate what can be expected to take place during a sizeable raid. A raid of any proportion which taxes our equipment limitations would result in frequent mistakes in data handling and a large percent of tracks would be lost or not reported, thus permitting unidentified vehicles through the defense perimeter. This would result in some interceptors being mis-directed, forgotten or lost and unable to complete mission. Assignment of the interceptor force over the bomber would not be uniform and vectoring accuracy would suffer according to the method of control and the amount of counter measure employed by the attacker.

The use of the NIKE, unmanned missile, eliminates the pilot limitations and provides a higher percent of interceptions provided the control and guidance systems are not influenced by electronic counter measures or saturation. The NIKE control system is susceptible to the same counter measures as other radar and communications equipment, but it promises to be the most reliable weapon in our defense arsenal for altitudes ranging from 30,000 feet to 60,000 feet.

__Recovery__: In order to maintain a sustained operation with the forces available, it is necessary to recover our manned interceptors and prepare them for subsequent launchings. In visual flight conditions this is a relative simple procedure, but we must be capable to launch and recover in all-weather conditions. Here again we are at the mercy of the capabilities of electronic equipment. The GCI and GCA radars, radio ranges,

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beacons and radio voice communications used for recovery purposes are all susceptible to electronic countermeasures, jamming and the limitations imposed by a saturated condition.

To sum up briefing, the resources available now and programmed to be available by 1957 cannot be expected to provide better than a 20 to 50 percent interception capability.

When we apply the interception phase of the Air Defense System to our evaluation criteria of suitability, feasibility, and acceptability, we find it falls far short of that degree of success which is required.

Suitability: The system is not capable of providing the necessary firepower and destructive force required with the percentage of kills necessary to defend adequately this country. When we speak in terms of manned interceptors they do possess some flexibility in employment but all other elements of the system are incapable of flexible operations. The system is vulnerable to sabotage and ECM. A complex communication system operated by a civilian telephone company is required. All this equipment is not mobile in the time period deemed necessary. The present system does not harmonize with the requirements of the time period beyond 1960. The manually-operated intercept system can be overloaded and would then not possess the ability to oppose attacking forces if they attack in large numbers. The intercept phase is dependent upon accurate, fast, and correctly interpreted information from other parts of the system. The value of this information is very important to actual interception. A breakdown in any part of the system or inaccurate information degrades the effectiveness of the interception functions.

Feasibility: This system is feasible and with proper effort by all concerned it can be produced, installed and managed. Its reliability

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and durability is open to question. The complications that accompany high performance jet aircraft equipped with complex electronic equipment make its reliability far below that desired. It is also questionable if adequate resources have been expended to counteract every ECM so that the system can counteract resources of the USSR expected to be employed to degrade the end results.

Acceptability: We can accept, if we so desire and deem it advisable, the cost of developing, producing, operating, and maintaining the system in terms of material and human resources. In relation to time, it is not acceptable as only 20-50% interception can be expected by 1947. This percentage must be improved in this time period to meet the proposed threat. The time required to bring the system to full operational capacity is also beyond that acceptable.

In summary we can only say the interception function during this time period is one of questionable success and in any case the total successful interceptions from the system is not more than 50 percent.

The fourth element of air defense, that of destruction is the "payoff". It is for this purpose that the other three elements exist.

The limited amount of data available in the Air Defense Command report and that presented by guest speakers does not provide an adequate basis upon which to conduct an evaluation.

Information was presented during this study that indicated a trend for increasing the firepower of interceptors, guided missiles, and anti-aircraft guns. The increased effectiveness to be achieved by this trend cannot be assessed for a number of reasons. In many cases the improved rockets and new missiles are still in the development stage and have not undergone suitability test under combat conditions. Based on theoretical studies the potential of these new weapons hold great promise but the final determination as to their worth must await further testing. The same can be said for the fire control system to be installed on new interceptors to be introduced into the 1957 programmed force.

It does not appear that sufficient emphasis has been given to electronic countermeasures that may be employed against the fire control systems in the armed interceptor and the guidance system in the missiles. Suitability tests conducted by the Air Proving Ground with the F-86D have demonstrated that the fire control system is very vulnerable to chaff. The use of this countermeasure has been successful in breaking the "lock-on" of the radar. Insofar as known, there has not been a suitable remedy developed to cope with this situation.

Test of the NIKI missile also have demonstrated that this weapon is likewise very vulnerable to chaff. In some cases, this countermeasure caused guidance errors in the order of 30 miles.

Both the NIKI missile and the manned interceptor are almost completely dependent upon vulnerable communications from ground controllers during periods of low visibility. Although each system has the flexibility for selecting a number of radio frequencies upon which to operate it is not believed that this feature insures the desired security against countermeasures. There are currently under development and production, broad band electronic jammers. These equipments have the capability of covering the frequency spectrum used by these two weapons. Information was presented by guest lecturers that indicated suitable measures have been taken for sweep jammers. It must therefore be concluded that such a capability in the hands of the Soviets will gravely effect the destructive capability of the air defense system.

Thus, the fourth element of the air defense system fails to pass the weapons evaluation test.

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In conclusion we find that our programmed air defense system is not adequate to perform its mission, however it is considered to be a realistic effort within the time limit provided and considering the present status of technological capabilities. More funds would doubtless improve the capability of the system but since they could not make it completely adequate it is considered unwise to expend more of our limited budger in air defense at this time.

For the present we must disregard the concept of a preventive war. Active defense or the concept that an offense is the best defense is not discussed as the problem is considered to be limited to the first major overt act on the part of the USSR. In other words, the defense is primarily concerned with defeating the initial enemy effort.

Further, even though the defense system is not adequate we must be practicable and recognize that the American people demand a defense effort on the part of the military. In addition the system may be effective enough that we can absorb the initial blow and SAC will be able to accomplish its mission.

Some may argue that the ultimate threat is the intercontinental ballistic missile and we should take a calculated risk and build for defense against this threat. This is not sound as the defense against this missile may not be effective against the low and slow airplanes and since only a few weapons are sufficient to accomplish the mission we must provide the best defense possible against all threats.

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Having given the enemy the initiative we are faced with a problem which can be solved in only one of two ways. Either we must provide an air defense system which will assure a kill of approximately 100% (this coupled with adequate covert protection) or we must provide a retaliatory capability which assures that the enemy will not attack. A retaliatory capability which does not assure that the enemy will not attack is of little practical value as it is considered that little comfort is afforded a deceased to know that his adversary is in a like state.

At present an adequate air defense appears to be beyond the technical capability of this nation, however, a certain amount of air defense is needed as it serves as a partial deterrent itself and further it partially protects the retaliatory force which serves as the major deterrent force.

SOLUTIONS SEMINAR NO. 6

F

AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
Date Submitted

STUDY NO. 1954-6

(Scheduled dates 4 Jan - 30 Jan 54 **)**

SEMINAR NO. 6

INSTRUCTOR Col Shannon Christian

STUDENT CHAIRMAN Colonel Droz

SEMINAR MEMBERS:

1. Col Basye
2. Col Cate
3. Col Lemmon
4. Col Neeley
5. Col Rowden
6. Col Summers
7. Col Hunt
8. Col Pettinger

Col K. S. Wilson

STATEMENT OF THE PROBLEM:

In general terms, analyze the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

SPECIAL PROBLEM OF STUDY TREATED:

Instructor's Signature
SHANNON CHRISTIAN
Colonel, USAF
Study Director

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(Use reverse side for remarks)

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STUDY NO. 6

SEMINAR NO. 6

SEMINAR CHAIRMAN: Col. Droz

SEMINAR RECORDER: Col. K. S. Wilson

SEMINAR MEMBERS: Col. Basye
Col. Cate
Col. Lemmon
Col. Neeley
Col. Rowden
Col. Summers
Col. Hunt
Col. Pottinger

MAXWELL AIR FORCE BASE, ALABAMA

26 January 1954

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I. INTRODUCTION

At the outset it should be understood that the purpose of this paper represents an exercise to provide a better understanding of the basic problems of air defense, and secondly, to analyze the development of our existing and projected air defense capabilities within prescribed limitations. From the purely military viewpoint, the only real answer for a defense is to destroy the enemy forces before they begin their attack. However, with our national policy of retaliation only, air defense, becomes particularly important, if for no other reason than to provide a warning to our retaliatory force. We cannot agree with Douhet that "We must therefore resign ouselves to the offensive the enemy inflicts upon us while striving to put all our resources to work to inflict even heavier ones upon him." By the same token, neither can we agree with the statement contained in one of the lectures that "therefore, in an all-out war, which may not be possible for us to avoid, the armed forces must provide an adequate defense for its national establishments - - - -." Adequacy is a relative term and its reference point must be understood. An examination of printed material offered for our reading, and the lectures from the platform, indicate that we will have neither an adequate nor a satisfactory air defense for 1957, in either a military or civil sense.

Within this frame of reference, Seminar 6 proceeded to consider the specific problem of analyzing the development and deployment of the forces we will have during the critical period of 1957.

Early in our discussions it became apparent that we must accept certain assumptions if we were to keep the problem within manageable

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limits. Thus, we assumed the following:

1. The intelligence estimates contained in Cost vs Kill as to the capabilities of the Soviet Union to deliver the amounts of destructive force described are valid.

2. The United States is vulnerable to such an attack as outlined in Cost vs Kill.

3. That only the Soviet Union, presents a threat to the U.S. based upon its economy, ability, and ideology.

4. That our national policy of retaliation only will remain in effect.

5. That we are considering air defense defined as including all measures necessary to prevent, to interfere with or to reduce the effectiveness of the hostile air attack after the enemy air weapons have become airborne.

In considering the problem, it became apparent that there are two sets of factors that influence the concept, amount, and strategy of air defense. These can be categorized as (1) the factors directly applicable to air defense, that is; firepower, mobility, and vulnerability as they apply to the principles of detection, identification, interception and destruction; and (2) external factors, such as enemy threat, the will of the people, the cost, and the degree of effectiveness required. In analyzing the development and deployment of air defense forces projected for 1957, Seminar 6 elected to discuss these external factors first.

To our minds, the threat of the enemy constitutes the primary factor to be considered. There appears to be considerable disagreement between various countries and between political elements within these countries as to the threat posed by the Soviet Union. This disagreement seems to be reflected in the amount of air defense being planned, and certainly any plans evolving must constitute a large amount of compromise.

The evaluation of an enemy threat must necessarily be based upon a consideration of these three factors:

1. His objectives
2. His capabilities
3. His rational or irrational adjustment of these capabilities to his objectives.

Without reciting the elements of proof contained in the writings of Marx, Lenin, and Stalin, we have accepted the fact that the ultimate goal of the Soviet Union is world domination. Further significant progress in attaining this goal is dependent upon the defeat of the United States by military means.

Rationally, within his present capabilities, the odds do not appear favorable enough to him to warrant the risk. Historically, the Soviet Union has always acted rationally, to a degree of requiring a preponderance of force in its favor before acting. This condition does not exist today in view of the capabilities of the U. S. Strategic Air Command. Nevertheless, the possibility exists that what appears irrational to us might well be considered rational from the point of view of the Soviets. Against this contingency, however remote it might seem, we must be prepared. We cannot deny, if we accept the Soviet ideological goals, that a threat exists at all times.

As to his capabilities, we accept the intelligence estimate of the amount of destructive force the enemy could deliver on vital targets of this country. For purposes of the exercise, however, we feel that this capability should be commented upon in relation to the establishment of the projected air defense for 1957. It was the opinion of the seminar that in some cases Soviet capabilities have been assessed at a maximum level, exceeding the capabilities we ourselves believe we could achieve with similar equipment. While we agree that enemy capabilities should be assessed in terms of the maximum damage he could cause, we also feel that consideration should be given to the known fallabilities that limit our own similar weapons.

In a democracy, the people have the ultimate voice in any decision. This is as it should be, if we consider our way of life to be the best. Therefore, any and all decisions which affect the populace as a whole must be geared to public opinion. To act contrary to this for purely military considerations would be to deny the foundations on which our society rests. For this reason, we feel that political considerations must affect the size and disposition of our air defenses. We feel however that the disposition of our primary or first team defense forces need not be seriously compromised for these reasons.

Civilian morale and understanding is vital to our national survival. Thus, we accept the idea that the people want and need sufficient air defense to quiet their alarm and to give them a sense of security, however relative it may be. We feel that if this is what they want, this is what they should have. It is unthinkable to our way of life to cold-bloodedly accept millions of casualties based on a reasoning that to do so would be the best means of achieving an ultimate victory.

With this in mind, we accept the concept and philosophy of an area defense spread out so as to provide a high degree of defense to vital areas, but with some defense for all. The thought of concentrating our defenses around the vital northeast industrial area to the exclusion of the balance of the country was considered, but discarded because of the apparant low order of defense attainable even with increased effort. The gains in kill potential at the present state of the art would in no way compensate for the morale effect of having so much of the nation undefended.

The apathy of the people toward the problem, as outlined from the platform was also considered. It was our opinion that this is a natural outgrowth of the democratic way of life, and indeed, partly the responsibility of the military, whose job it is, in the service of those people, to make them aware of the issues at stake. We feel that the people could be awakened to the enormity of the danger, but agree with General Chidlaw that the dangers of overemphasizing the possibilities might easily outweigh the disadvantages inherent in their present apathetic attitude.

Given an enemy threat and capability, two additional factors immediately present themselves. These are (1) how effective must the defense be and (2) how much will it cost. Seminar 6 has agreed that the limitations imposed on the problem make a true relation of cost to effectiveness somewhat unrealistic, except as it relates to that can be done within the limits of the money specified. We have been presented costs which will not be exceeded, regardless of whether they are sufficient to the job or whether the economy of the nation could stand the cost of preparing an adequate defense.

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Necessarily, therefore, our analysis of the development and deployment of our air defenses for 1957 has been confined to a consideration of the external factors or pressures which caused the decisions on hardware and concept, and a discussion as to whether, within this framework, we have accomplished the most possible.

Within our economic structure, certainly, a total of 15.2 billion, cumulative for a 5 year period, could not be considered to represent too large a share of our gross national product. Indeed, a view of the annual military budget indicates that this amount represents only a fraction of that which could be spent. The question arises, then, as to whether we consider this cost acceptable in relation to the job it will do, and whether the monies could be better spent elsewhere.

Advocates of the offense as being the only true measure of defense quite naturally feel that the cost is excessive. They feel that the same amount spent for offense would act more as a deterrent to the threat and would be subjectively better spent in supplying more offensive striking power.

Seminar 6 did not feel that the merits or demerits of this controversy were within the scope of the problem and confined themselves to considering:

1. What we are buying.
2. The relationship of this cost to the job to be done.
3. An examination of the factors causing the decisions of the projected air defense system.

In brief, we could only conclude that we are buying a very inadequate defense which, in the absense of other factors, would not be warranted.

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However, when the external factors were examined, we accepted the realization that as a democracy we could do no less than provide some defense, irrespective of costs or effectiveness, and that in this light, the cost is reasonable.

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To this end, we considered that wars are no longer a play between opposing military forces but are wars between nations. Thus the nation with the will to fight, the courage to absorb punishment, and the strength to fight back is more important today than costs or the preponderance of one type of military force over another. We believe that to maintain this national will and ability to fight back, is in itself justification for an air defense capability.

With regard to the factor of effectiveness, and accepting the estimates of the various lectures and bibliographic material, it was obvious to the seminar that with the advent of weapons of mass destruction, the desired effectiveness is 100%. Also obvious was the fact that the planned air defense forces fall far short of this goal, giving rise to a natural question of whether any of the effort is worthwhile at such high costs.

In answer to this question Seminar 6 summarizesos that our investment in air defense is justified for the following reasons:

1. Any losses it inflicts on the enemy will reduce our casualties and physical destruction.

2. An air defense will increase the cost to the enemy of delivering an air attack. In addition to the cost of aircraft we will destroy in the event of war, our growing capability for air defense is currently forcing the Soviet Union into expensive improvements and de-

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velopments in air weapons.

3. An air defense is necessary to provide the warning and time required to take passive defense measures. This includes the protection of our strategic offensive force.

4. An air defense is vital to the morale of our people and will have an advantageous effect upon their will to wage war if it becomes necessary.

5. Any defense must be developed through technological advancement and evolution. Without a start this could not occur. Indications show a continued improvement in kill effectiveness. It is quite possible that during the process of development some new unpredictable advancement will drastically improve the effectiveness.

6. If the above reasons are valid, our air defense capability will contribute in deterring the Soviet Union from aggression.

Against this background Seminar 6 analyzed the development and deployment of air defense forces in three elements which are; Organization, Radar and Communications, and Destructive Weapons.

II. ORGANIZATION

The proper organization of air defense forces to rpovide for effective control of all elements in the hands of competent authority is imperative under the conditions which we have assumed. A study of present organizations and activities indicates that policy makers are aware of this and that serious study is being given to the problem. The elements of this matter that appear to be most critical to this seminar are outside of the scope of this paper. However, they should be mentioned. The relationship between Canadian and United States air defense forces should be made firm and authoratative in order that the two organizations may continuously complement each other to such an extent as to be as efficient as one integrated organization. Likewise, the control of augmentation forces must be clearly established for air defense purposes in order that there is no question as to the course of action to be taken in time of crisis. There will be no time available to resolve inter service, or intra service differences in the few short hours that may be available to throw all resources into the fight. Seminar 6 feels that much more must be done along these lines if we are not to run the risk of losing the value of a vast and expensive defense organization through the frailties of human nature.

Under the present ADC organization the United States is divided into three Air Defense Forces which report directly to Headquarters Air Defense Command. Each of the Air Defense Forces is broken into Air Divisions which have assigned or available radar stations, interceptor bases, ground observers, filter and control centers, and anti-aircraft artillery units. The radar and D/F equipments are operated by Aircraft Control and Warning Squadrons which are asigned directly to the Air Division. The filter and control centers are also operated by the AC&W Squadrons. Units subordinate to the Air Division in addition to the AC&W's already mentioned are Defense Wings, Air Defense Groups, and Fighter Interceptor Squadrons.

The Air Divisions vary in size depending generally upon the number of potential targets and population densities in their assigned areas. There organization is specifically tailored to the needs of the target complex. Wing and Group Headquarters are established only where dictated by administrative and maintenance requirements.

The outlying early warning radar stations are tied in with the GCI stations at the Air Defense Direction Center. The ADDC's are tied in with the Air Defense Control Centers which are located at the Air Divisions Headquarters. Above the Air Division level are the Combat Operation Centers at the Air Defense Force Headquarters and at Headquarters Air Defense Command.

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This vast system which covers an area of approximately 3 million square miles is tied together with a complex network of communications. It is the function of the communications system (1) to pass perimeter detection information from radar and ground observer stations to the appropriate command echelons and similar adjacent facilities; (2) to alert interceptors and guide them to the aggressor; (3) to link the command echelon with fixed defense facilities; (4) to inject friendly aircraft movement information in to the system; (5) to provide aid and rescue facilities for interceptor aircrews. All of this must be accomplished with the utmost emphasis on speed reliability and accuracy. The difference between success or failure may hinge on the time lost in passing information from the radar or ground observer perimeter detection and system to that echelon of command capable of assessing the situation and making the decision as to action required.

Because the number of destructive weapons at any one point is obviously limited, the commitment decisions must be made at the highest practicable echelon to achieve optimum results. In conflict with this principle however, is the fact that as the enemy air weapon increases in speed, friendly air defense is forced to decentralized authority to meet this threat unless the data handling system can be speeded up.

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The seminar concludes that the present organization of ADC is sound. However in view of the complexity and importance of communications and electronics to air defense, there appears to be a need to elevate this function to more authoritative positions within command and staff organizations. Canadian experience appears to lend validity to this recommendation. And, further the vulnerability of the vast communications net is such that much emphasis must be given to its security. Communications may well be the weakest link in this chain of defenses.

III. RADAR AND COMMUNICATIONS

In attempting to evaluate and to determine the effectiveness of the communications and radar components of the programmed air defense system for 1957, we broke the problem down into three general areas to make the problem manageable: first, the early warning radar network or the planned McGill Line; second, the contiguous radar network in the Z.I. and immediate adjacent land and sea areas; and third, the communications network as it is related to the operation, control, and command of the various air defense weapons.

Our efforts on this portion of the problem are not intended to provide any detailed weapons system evaluation i.e. consideration of such factors as firepower, mobility, cost, concentration in time and space, etc. Rather we concluded that radar and communications when considered separate and distinct from the rest of the air defense system do not lend themselves to such an evaluation. We, therefore, limited our study of the effectiveness of the aforementioned components of the air defense system to a determination of the answer to one question - - - will they or won't they accomplish the desired task? To answer this question our analysis includes; (1) a brief statement of the function or mission the particular component performs in the air defense system, (2) the factors taken into consideration in the evaluation of its effectiveness, (3) brief conclusions reached as to its effectiveness, and (4) recommendations for improvement if deemed appropriate or acceptance of the component as programmed.

Our concept of the primary function of early warning radars requires this portion of the air defense system to provide the only information of the initial detection of an enemy air attack. In our opinion, the probability of currently obtaining reliable intelligence is extremely remote and should not be considered in evaluating the effectiveness of any segment of the air defense force. However increased emphasis should be placed upon intelligence efforts and an aggresive policy for the collection of intelligence within the Soviet Union.

In view of our definition of the function of early warning radar we we feel therefore that probably the most important factor to be considered in an evaluation of its effectiveness would be the amount of warning time provided. The time thus provided can then be utilized to accomplish the numerous actions which are essential to the successful implementation of the Air Defense Command's plans to repel or to minimize the consequences of such an attack. There are many such actions, but for our purposes the following are furnished:

1. The evacuation of SAC.
2. The evacuation of industrial target areas.
3. Maximization of ADC interceptor availability.
4. The augmentation of ADC's interceptor forces.

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5. The diversion and grounding of domestic air traffic.

6. The alerting of civil defense.

Thus we can make our evaluation of the effectiveness of the early warning net by comparing the amount of warning time available with the amount of time required to carry out the necessary defense measure, this information is provided in Table I.

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FOR ENEMY AIRCRAFT OF THE TU-4 TYPE

PASSIVE OR ACTIVE DEFENSE ACTION	WARNING TIME REQUIRED*	WARNING TIME AVAILABLE*	REMARKS
1. Evacuation of SAC	2 Hours	5 Hours	Adequate
2. Evac of Indus Target Areas	1-2 Hours	3 1/2-4 Hours	"
3. Max ADC Inter Availability	3 Hours	" "	"
4. Augment ADC Interceptors	4-6 Hours	" "	Min Satis
5. Divert and Ground Domestic Air Traffic	1/2 Hours 1/2 Hours	" " " "	Adequate "
6. Alert Civil Defense	3** Hours	" "	"

FOR ENEMY AIRCRAFT OF THE B-47 TYPE

1. Evacuation of SAC	2 Hours	3 1/2 Hours	Adequate
2. Evac of Indus Target Areas	1-2 Hours	2-3 Hours	"
3. Max ADC Inter Availability	3 Hours	" "	Marginal
4. Augment ADC Interceptors	4-6 Hours	" "	Unsatisfact
5. Divert and Ground Domestic Air Traffic	1/2 Hours 1/2 Hours	" " " "	Adequate "
6. Alert Civil Defense	3** Hours	" "	Marginal

* Information obtained from RAND Study #1031

** Information obtained from Final Report of Summer Study Group.

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A perusal of this Table reveals that the early warning net is effective for all considerations with one exception, that being the augmentation of ADC's interceptor capability with aircraft from other commands. It should be noted that even this requirement is met to some degree when considering the TU-4 threat and could possibly be alleviated even under a B-47 type aircraft attack if speeds of deployment of the augmentation forces were increased. Thus, in conclusion, we consider the early warning to be reasonably effective and our one recommendation for improvement would be to accelerate the deployment process or improve the present plans for deployment to coincide with the warning time provided.

Our concept of the mission of the contiguous radar network visualizes this portion of the air defense system performing the identification function and assisting the various air defense weapons in the accomplishment of their respective interception functions. In our investigation of this portion of the problem such factors as, high and low altitude coverage, range of the radars, automatic features of the system, interceptor performance as compared with the limitations of radar coverage etc. were considered. Provided positive identification is accomplished by electronic means, by far the most important of these factors is the range and altitude coverage of the radars. It was determined that the required coverage, keeping in mind the enemy threat, should extend to a minimum of at least 300-400 miles* and to a more desirable distance of 500-700 miles* from the critical target areas. The programmed system, as deployed, approaches this coverage although it is marginal for some attack routes and almost non-existent on the southern approaches to the United States.

* RAND Study #1077

It will be remembered that we prefaced the statement regarding the importance of the range and altitude coverage of the contiguous radar network by a proviso that positive electronic identification must be accomplished. The existing network does not have an operational IFF system, but we could find no information indicating that this deficiency would not be corrected by the 1957 period. Provided this weakness is eliminated and accepting the calculated risk that enemy directions of attack will not approach from the South, we consider the 1957 contiguous radar network to have an acceptable operational effectiveness.

We make no recommendations for improvement of the contiguous radar network as in our opinion improvement could only be obtained by expanding the coverage and such a course of action is not possible within the budget limitations imposed on the preparation of this paper.

The function of the communications network as it is related to the operations, control, and command of the various air defense weapons is to enable the identification and interception of the air vehicles creating the non-friendly tracks. Except for the necessary intervention of human judgement at critical stages, performance of these functions is a mechanical handling of data; where handling includes the tasks of assembling, processing and correlating information and transmitting appropriate instructions to all or portions of the air defense system.

RAND Report No. 1079 says this of a data handling system:

> "The primary objective of an air defense data handling system is to present the tactical commander (or commanders) with a picture of the air traffic which is clear enough, complete enough, and timely enough to allow him (or them) to evaluate potential or existing enemy aerial attacks, to allocate defense forces

to these attacks, and to direct, from a remote position on the ground, the actual air battle."

These words stand out in the above quotation, vitally important to a successful data handling system: PRESENT, CLEAR, COMPLETE, and TIMELY. They refer to the mechanical handling of data. EVALUATE, ALLOCATE, and DIRECT refer to the participation of human judgement, <u>of the commander</u>, in data handling; not forgetting that mechanical means must be available to transmit instructions leading to the allocation and direction of forces in the actual air battle.

It is clear, therefore, that an air defense data handling system, as its ultimate goal, must be able to present clearly, completely, and expeditiously the true air traffic situation and also be able to transmit clearly, concisely, expeditiously and reliably instructions covering the allocation and direction of forces in the actual air battle. Three other considerations, in part contained in the terms already used, should be mentioned for emphasis. The data handling system should be simple to reduce the problem of training operation and maintenance personnel. It should be capable of handling the heaviest load of data that any enemy attack can generate and handle it reliably and expeditiously. And, it should be capable of reliably and expeditiously handling this load over extended periods.

It is recognized that the operation and maintenance personnel associated with the data handling system can and will affect the degree to which the system approaches or attains the ultimate goal described above. It is considered that this effect can be brought within desirable limits by the initiation or intensification of suitable training programs, utilizing any training aids which can be devised, and that the

Air Defense Command will actively pursue such programs. We have had insufficient information to permit further intelligent comment on this personnel consideration.

Passing now to the electronic gear and other equipment in the data handling system, we have examined the available information to determine the nature and capabilities of the system in 1957. The picture at that time is not completely clear in detail since the realization of certain developmental hopes and plans is a prerequisite and it cannot be guaranteed at this time. It is evident that these hopes and plans are directed toward the attainment of greater reliability, increased simplicity of operation, greater load capacity, and less susceptibility to saturation. We believe that these aims are correct. We understand that their attainment depends upon the state of the art, and its improvement, between now and 1957. We assume that continuing efforts to improve the state of the art and rapid incorporation of appropriate improvements will characterize the continuing development of the air defense data handling system.

We recommend that, in addition to programmed developmental projects for improvement in components of the air defense data handling system, positive action be taken to develop the most reliable and fastest transmission of data from detection site, through interception control site, to interceptor vehicle site.

IV. DESTRUCTIVE WEAPONS

Our analyses of destructive weapons within air defense is treated in two parts which are their development and their deployment.

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We based our analysis of air defense weapons upon their maneuverability, firepower and vulnerability.

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Development

The piloted aircraft weapons programmed for the Air Defense Command in 1957 are the F-102, F-89D and F-86D. Their manuverability insofar as rate of climb and speed are concerned is adequate to cope with the TU-4 type of threat.

The F-102 should be an outstanding air defense weapon. It was initiated in 1951 and conceived as an intergrated weapons system incorporating the Hughes fire control system and the air-to-air GAR-1 missile. Its design incorporates the favorable aerodynamic characteristics of the delta wing, as well as the rusults of the latest supersonic test data. The performance of the F-102 should be adequate to cope with the medium and heavy jet bomber threat.

Although the F-86D and F-89D were initiated in 1949 and 1950 respectively, they are both model improvements of aircraft which were initiated in 1945. Hence in basic design they are relatively old aircraft. We consider that their ability to cope with modern medium and heavy jet bombers in 1957 will be at best marginal. Another factor to be considered under manouverability is radius of action. As the early warning coverage is extended seaward and toward the arctic, the seminar believes the combat zone should also be extended. This could be accomplished by the introduction of a long range, high performance interceptor capable of coping with the jet bomber threat. An examination of the aircraft Characteristics Summary indicated the F-101 possesses the desired performance to fulfill this requirement. It is believed that if an inter-

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ceptor version of the F-101 were initiated immediately it could be available in late 1957 or early 1958. If funds can not be made available for the additional cost of the interceptor version of the F-101, then serious consideration should be given to programming a lesser number of F-89D's to compensate for a quantity of long range high performance interceptors. We should not compel the Air Defense Command to fight a 1960 bomber with a 1945 interceptor.

With reference to firepower the seminar believes that the rocket and GAR-1 armaments are adequate for the distruction of enemy bombers once interception is accomplished.

With regard to vulnerability the range of the armaments mentioned above is such that the interceptors should be relatively invulnerable during the destruction phase.

The Point defense missile or NIKE appears to be an effective weapon against both the TU-4 and jet bomber threat, insofar as firepower and performance are concerned. In spite of statements from the platform, the seminar believes that the ground tracking radar component of this weapon system is vulnerable to electronic counter measures. We recommend development be expedited to eliminate this deficiency. The BOMARC missile appears to be a logical and beneficial complement to the piloted interceptor in the area defense mission. It is obvious that an electronic identification system must be in operation before BOMARC can be used. The seminar believes that the manned interceptor cannot be completely replaced by BOMARC since visual identification will have to be made of battle damaged strategic aircraft and special mission aircraft of neutral nations. Development of counter ECM devices should be

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expedited for the BOMARC.

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Deployment

We have stated that we accepted the intelligence estimates contained in Cost vs. Kill as to the capacity of the Soviet Union to deliver the amounts of destructive force described. However, we do have certain comments and suggestions which we feel warrant consideration.

Cost versus Kill has assumed a maximum capability on the part of the Soviets for aircraft, crews, and mass destruction weapons. On the other hand, it has assumed that the Soviets will only send over a limited number of aircraft from their total strength.

Much more reasonable would appear a more massive attack along some part of the periphery of the U. S, Canadian border with appropriate diversionary attacks along other parts. By this means, the most valuable attributes of air strength - tactical mobility and flexibility - could be negated. Such an attack could result in:

1. Saturation of the radar system.
2. Saturation of fighter defense areas.
3. Saturation of or avoidance of AAA defenses.
4. The negation of mutual support between adjoining defense areas.

From lectures, discussions and reading material, Seminar 6 was convinced that the disposition of aircraft had been influenced by many factors other than those directly related to attacking the incoming enemy and destroying him as far from the target as possible. Those factors were felt to be:

1. Political pressure and public opinion. The desire of all people of the U. S. to have some protection has probably been a factor here.

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2. International boundaries. While this should not be a factor, it probably hampers complete freedom of movement and perfect interchange of assistance.

3. Availability of airfields. The fact that some airfields are already constructed and available has probably been the reason for their use in many cases. Cost has been the important factor in this consideration.

4. Housing. Although housing is a definite problem even under the present disposition, it probably has affected the choice of aircraft locations in many cases.

5. Weather and Geographic conditions. Even though the crews and aircraft could operate under adverse weather conditions, the rugged weather and terrain of the far North have precluded the disposition of interceptor forces in otherwise advantageous locations.

6. Logistic difficulties. Isolated airfields and the great difficulties caused by remoteness from logistic bases have affected intercept locations.

7. Communications problems. The necessity for locating radar installations in remote areas and the hardships placed on operating personnel have been factors in this field. Terrain has been a factor here also.

Within the abilities of Seminar 6 to evaluate the dispositions of AAA forces, it would appear that the job has been well done. They have been placed around what will probably be the principal Soviet targets and the distribution of numbers seems to be sound. One matter in their disposition warrants comment. If surprise is no longer a vital factor in

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1957, it does not seem adviseable to dissipate the efforts of AAA forces around SAC bases, unless it is felt that the aircraft, out of flyable condition, and the base facilities would warrant use of the AAA defenses.

If the foregoing comments are valid, it would appear that the disposition of air defense forces can be appreciably improved. Furthermore, if the Soviet capability increases steadily past 1957, it is not believed that the present concept will lend itself to an economical and rapid expansion to meet the increased threat. With these considerations, Seminar 6 proposes that a study be initiated to examine the feasibility of modifying the deployment of ADC fighter forces, to increase their effectiveness. This study should consider:

1. The deployment of ADC fighter forces in a horseshoe pattern with the toe of the shoe lying as far north in Canada as feasible and the sides extending down the east and west coasts of the U. S.

2. The defense of the central and southern areas of the U. S. should be delegated to augmentation forces. These forces should be capable of being deployed into the horseshoe perimiter as needed.

3. The establishment of an authoritative centralized control for these two systems.

4. The construction of auxiliary refueling bases in the perimeter to facilitate the movement of interceptors outward as the battle developes.

5. The separation of fighter interceptor areas from the AAA line in order to allow full exploitation of AAA defenses.

6. The authorization of more positive action against unknowns and border violators.

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SOLUTIONS SEMINAR NO. 7

G

AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
Date Submitted

STUDY NO. 1954-6 SEMINAR NO. 7

(Scheduled dates 4 Jan - 30 Jan 54)

INSTRUCTOR Col Shannon Christian STUDENT CHAIRMAN Col Jones

SEMINAR MEMBERS:

1. Col Bearly
2. Col Chandler
3. Col Hammerle
4. Col Kime
5. Col Kyes
6. Col Tarver
7. Col Mallary
8. Col Prewitt

Col Woodard

STATEMENT OF THE PROBLEM:

In general terms, analyse the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

SPECIAL PROBLEM OF STUDY TREATED:

Instructor's Signature

SHANNON CHRISTIAN
Colonel, USAF
Study Director

(Use reverse side for remarks)

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SEMINAR SOLUTION

STUDY NO. 6

SEMINAR NO. 7

SEMINAR CHAIRMAN: Col. Jones

SEMINAR RECORDER: Col. Woodard

SEMINAR MEMBERS: Col. Beerly
Col. Chandler
Col. Hammerle
Col. Kime
Col. Kyes
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Col. Mallary
Col. Prewitt

MAXWELL AIR FORCE BASE, ALABAMA

20 January 1954

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Introduction

The problem as presented for seminar solution was, in general terms, to analyze the development and deployment of Air Defense forces as programmed for 1957. The analysis includes justification for accepting or for changing the program in order to provide the best air defense of the U. S.

The limitations placed on the problem were as follows:

a. The geographical area of consideration was Canada, Alaska, NEAC, and the sea approaches to the continental U. S.

b. The budget allocation for the programmed air defense forces was not to be exceeded.

c. No consideration was to be given to Canadian forces or to augmentation forces. Only those forces assigned to the Air Defense Command were considered.

d. No consideration was to be given to passive air defense.

e. No consideration was to be given to the U. S. strategic retaliatory forces' offensive as a means of air defense of the U. S.

It was further decided that due to the shortage of time and inadequate technical knowledge the seminar group would generally accept the technical details and related computations as presented in the program.

<u>ADC 1957 Program</u>

The approved and/or proposed ADC 1957 program must be examined in the light of two fundamental premises:

a. The entire cost of air defense for the period 1952-1957 must not exceed $15.5 billion, and;

b. The enemy intent to attack remains constant throughout the period.

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With respect to the first point, i.e., the cost, ADC emphasizes that it does not believe that this budgetary limitation permits adequate protection of the country. The $15.5 billion figure is used because it is the amount of money ADC expects to receive providing air defense continues to get approximately the same attention, relative to the total defense effort, that it has been getting over the period of the last few years.

With respect to the second point, i.e., the enemy intent to attack, ADC has no choice but to accept the extant national intelligence estimates which have consistently stated for the last several years that the enemy can mount an attack without warning at any time. This appreciation of enemy intent means that throughout the period under consideration, ADC is responsible for maintaining a high state of readiness to meet an attack which may occur at any time together with the responsibility for incorporating within the program the necessary flexibility to meet an ever increasing enemy capability.

In the following discussion of the ADC program, these two highly restrictive premises must be constantly kept in mind.

The ADC 1957 program provides for very significant general improvements in the air defense order of battle. With respect to radar there will be true low altitude coverage out to the same boundaries which previously had only high altitude coverage.

Of particular importance will be the completion of the McGill early warning radar line. This will extend from Hawaii to Canada, across Canada following roughly the 54th parallel, across to the tip of Greenland, up the Greenland coast, across to Iceland and thence to Scotland.

Data handling and transmission in the AC and W system will be

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bolstered substantially by 1957 with the introduction of the Air Defense Integrated System for Surveillance and Weapon Control (ADIS).

By 1957 there will be in ADC 61 fighter squadrons, all possessing an all-weather capability. This interceptor element includes 12 squadrons of the first supersonic interceptors, the F-102s; 34 squadrons of F-86Ds, and 15 squadrons of F-89Ds. The fighters will be armed with Falcon guided air rockets and some 2.75" rockets. It is anticipated that three Bomarc sites of 30 missiles each will be in operation by this time. AAA defenses will have been increased to a total of 60 Nike and 8 Skysweeper battalions.

With respect to deployment, it is assumed by ADC that the USSR will elect to attack the 80 most important urban areas in the country. ADC's deployment is designed to effect maximum possible defense by deployment to defend island complexes containing the major urban and industrial concentrations. It is noteworthy, as contrasted to the 1952-1955 period, that SAC bases are no longer considered to be primary Kremlin targets. This is because the early warning net will deny the Soviets tactical surprise giving SAC sufficient time for evacuation.

Let us now examine the effectiveness ADC expects it would attain against an enemy attack in 1957. ADC estimates that against a low altitude night attack by 800 enemy bombers, 45% would be killed before BRL; against a high altitude day attack by the same size force, 40% would be killed before BRL. The kills are expected to be divided almost equally between fighters and AAA. Thus despite the defense system, ADC estimates that in 1957 the USSR could deliver on target 162 to 200 A-bombs plus a number of CW and BW weapons.

In the analysis of the problem, Seminar No. 7 considered the enemy capabilities; the six principles of air defense; defense of selected objectives, comprehensive defense, defense in depth, concentration of force, defense in being, and progressive and flexible defense; and the four phases of defense; detection, identification, interception, and destruction.

Enemy Capabilities

Intelligence regarding the enemy capability is exceedingly sparce especially concerning the USSR developments of air vehicles other than the TU-4, the medium jet bomber, and the heavy jet bomber. No intelligence indicates that the USSR is working on the develoment of an intercontinental missile either ballistic or guided. It is presumed that the USSR technology is capable of paralleling the United States developments in the missile field.

Capabilities paralleling those of the United States would provide the USSR with ground-to-ground missiles of 200-500 mile range and air-to-ground missiles 50-150 mile range by 1957. Both of these missiles are capable of being equipped with atomic war heads by 1957, and of attaining Mach 1 plus speeds.

Delivery of missiles of the ground-to-ground type can be made from off shore launchings by submarine or surface vessel launchers. The air-to-ground missiles can be flown to missile release range by subsonic jet bombers of the 500 plus knot class.

Defense of Selected Objectives

In view of the fact that the USSR now possesses a nuclear weapons stockpile which probably includes the H-bomb, and has the capacity of delivering these weapons by aerial means, it is mandatory that the Air Defense Command prevent the delivery of these weapons on vital targets.

However, it is not economically feasible to provide a completely airtight defense against attack for the entire land mass of the United States. Therefore, it becomes necessary to provide adequate protection for those critical targets, the destruction of which would prevent the United States from continuing the war. An air defense of this magnitude is possible, and in fact does not appear to be of staggering proportions in this study, since the problem assumes that there will be sufficient warning time to evacuate the aircraft from SAC bases. Evacuated SAC bases are not critical targets and, therefore, will absorb a minimum of the air defense effort.

An examination of the industry distribution of the United States and Canada indicates that virtually all the vital industry is located in the area bounded by Montreal, Ottawa, Milwaukee, Chicago, St. Louis, Cincinnati, and Washington, D. C. In addition to this island, the only other concentrations of critical targets are the aircraft and shipbuilding industries located in the two Pacific coast areas of Los Angeles and Seattle. From this examination it is obvious that these areas must be provided adequate defense before considering the defense of other targets, the destruction of which would be serious but not fatal to the United States.

The Air Defense deployment plan indicates that against a mass attack on our Northeast area employing as many as 186 heavy jet bombers, 47 medium jet bombers, and 190 type 31 bombers, we would have only 625 Air Defense Command fighters deployed in the area where they could be brought into the air battle. The resultant ratio is but 1.48 deployed fighters per bomber. Due to maintenance considerations this would undoubtedly result in an actual fighter to bomber ratio of less than one in the air battle for this vital area.

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Accordingly, after due consideration of the political implications as well as the actual danger attendant thereto, it was decided that better defense of the industrial islands should be provided before fighter squadrons could be deployed in quantity for specific defense of the South and Southwest areas of the United States. Another reason for redeploying a major portion of these fighter squadrons is the fact that adequate detection and control radar cannot be allocated to the Gulf coast area in the 1957 time period. Thus the fighters that are deployed in the South and Southwest cannot attain their maximum effectiveness. Therefore we believe that six of these fighter squadrons now deployed in that area should be redeployed into or near the Northeast area, thus raising the deployed fighter-bomber ratio to 1.83 in that vital area. It is fully recognized that moving this number of fighter squadrons would leave a weakly defended area. Although we are not considering augmentation forces in this problem, it is likely that they could serve admirably in this area to quiet the politicians and help to maintain the morale of the people.

Comprehensive Defense

The ADC plan gives the USSR the capability to attack each of the industrial islands from any point on the compass. Although ADC deploys the Air Defense Forces generally in consonance with the principle of a comprehensive defense, the primary target complexes are not fully defended against air attack from all approaches. A deficiency is found primarily in the early warning radar coverage to the south of the northeast industrial complex, the southwest approaches to the San Diego-Los Angeles complex, and the entire southern border of the U. S.

Defense in Depth

The principle of "Defense in Depth" provides sufficient early warning

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to permit interception and engagement of an enemy force great distances from the target area and continuing attack upon that force until it is destroyed or has dropped its bombs. The deployment of forces for air defense in 1957 set forth in the ADC plan indicates that this principle has been followed to the greatest degree possible from the funds and resources to be available for the air defense mission.

Concentration of Force

With the exception of the previously mentioned fighter squadrons deployed in the South and Southwest, this plan appears to take into consideration the necessity for bringing a maximum amount of firepower to bear on hostile aircraft in a short period of time. Redeployment, as recommended, would tend to further this important principle.

Defense in Being

The ADC plan will provide in 1957 the greatest air defense in being our country has known. This force with its 24-hour alert status will be capable of dealing effectively with any air attack the enemy can mount against us at that time. However, it is admitted that even under the best conditions the effectiveness of this defense in being is only somewhere between 30-50%.

Progressive and Flexible Defense

The ADC plan will provide a reasonably progressive and flexible defense in 1957. Steady improvement is provided as new and better equipment and funds become available.

The radar net capability will be extended by the addition of the McGill line with its important sea approach extensions. This sea coverage is vitally needed today. The addition of a new small type low altitude radar will make the net able to deal more effectively with both low and high altitude attacks. A planned modification will insure better high altitude coverage against jet bombers.

The fighters programmed show best use of what is available today (F-86D and F-89D) and is to become available (F-102). The F-102 with its supersonic interception speed will increase greatly our ability to deal with jet bombers. The all-weather capability requirement for the whole force of manned fighters is a most important factor lending maximum flexibility to the force. The inclusion of unmanned Bomarc units is a progressive step to counter the increase in speed problem and it also adds flexibility in weapon employment.

Detection

This plan recognizes the limitations of present day radar equipment and the requirement for contiguous coverage. On the other hand is the necessity for early warning detection. The plan represents a realistic compromise between these two requirements. It appears that contiguous radar coverage of critical areas is designed to expand and keep pace with an increasing intercept capability. Satisfying this inner defense requirement, the plan envisages an early warning line which appears feasible within the time period.

As planned, the program permits a progressive and flexible expansion of facilities and coverage. The fixed installations provide a framework throughout which AEW aircraft may be employed if a need is determined - for gap filling or line extension.

Identification

Aerial target identification is considered to be one of the weakest points in the Air Defense Command system in the 1957 time period. It is highly improbable that the NIKE batteries will be able to distinguish fighters from bombers to a degree that will permit the manned fighters from pressing the attack in the gun defended areas.

TALOS, BOMARC, and FALCON equipped with active target seeking devices will be difficult to employ in an air space in which friendly fighters and enemy bombers are randomly spaced.

At the present time twenty-five thousand daily flights must be identified by nonautomatic means. In the future it is anticipated that the number of flights will increase to the extent that the present system of CAA flight control and ADC identifications procedures will be saturated with the normal commercial and friendly military traffic in flights over the United States. The use of electronic identification devices for all aerial vehicles flying over the United States is the only indicated solution. The use of corridors and flight maneuvers at check points is considered essential until such an electronic device becomes available.

Interception

The interception vehicles available in 1957 all depend heavily on radar to locate the aerial target and to steer a collision course for target destruction. It is unrealistic to assume, as the Air Defense Command plan does, that these functions of tracking the target and steering the interceptor to the bomber will be carried out without effective interference from the hostile force. It appears more realistic to assume that the bomber aircraft will be accompanied by aircraft devoted entirely to the function of jamming our ground and airborne radars. This interception interference capability exists even if the enemy exploits only all the capabilities of chaff.

The ADC plan indicates an increasing capability to defend against a low altitude attack between 1953 and 1957. This increase is attributed primarily to the installation of gap-filler radar and GCI control.

Destruction

It is clearly appreciated that a kill probability of 100% in the destructive phase of air defense would not directly increase the effectiveness of the detection, identification, and interception phases. Nevertheless this fact does not give us license to ignore any possibilities of improving our destructive capabilities. While the 1957 air defense plan employs air defense weapons with H.E. warheads, it lacks consideration for nuclear munitions.

It is utter folly to mitigate a chance of National survival by failing to allot nuclear munitions for defense purposes because its cost will not fit into the defense budget. We consider nuclear stockpile material to be material on hand for the most effective use. As a precedent, SAC is not charged for the atomic bombs it will drop on the enemy.

Not only should every effort be placed on improving the "weakest" phase of our defense, but all phases. To fail to do this exhibits considerable lack of vision and foresight in our planning, and is subject to great and justifiable censure. Future plans involving only HE warheads against enemy atomic weapons is just not in consonance with an all out atomic war of total destruction. Sudden and unexpected increases of effectiveness of the other phases of air defense should under no circumstances find the most advance phase, destruction, not capable of being employed to its maximum effectiveness. Conceivably, due to the critical and crucial need to maximize air defense capabilities, the extra over-all defense effectiveness achieved by maximizing the destructive phase might

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determine if we shall be sufficiently fortunate to survive.

The philosophy of all combat must be that nuclear munition is no absolute cure-all, and air defense is no exception. HE warheads must be exploited to the maximum and nuclear munition must not be used if HE munition would suffice. This point is important and requires great stress.

Since defense in depth is a cardinal principle of any defense and also since it is more desirable to detonate our own nuclear munition in uninhabited areas because of altitude restrictions, it is indicated that more thought should be given to location of defense units employing nuclear munition in depth. This **relocation** in depth of defense units delivering atomic munition might also increase the effectiveness of the interception phase.

By 1957 we could be capable of air delivery of medium size atomic munitions by the following means:

a. "Outboard" fighter delivery by toss bombing.

b. "Outboard" fighter delivery by the Navy BOAR rocket.

c. NIKE B.

d. BOMARC (Modified).

e. TALOS W.

f. TERRIER.

g. SHRIKE.

It is <u>not</u> recommended that small inefficient low yield atomic weapons that could be delivered in the NIKE I be considered. The medium size atomic munition has capabilities of achieving relatively very high yields, but can achieve a small though efficient yield with the use of small nuclear components. This is consistent with the current guided missile warhead philosophy of always using the largest and most efficient warhead and

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controlling the yield by selection of nuclear component.

Lt. Colonel Elstun and Gaitley of the Air War College Evaluation Staff, in writing the AWC Staff Study AU-13-52-ES AWC, "Fighter Delivery of Atomic Weapons in Strategic Air Operations," in November 1953, thoroughly investigated the delivery of atomic weapons by fighter aircraft using the LABS method and they firmly believe that toss bombing can be effectively used for air-to-air delivery. Recently there has been some evidence of experimentation on such a delivery. In addition, the Navy BOAR rocket can be carried outboard on fighter aircraft and will deliver a medium size atomic warhead with a range of 30,000 feet.

All NIKE B units and all BOMARC units should be trained and stockpiled with medium atomic warheads. The range of the modified BOMARC that will carry the medium size atomic munition will be 20% less than the range of the BOMARC carrying the 300 pound warhead. Investigation should be made for use of TALOS W, TERRIER, and SHRIKE for delivery of atomic weapons in air defense.

It cannot be overlooked that the use of atomic weapons in air defense will require an entirely "new look" in national atomic policy and stockpiling. The authority for use, as well as the atomic weapon itself, must be immediately available.

Project HEAVEN BOUND by ARDC, on the use of atomic weapons in air defense, is currently active. In view of the progress made and the volume of reports already issued on this project, it is not understandable why its capabilities are not more fully recognized in planning for air defense for 1957.

RAND Study, RM-1082, "The Use of Atomic Explosives in Air Defense," May 1953, though far from flawless and somewhat unrealistic, is indeed a step in the right direction. These references, as well as two AWC thesis done last year, are highly recommended for careful consideration by all air defense personnel. These **excellent** theses are "Feasibility of Atomic Weapons in Air Defense" by Colonel O'Horn. The increase of kill probability by using different size atomic warheads can be computed by the method given by Colonel Harmon in his thesis. A considerable increase probability is expected from the use of atomic warheads in air defense.

The references cited, and other standard atomic effects references, will have to be consulted for radii of aircraft destruction and safe heights of bursts for ground installations and personnel. For an appreciation of the order of magnitude involved, the following approximate figures are given: It is believed reasonably safe to detonate a 20 KT bomb at a minimum height of 10,000 feet and a 500 KT bomb at a minimum height of 30,000 feet. Obviously, smaller heights can be used over water or desolate areas. The radii of destruction of aircraft is in the order of miles, but since it is critically dependent on the attitude of the plane, the type, speed, and altitude **details** are not given.

Unquestionably, the use of large yield atomic weapons against large, close, enemy bomber formations would be extremely lucrative. Whether such formations will be encountered, even enroute to the target area, is highly debatable. However, we should be prepared to engage such a target of opportunity with atomic weapons. Obviously, the use of an atomic weapon against a single plane bearing a weapon of mass destruction is justifiable if there is no other means of obtaining a near 100% kill probability.

The effect of minimizing the probability of saturating any local defense by over-all use of atomic weapons in air defense is not accurately known, but it is apparent that it is possible to drastically reduce this probability. Also the use of atomic munition in air defense should materially reduce the fighter to bomber ratio required to achieve an adequate defense. It is thus possible that the critical nature of the timing of the air defense phases prior to the destruction phase could be rendered less important. In essence, effectively more time is given for these phases, and this should result in increasing their effectiveness.

Conclusions

1. In general the ADC planned program is acceptable in consonance with the budgetary limitations imposed and the assumption advanced. We agree with ADC as to its over-all inadequacy.

2. A better industrial island defense can be obtained from existing forces by moving six fighter squadrons from the South and Southwest areas into or near the Northeast area.

3. A positive electronic identification device needs to be developed not only for the benefit of the Air Defense Forces, but for air traffic control in general. Until such a device is available, all military aircraft should be equipped with an IFF device.

4. The ADC approach to ECM usage is unrealistic and far greater emphasis should be placed upon the development of a counter ECM system of maximum effectiveness.

5. The omission of a plan for use of atomic weapons in air defense in 1957 is unrealistic. Immediate plans should be initiated that will utilize every possible means for delivery of atomic weapons against enemy air targets when HE warheads will not suffice.

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SOLUTIONS SEMINAR NO. 8

H

AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
Date Submitted

STUDY NO. 1954-6

(Scheduled dates 4 Jan - 30 Jan 54**)**

SEMINAR NO. 8

INSTRUCTOR Col Shannon Christian

STUDENT CHAIRMAN Col Triffy

SEMINAR MEMBERS:

1. Col Bell
2. Col Chase
3. Col Helmick
4. Col R C Orth
5. Col Ruebel
6. Col Thompson
7. Col Powell
8. CAPT Coffin

Col Zoeckler

STATEMENT OF THE PROBLEM:

In general terms, analyze the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

SPECIAL PROBLEM OF STUDY TREATED:

Instructor's Signature
SHANNON CHRISTIAN
Colonel, USAF
Study Director

(Use reverse side for remarks)

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SEMINAR SOLUTION

STUDY NO. 6

SEMINAR NO. 8

SEMINAR CHAIRMAN: Colonel Triffy

SEMINAR RECORDER: Colonel Zoeckler

SEMINAR MEMBERS: Colonel Bell
Colonel Chase
Colonel Helmick
Colonel Orth, R. C.
Colonel Ruebel
Colonel Thompson
Colonel Powell
Captain Coffin

MAXWELL AIR FORCE BASE, ALABAMA

25 January 1954

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AN ANALYSIS OF THE DEVELOPMENT AND DEPLOYMENT OF THE AIR DEFENSE FORCES AS PROGRAMMED FOR 1957

1. INTRODUCTION.

A. At the time of Hiroshima and Nagasaki the United States held the unique position as being the only nation able to construct and deliver an atomic bomb. This terrifying news was received in various capitols of the world with mixed emotions. For the most part the only consoling feature was that the bomb was the monopoly of a philosophically non-aggressive, peace-seeking nation, and that the weapon could be used as a deterrent to war. Notwithstanding the many problems facing the United States and her Allies in rehabilitating the war-torn countries, trying war criminals, and attending the peace conferences in a methodical effort to secure the peace, the possession of the atomic bomb by the United States did much to assure the world that peace was here to stay. In fact, except for a few far-seeing high government officials in the Atomic Energy Commission and, of course, the military planners; the American people were eager to accept the "long-hairs" predictions that our nearest competitor, the Soviets, would be able to construct something resembling an atomic bomb no sooner than 1960. We shouldn't be unkind to any select group of forecasters because it is safe to judge that under the circumstances most of us were following the same thought processes. So, we all sat back on our respective big fat complacencies until we were rudely awaken by President Truman's

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announcement in the Spring of 1949 that the Russians had performed an atomic explosion. Merely twelve years ahead of schedule.

Fortunately, the United States Government had expended some funds and effort to continue the advancement of techniques of manufacture and other important aspects of atomic development, including the increase of our stockpile; so that when the shock of the rude awakening passed off, a quick assessment revealed that although we were considered to be ahead in the atomic race - - - a rival and dangerous threat loomed on the horizon. We all know too well that in only four short years the position of the United States changed from one of being all-powerful to the position of being challenged for leadership and consequently having to consider defending herself from possible atomic attack. Recognizing this, the Air Defense Command was organized as a separate function in the Fall of 1950.

A few days ago we had the fortunate experience of listening to General Chidlaw give us a thumb-nail sketch of his unenviable position awaiting a possible surprise attack and thus be the man to order the pressing of the button which will spring the latch on World War III. By Executive Order, the Air Force has been given the responsiblity for the control and direction of air defense of the United States. General Chidlaw told us of his effort to obtain a list of priority targets for defense, and how finally his list was approved by the JCS "without objection". Needless to say, throughout the country there are several schools of thought - - somewhat conflicting - - each urging its own answer as to the best way to avoid disaster. This division of opinion reaches into the National Security Council, the Cabinet, the Pentagon, the Congress, - - into this very room - - and Seminar 8 was not unique in this respect for the first few days. What do you think? Who knows if it is best to place more emphasis on a stronger offensive force at the expense of defense; or to place emphasis on the strongest possible defense even at the expense of a smaller, less potent strategic force? Where do you stand on the gravest question of our time? Well, chase away the gloom - - relax - - be happy - - for Seminar 8 has the solution for you.

B. As stated by General Chidlaw, the primary objectives of Air Defense are:

1. To prevent hostile air forces from inflicting such critical damage that national survival will be jeopardized.

2. To preserve the military means for conducting sustained defensive and offensive operations by air to defeat the enemy.

3. To aid in sustaining the Nation's will to resist.

II. PROPOSITIONS.

A. An evaluation of the threat as stated in "Cost vs Kill" and as presented by qualified speakers is accepted by this seminar. In brief, the threat which we consider the maximum is as follows:

1000 TU-4's; 250 Turbo-prop heavy bombers; 900 turbo-jet medium bombers (B-47 type) 250 Turbo-jet heavy bombers (B-52 type), and 500 atomic bombs.

We agree unanimously with General Chidlaw that the additional warning time provided by the Lincoln DEW line is a paramount necessity, and

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in spite of the fact that under present programs it will not be installed and operating by 1957, we agree with the Summer Study Group's report that with an all out effort the line could be completed by 1957. Tactical surprise can thus be denied the enemy due to the advanced position of the early warning net. With warning, the SAC bases and AEC installations will probably lose their criticality as targets if the bombers and trained personnel are the objectives. Under these circumstances, the population of the principal cities will present the logical target system, and herein also are concentrated the large percentage of the industry, transportation, and communications facilities of the country. The enemy task forces penetrating the defense is estimated about 800 bombers, aimed at 80 of the largest cities, with an average of four bombs per target. With surprise ruled out as a factor, and due to the potential high kill ratio of the engaging aircraft, and Nike, Falcon, and Bomarc missiles; it is believed that the enemy will attempt a large-scale mass attack. To protect its o wn population and industrial and war-making potential, SAC overseas and staging bases will have to be attacked by the enemy. ADC estimates that the Soviet will attack these bases before penetrating the Continental U. S. Defense Net, thereby giving a warning of approximately ten hours. We disagree with this ADC estimate, and instead believe that the bases will be attacked nearly simultaneously with the main attack on the U. S.

Other factors which may be an integral part of any attack are; (1) submarine launched missiles at our coastal cities - - using warheads of mass destruction; (2) and the use of sabotage and subversion - - however,

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these are to be coped with by passive defense forces and are not discussed due to the limitations imposed in this study.

B. Limitations.

1. The geographical area of consideration is Canada, Alaska, NEAC and the sea approaches to the continental United States.

2. The budget allocation for the proposed air defense forces will not be exceeded.

3. Force tabs include U. S. forces only. No consideration will be given to Canadian forces or augmentation forces.

4. Only active defense forces and not passive defense forces were considered.

5. The analysis was confined only to the Air Defense Command document "COST vs KILL".

III. <u>EVALUATION CRITERIA</u>

The process of evaluating a weapons system, on paper, without the opportunity of actual tests, must be based upon imperial guide lines. This group chose to establish four main areas for consideration in detail. These areas are criteria which must be used in the evaluation of any weapons system. They are: effectiveness, feasibility, adaptability, and vulnerability. Within the area of each general criteria we have divided the system into two main components:

(1) The air surveillance and control system, and

(2) the engaging forces.

The usual grouping of military evaluation factors has been employed, i.e., capabilities and limitations.

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A. EFFECTIVENESS

1. The air surveillance and control system.

a. Capabilities.

(1) Detection capability is the first functional requirement of the air defense system. Dependability and timeliness in the detection capability are the most important aspects of the function. Early warning will be provided by AEW aircraft stationed from Hawaii to Alaska where the line will join the Alaskan Air Defense System which will be integrated with the Canadian line (McGill line) stretching across Canada at approximately the 54th parallel. There it will join the NEAC system. Picket ships will carry it to Greenland, thence by 15FPS - 8 radars to Iceland, ships on to Scotland. West Coast seaward coverage, to form low altitude and continuous tracking, will be provided by additional AEW and C aircraft stations. This program will provide adequate detection, but it will not provide adequate warning time.

(2) Identification. However, the 1957 program offers many improvements over present unsatisfactory capabilities. More warning and better control facilities improve the capability for identification of friendly aircraft from known flight plans, and gives greater capability for controlling flight paths of these aircraft. An uncompromised and competent IFF system can be expected to be available in the near future for military aircraft. This is the only reasonable answer to the identification problem, particularly in the air battle area. This group assumes that availability of the equipment is possible for 1957.

(3) Interception - requires adequate GCI coverage and sufficient warning to place engagement forces in position to provide

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sufficient engagement time. Seminar C does not consider the 1957 height finding capability for GCI coverage in 1957 to be anything but minimal. However, we believe that if the system is operated at maximum efficiency by well qualified personnel, the additional warning provided will give sufficient deployment time for the engaging fighters to make the predicted number of kills. Continued acquisition of additional warning time and expanded GCI capability must be pursued vigorously.

(4) Destruction - the payoff phase, in terms of surveillance and control, is dependent upon the accuracy of positioning and the amount of engagement time provided by the system. We have stated that GCI coverage will be somewhat less than adequate, insofar as such things can be measured on paper. The additional warning anticipated will compensate for this by giving interceptor aircraft maximum use of GCI coverage as combat area.

B. Limitations.

(1) Detection will be technically adequate but with diminishing effectiveness at altitudes in excess of 35,000 ft. The warning time provided is considered to be a bare minimum. Only by final addition of the DEW line proposed in the Lincoln Study can a reasonable degree of readiness be achieved. Civil defense measures cannot be implemented satisfactorily until this line is installed and operational. Spoofing and ECM can be very effective against these ground radars and the detection process as a whole. These measures could be particularily effective if employed by the enemy in a planned coordinated attack.

(2) Identification will continue to be the weakest link in the air defense chain. Ease of identifying friendly flights will be

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enhanced by the addition of the DEW line. But after the area of contiguous coverage is reached (McGill Line), IFF seems to be the obvious answer and a critical requirement.

(3) Interception - capability will be limited by lack of GCI coverage. Time of engagement must be increased by extension of ability to track enemy sooner. The enemy is limited in routes of approach but there is sufficient leeway available to him to make effective use of diversion attacks, low altitude approach, and ECM. Saturation of GCI radar at critical target areas is a distinct enemy capability. The need for additional AEW and C aircraft with long range fighters under control is a pressing one.

(4) Another limitation is the reliability of the system, which is largely dependent on the effectiveness of communications and personnel.

Ground communications must be backed-up by substitute in every instance. They are susceptible to sabotage and jamming. Only actual tests of new radio techniques under actual conditions, will give reasonable knowledge of reliability.

Air-ground communications can be jammed. Frequencies are often insufficient. Power generators are not always reliable. It is realized that radar and other electrical and electronic systems are equally limited but we wish to emphasize that if certain parts of the communications system, especially air-ground, fail, the entire system can be reduced to negligible effectiveness.

The system requires sufficient numbers of trained personnel reliable, skilled, versatile, and emotionally fit for jobs which are not appealing. Trained personnel will probably continue to be another of the chain's weak links.

2. Engaging Forces.

a. Capabilities and limitations.

(1) Aircraft. Air Defense fighter forces will be incresed to 61 interceptor squadrons, and will include 12 squadrons of F-102's, and will include 12 squadrons of F-120's, 15 Squadrons of F-89D's and 34 squadrons of F-86-D's. These squadrons will be deployed on 52 bases. All will be armed with 2.75 inch rockets and some with GAR-1 falcon missiles.

Let's look at the firepower and relative performance as shown on Chart # 1.

Now lets look at a chart of the firepower and relative performance.

Type	Basic & Highspeed Knots/Feet	Combat Radius N. Mi.	Combat Radius Hrs.	Combat Ceiling	Armament No.	Armament Type
F-86-D	524/50,000 613/SL	332	.78	54,200	24	2.75 FFAR
F-94-C	477/35,000 568/SL	341	1.26	53,000	24	2.75 FFAR
F-89-D	496/35,000 562/SL	370	2.41	50,200	104 6	2.75 FFAR GAR-1
F-102-A	1100/50000 1170/35000	458	2.03	58-59,800	24 6	2.75 FEAR GAR - A1
F-99 BOMARC	2.5 M/60,000 2.7 M/80,000			80,000	1 1	300 # HF Atomic

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This chart indicates that the programmed manned interceptors are capable in (speed, range and ceiling) of countering any bombardment aircraft the enemy can be expected to operate in 1957. They are all-weather types.

ADC lecturers have given this force a maximum of 50% kill capability against a surprise attack, giving all the favoring factors to the enemy. But this does not take into consideration a human factor that the operational analist has not been able to put into his computer. This factor is that jet pilots will be fighting over and for their home territory. We believe that this fact adds considerably to the destruction probability after interception.

Let's look at some of the limitations of the aircraft. A manned interceptor is limited in speed, range, altitude, rate of climb, and maneuver accelerations, which can be built into it. The piloted interceptor must be more complicated because of the requirement for pilot accomodations and the equipment necessary to return the aircraft to base and land it.

(2) BOMARC (F-99). The Air Force is developing and procuring a pilotless interceptor. The first F-99 squadrons will be assigned to the ADC in late 1956. The complete program of 24 squadrons will not be operational in late 1960.

The mission of the F-99 is the interception and destruction of hostile aircraft and missiles from subsonic to Mach 2.0 speeds, at altitudes from 10,000 to 80,000 ft. at ranges from 250 to 325 miles from its launching site.

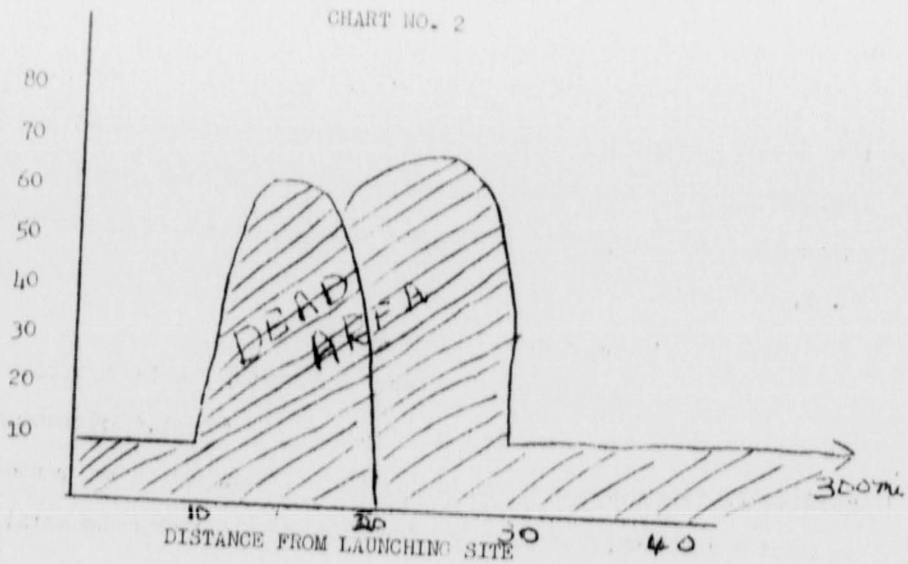
Although tests reveal that the Bomarc is an exceptionally reliable weapon. The lack of discrimination capability should be recognized. Toward the end of mid-course flight the target seeker is activated and the missile will home on any aircraft within a radius of about five miles. Any friendly fighter within three miles of the course centerline must be considered vulnerable to attack.

The BOMARC (F-99) has two main limitations. Due to its verticle launching trajectory, large turning circle immediately after launching, and the fact that the radar activated target-seeker is inoperative below 10,000 feet, the F-99 has a dead area as shown on Chart No. 2.

3. AAA - Nike I and Nike B.

As suggested by General Bennett, the ideal defense is one which engages the enemy from the "nest to the target." Preceding sections of this paper have enumerated the deficiencies in the capability to inflict substantial or telling attrition on an attack force until the final stages of the attack. The "last-ditch" stand is the mission of the anti-aircraft element of the defense system. The least desireable place to destroy the enemy carrying a nuclear weapon is in the close proximity to an aiming point in a densely populated area. In view of this inherent deficiency, this seminar considers that no additional emphasis should be placed on anti-aircraft at the expense of interceptor or longer range defenses. As long as subs nic aircraft constitute the principal enemy threat the target is not different from that faced in WW II. The difference in the offensive potential of the target, of course, requires an effectiveness which in the past has been claimed only with respect to the purity of Ivory Soap. Although the capability at present and in the foreseeable future falls short of meeting this staggering requirement, the picture is not entirely black.

CHART NO. 2



This fact is readily apparent when we review the defensive operations of the British against the German V-1 missiles during WW II. According to the statistics presented by Dr. Ermin in his lecture of Jan. 19, 50% of the 1078 launched missiles were destroyed by the anti-aircraft defenses of England during the last two weeks of August 1944. During a shorter period, the total kill reached a high of 79%. V-1 presented a much smaller and faster target than the TU-4. The firepower and accuracy of the command controlled Nike missiles far exceeds that of a like number of AA guns relying solely on predicted fire. It is further probable that the V-1 achieved greater saturation than the Soviet bomber force can achieve in 1957. Considering these factors, it is reasonable to expect greater attrition from modern weapons than has heretofore been possible.

A factor which has been somewhat discounted is the effect of anti-aircraft on morale. Operational experience indicates that only carefully selected, very experienced lead crews could be expected with reasonable accuracy to drop their bombs in the face of heavy anti-aircraft opposition.

In evaluating the modern anti-aircraft system with the Nike B missile, it is evident that the capabilities with respect to concentration of fire, accuracy, and the reliability and ability to operate in all weather conditions exceeds that of the systems in the past, and indeed in some respects may be said to exceed the capability of manned interceptor aircraft.

The limitations, however, still remain. These may be summarized as immobility, lack of range, (even though this exceeds that of previous systems), the time of engagement, vulnerability to ECM, lack of effectiveness against low-level attack, and vulnerability to saturation.

B. <u>Feasibility</u>.

1. Air surveillance and control system.

a. The DEW line #1 (44 arctic stations with automatic gap fillers) and line #2 (33 Canadian stations with automatic gap fillers). Since these lines posses similar characteristics and present similar problems, they will be considered together for evaluation of feasibility.

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(1) The alerting radars - - the Summer Study Group proposes to use simple aural presentation manned radars at intervals of approximately 100 miles. The Rand Report agrees that either these radars or the Lincoln Lab Mulders are feasible but suggests that tests be conducted to select the better system. Simple unmanned radars developed by Prof. Woonton of McGill Univ., and apparently proven, are to be used as gap fillers to provide the low attitude cover.

(2) Communications - - Recognizing the unreliability of low frequency communications in polar regions, the Summer Study Group proposes to make use of high powered ionospheric scattering techniques being developed by MIT.

(3) Logistics and Personnel - - The sites were selected so as to be accessible from the sea or by air, in emergency. The limitation of manning with only ten men per station greatly reduces the facilities requirements. With the experience gained in the construction of Thule and other arctic stations, the construction of these stations should be entirely possible. Limiting the personnel to ten men per station creates a requirement for multiple skills. This presents a training problem but should be entirely feasible. Study should be given to the advisability of using civilian personnel to man these stations.

b. The McGill line consists of 33 radar sites along the 54th parallel and to be constructed and operated by the Canadians. The line was selected generally to conform to the northern lines of the Canadian railway system so as to permit year-round support and supply by rail. The construction and operation of this line is entirely practicable.

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Concerning the augmentation forces of this line:

(1) The ten picket stations will be manned by 25 ships. Captain Leverton advised that Liberty ships are being converted for this purpose and should all be ready and operational by 1956-57.

(2) The AEW and C squadrons will use Lockheed RC-121's with search radars of approximately 100 miles of effective coverage. Delivery of the 60 aircraft is programmed will be completed by the second quarter of '56.

(3) The FPS-8 radar is a medium power long range search set with a 200 miles range at 40,000 feet. The Doppler gap filler radars are simple alerting type. Both are straight forward adaptations of known principles.

c. The remainder of the system will consist of 75 permanent radar stations in the U. S. and 79 mobile radar sites in the U. S. and Canada. This will give a relatively contiguous detection and tracking capability from the McGill line South to the principal target areas. Since most of this system is now manned and operating, its feasibility is recognized.

d. At present we are dependent upon the Ground Observer Corps for low altitude coverage. This is a functioning organization of some ability and substitution of 325 small automatic gap filler radars in the 1955-57 period will provide this capability.

2. Engaging Forces.

a. Airborne defenses (aircraft).

In considering the proposed Air Defense program, the

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increase in numbers of fighter aircraft amounts to less than 900 additional over those available in 1952. In terms of production capability, this will be no burden on the industry, even considering the SAC and TAC aircraft requirements for this sa me period. It is believed that industry is more than capable of producing all the airframes, engines and equipment to support the program. Any deficiency will most likely appear in the field of mass production of electronics equipment and in air-to-air missiles (falcons) because of the attendant requirements for extremely high reliability, long-life, and maximum performance.

b. Static defenses.

(1) AAA including Nike I and B. In the phasing-in of these weapons and the gradual elimination of the AA guns, the program calls for 60 Nike and 8 sky-sweeper battalions by 1957. Only in this area of defenses does there seem to be any tendency of over optimism, and this may be justified in sufficient emphasis is placed on the missiles development program. The really difficult task consists of re-engineering to incorporate reliability, longshelf-life, and simple go-no-go check procedure. To make this weapon simple and at the same time expremely reliable and fol proof is actually of momentous proportions. Until this is achieved, the defenses must rely on the use of their now present conventional guns and projectiles, and it is considered impossible to predict at this time when missiles will reach the same degree of reliability.

(a) Bomarc and Talos.

The comments in the previous paragraph apply to these weapons as well. It is significant that the plan projects no replacement of fighter aircraft strength based on the availability of Bomarc and Talos, even though two Bomarc squadrons are programmed for '57. This is believed the conservative approach and the correct one.

(3) ECM and Conelrad. These programs are relatively far advanced today. It is believed that the plan has conservatively assessed the capability and effectiveness of these measures, as well as their availability in'57.

(4) Although traffic corridors are only a stop-gap measure, due to the unavailability of acceptable IFF, they constitute a good feature and will undoubtedly be of greater value when IFF is made reliable. The use of identification maneuvers has further improved this plan, but the absolute necessity of the production, installation and use of IFF is not sufficiently emphasized. The timely availability of a secure IFF system will improve the efficiency of the warning net and interceptor forces through the elimination of the friendly unknowns; it will similarly improve the capability of close-in AA defenses for the same reason; and will give the fighters greater security while pressing the attack through the target area greatly increasing the kill probability.

C. Adaptability.

Various elements of the defense system programmed to be in place in '57 will have the capability of adaptation to future developments. The stations established across Canada, and the adjoining barriers operated by the Navy, should be well suited to aid the defense of the U.S., even into the age of inter-continental missiles. The installations required to support operating crews will require little change. The communications methods should readily absorb improvements without extensive alterations.

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The launching sites of missiles are convertible to a degree to any advanced missile program and the system of logistic support should require only slight improvement to accomodate any technological advances.

By the end of '57 the Soviet attacking force will be matched by Nike, Bomarc, Talos and F-102's, plus a host of lesser weapons. The weapons developed and programmed at the present time can be well adapted to the potential Soviet threat. It seems highly improbable that the Soviet threat in '57 will contain a ballistic missile with sufficient range to molest the continental U. S. Nevertheless, when such a threat materializes much of the basic equipment completed by 1957 will be usable in a new defense program.

Any countermeasures that are developed to reduce the effectiveness of the enemy attack during the next four years will remain effective until such time as the inter-continental missile becomes a reality. Consequently, funds which are applied to the development of countermeasures will have a far reaching effect.

The possibility that technological changes and advances could abruptly make obsolete the equipment of the programmed defense systems seems remote. It is reasonable to assume that changes will be evolutionary in nature, dictating a gradual change-over. The same assumptions may be applied to the Soviet advances in methods and means. Our intelligence must keep their fingers on the pulse beat of the weapons systems behind the Iron Curtain.

D. Vulnerability.

By 1957 the air Defense System will not be significantly

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vulnerable to either direct or subversive assault. It is extremely unlikely that direct assault would be attempted by troops, airborne or otherwise. Direct attack to the DEW line would be warning in itself to the nation's defenses. Effective subversive action by enemy agents or fifth column is also unlikely. The Communist Party in the United States, though requiring the utmost of security vigilance is not capable of neutralizing the Air Defense System. We believe that clandestine efforts would more likely be directed towards facilities not directly the responsibility of ADC to defend, but which are nevertheless of vital importance to ADC, such as communication centers.

Countermeasures for the protection of the defense system are dependent upon our over all security; internal security vigilance; a good intelligence system; and the usual methods employed to safeguard the already existing military and other installations. However, the system is vulnerable to the Electronic Countermeasures which the Soviet are credited with having the necessary skills to employ. We believe that they will possess the capability of jamming all frequencies from Low to Ultra High. Their bombers will be equipped to electronically jam NIKE radars and air-ground communications, and to dispense chaff. Increased capability in operating skills of our personnel along with technological advances in equipment afford a measure of promise in combatting this threat against our system.

Leading scientists assure us that our defense system need no longer be a victim of environmental factors if we exploit our capabilities in research within this problem area. Geographically we have Russia ringed, not she us. This fact provides us a tremendous advantage in permitting the establishment of warning devices far out on a perimeter from our shores and borders. Increases in scientific development and refinement of equipment will tend to alleviate the problems of personnel and logistics in arctic regions by the promise of more automatic equipment. Without such advances, already promised by competant authority, we still retain the capability of maintaining personnel whereever they may be required.

Although the task of operating effectively, maintaining, and protecting the system in the face of hazards of natural phenomena as well as the enemy's attempts of sabotage poses very real problems, we firmly believe that it is within our capability of preventing the destruction of the system as an effective part of our nation's defense forces.

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IV. Conclusions.

After reviewing the recommendations of Rand Corporation, the Summer Study Group, Air Defense Command, and certain Federal agencies (CDA) outside the Department of Defense, the conclusions of Seminar No. 8 may be summarized as follows:

First; the program for development, acquisition, deployment, and budgeting as developed by Air Defense Command for Fiscal Year 1957 is both sound and appropriate. It is our firm belief that the capability of the organization planned for that date will be improved as experience and training on equipment increases and as new techniques for employment are developed. Further, we believe that the threat as expressed is the maximum which can be envisaged, and that enemy tactics and operational problems may complicate the problem of enemy attack to an extent not reflected in the cost versus kill study.

Second; the 1957 Air Defense Program will add materially to the "massive deterrent" philosophy recently adopted by the Joint Chiefs of Staff and ably expressed by the Secretary of State. Not only does this defense program confront the enemy with immediate threat of unacceptable losses to his attacking forces but also the air defense warning network can substantially reduce the initial advantage of surprise and may create so many complications as to render his attack ineffective. Certainly no air attack will be launched against this country if there exists an air defense system capable of preserving a large proportion of our retaliatory,

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productive, and recuperative potential. It follows that forces in being for defense are indispensable to the "massive retaliation" philosophy to protect those forces on which it depends.

Thirdly; the 1957 program is properly devised to insure protection against surprise attack. Emphasis is placed on peripheral expansion of the radar warning networks improved high altitude coverage, and upon low attitude gap fillers to replace ground observers. Additionally a decisive attack may be prevented due to the wise assessment of target priorities by the Air Defense Command and through appropriate disposition of defensive dighters and anti-aircraft for their protection.

Fourth; the additional warning time provided by the distant early warning line is essential, particularly as enemy aircraft performance improves. Considering the budgetary limitations imposed, the provision for the DEW line in lieu of increasing the fighter aircraft strength is justified. This is particularly true if we accept the M. I. T. estimate that improved radar performance may be expected to provide warning of ballistic missile attacks.

Fifth; we conclude that to take full advantage of the distant early warning line there is a requirement for longer range aircraft with tracking and engaging capability. At present the warning provided merely serves to alert the country to imminent attack and permits the use of certain augmentation forces. These are of great importance to national survival and the increased effectiveness of the air defense forces. However, an ability to strike the enemy at maximum distance from our borders and to keep him under attack will produce far greater dividends than warning alone.

Sixth; development and installation of identification means has not kept pace with other air defense capabilities. Every responsible agency has indicated that this problem introduces the greatest possibility for error and shows least progress toward solution.

It is recognized that these conclusions are neither exhaustive nor all inclusive. However, based upon the premise that solution of major problems will normally solve the minor ills, it is believed that action to resolve these questions will result in improvement in air defense capability within the proposed program.

V. Recommendations.

The actions recommended by the members of Seminar No. 8 in solution or mitigation of the problems suggested by our conclusions are not revolutionary. We in no way share the views of the prophets of doom who insist that nothing can be done to provide an adequate air defense against enemy attack. Neither do we concur with those who would denude the Air Force of its offensive capability to concentrate solely on defense. Our position is in agreement with that expressed by the Commanding General, Air Defense Command, that, together a retaliatory force and a defense force properly complemented by an informed public, provide the best guarantee of national survival and a posture of international respect and confidence.

Our first recommendation, therefore, is that immediate high priority action be taken to approve and implement the major features of the Air Defense Command program for F.Y. 1957 as proposed in its Study, Cost versus Kill. The program is well designed, appropriately phased, realistically costed, and conservative in its demands on the nation's economic and material resources. It combines the best features of many authoratative air defense studies without overemphasis on any single defense measure. The proposed program maintains a suitable balance between the detection, identification, interception, and destruction capabilities. Without detracting materially from the effectiveness of over-all capabilities, the program provides a show of defense for those populous areas not generally considered primary or sensitive targets. Meeting this inescapable requirement head-on makes the program far more palatable to the taxpayer and his elected representatives. Similarly the plan recognizes the importance of well organized civil defense measures and the contribution they can make to national survival. Provision for the distant early warning line is of particular importance in this regard. A separate recommendation on this subject will be made.

To accomplish the early completion of this program it will be necessary to expand and expedite our efforts in the development and production fields to obtain the advanced weapons so desperately needed to counter the growing enemy threat. Continued high priority, adjusted as circumstances require but certainly second only to the Strategic Air Forces, should be accorded the production of radar, aircraft, missiles, and associated equipment. Similar priority must be given the training operating and technical personnel for this mission and to the assignment and retention of required skills within the Air Defense Command. Any effort which serves to expedite the completion date of the Air Defense program will add materially to the deterrent effect of our Air Forces and will provide earlier insurance against effective enemy attack.

Our second recommended action concerns the DEW line. We know of no technical, economic, geographic, or military reason why a reliable network providing four to six hours early warning could not be in operation within the time and budgetary limitations of this study. Although considerable development and evaluation remains to be completed on the radar equipment to be installed, it is known to be a straightforward problem capable of early solution. Controversy over comparative values of competing equipments must not be permitted to delay for one moment the installation of those items which can first provide the appropriate coverage. Although funds are programmed for this network, no capability is projected until after 1957. This date must be moved forward through immediate and continuous high priority effort. The contribution of this early warning line to civil defense actions and to the provision of augmentation forces to Air Defense Command marks this effort as most effective per dollar invested in Air Defense. Augmentation forces will reduce substantially the disparity between the growth of the enemy bomber force and the fighter aircraft assigned Air Defense Command.

The third recommendation made by Seminar No. 8 concerns a means for providing both a tracking and interception capability between the peripheral distant early warning line and the contiguous or continental defense lines. Should additional funds be made available for air defense, as has recently been reported by the press, we suggest that a substantial portion be earmarked for the creation of a long-range, tracking and interception air task force.

One approach is to provide airborne radar that need fly only when the early warning system indicates an enemy penetration is being made. After the enemy crosses the warning line he should be tracked so that our forces know how many aircraft are going where. Additionally our interceptors must be controlled over the millions of square miles of uninhabited waste land and ocean expanse to hasten the kill. Conventional land based or ship borne radar sites cannot be expected to blanket this vast and remote area, much less to give both high and low cover. Clearly this tracking, control, and interception operation requires introduction of new and imaginative tactical concepts. Airborne radar not only posesses the capability of maximum range high and low coverage but also has the mobility necessary to put it in the right place at the right time.

We believe there are several answers to this problem. At least two have been suggested by this seminar as worthy of further study. Aircraft of the RC-12 or similar type accompanied by long range fighter aircraft based along our borders and comprising mobile air tasks forces may provide the detection, identification, control, interception and destruction capability for which we are searching. A second suggested solution involves conversion of high-speed medium-range aircraft of the B-66 or B-58 type to interceptors with built-in AEW equipment similar to that carried in RC-121's today. In this case the tracking aircraft plays the dual role of interceptor. We believe there are many answers that hold promise of giving us control of the space between perimeter defense lines and our national boundries at reasonable cost. To realize this promise we believe that great emphasis on development must be made, both on equipment and tactical doctrine for its employment.

Because of the universal complaint expressed by all defense agencies, our fourth recommendation is that increased emphasis be given to development and universal installation of an effective identification device. Although we feel that the effect of the compromise of current equipments has been greatly exaggerated, there remains an unfulfilled requirement for such I.F.F. To date, both the Air Force and Navy have gone their separate ways in this field. It is time that joint service effort be applied and that the final production be installed and used in every military and commercial aircraft. Certainly our inventive genius has not yet been scratched in this field.

Because of the suggested transition of the enemy threat from piloted aircraft to guided missiles - to ballistic missiles, following the period of this study, it is our fifth recommendation that equipments and systems developed and installed from this point on be oriented toward this threat. This suggests that those weapons with capability for defense against ballistic missiles should be preferred to those solely adapted to aircraft, if the penalty to current performance is not severe. It is our considered opinion that, rather than a penalty, an increase in performance may be anticipated against the current threat if capability exists for use against ballistic missiles. Improved radar and missile performance and extensive research on counter-missile tactics give promise of some measure of success against this threat. Certainly it is sufficiently imminent to warrant the application of substantial research effort.

Like all sound programs, the Air Defense Command program for FY 1957 is deficient in some of its details. However, we must not permit delay in its implementation because of disagreement on, or lack of resolution of such details. We must proceed at full speed with the training of personnel, the procurement of weapons, the installation of equipment and the construction of bases necessary to its fulfilment. Modifications to the program will undoubtedly take place as experience and changing conditions dictate. We must carefully and objectively study suggested revisions, deletions or additions but we must not be diverted from our goal. It is obvious that a great deal of time and effort has been spent by highly competent and experienced people in devising this program. Seminar No. 8 has found what it considers to be many flaws in the details of the program. However, we have confidence in the soundness of the philosophy which it supports. The program as a whole has our unqualified endorsement and support. Let us get on with the job!

SOLUTIONS SEMINAR NO. 9

I

AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
Date Submitted

STUDY NO. 1954-6 **SEMINAR NO.** 9

(Scheduled dates 4 Jan - 30 Jan 54 **)**

INSTRUCTOR Col Shannon Christian **STUDENT CHAIRMAN** Col Foerster

SEMINAR MEMBERS:

1. Col Bleyer
2. Col Clement
3. Col Hogg
4. Col Paul
5. Col Saunders
6. Col Thomson
7. Col J Smith
8. CMDR Gage
   Col Zoller

STATEMENT OF THE PROBLEM:

In general terms, analyze the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

SPECIAL PROBLEM OF STUDY TREATED:

Instructor's Signature
SHANNON CHRISTIAN
Colonel, USAF
Study Director

(Use reverse side for remarks)

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SEMINAR SOLUTION

STUDY NO. 6

SEMINAR NO. 9

SEMINAR CHAIRMAN: Colonel Foerster

SEMINAR RECORDER: Colonel Zoller

SEMINAR MEMBERS: Colonel Bleyer
Colonel Clement
Colonel Hogg
Colonel Paul
Colonel Saunders
Colonel Thomson
Colonel Smith, J.
Commander Gage

MAXWELL AIR FORCE BASE, ALABAMA

27 January 1954

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AIR DEFENSE PROBLEM

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In August of 1953, Premier Malenkov told a cheering roomfull of Red officials in Moscow that America no longer had a monopoly on hydrogen weapons. Shortly thereafter the AEC announced that the Russians had conducted successful experiments involving both uranium and hydrogen reactions. Here was the ultimate threat to our civilization--so says Senator Styles Bridges in Colliers, January 8, 1954 issue.

President Eisenhower's presentation of a series of military programs totaling some forty-billion dollars will undoubtedly touch off a political debate of no mean proportions--the sort of debate which results when anxiety distorts reason. Throughout the Congress, the Pentagon, the AEC, our scientific research laboratories, our state and city governments, and even in public discussions, the participants in this debate will divide themselves into roughly four schools of thought as follows:

1. Those favoring continental perimeter defense, behind a radar, rocket, and interceptor screen;

2. Those favoring the building of a strong retaliatory force as a deterrent to enemy attack;

3. Those favoring the older concept of balanced forces, or preparation for all eventualities; and

4. Those soft spoken and as yet, very quiet adherents to the "let's settle it" approach--or the appeasers.

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There is yet another group that can get little consolation out of the fact that we have a defensive force that will cut the loss of life due to an atomic attack from some thirty-million Americans to something like five-to-ten-million, or that we have a Strategic Air Force that may be able to launch a retaliatory attack after the five-to-ten-million Americans are dead. This group considers only the gamble which we are taking by allowing our potential enemy to build in strength and granting him the privilege of the first blow. It takes the view that if war is inevitable, then let's get on with it as quickly as possible while the odds are still in our favor. Due to public persecution and in view of National policy, this group is necessarily quiescent; however, there is some indication that policy could swing in its favor. Mr. Gordon Dean, former chairman of the AEC, came out not long ago with a plea that the United States announce that it will wage atomic war on Russia should Communist aggression occur anywhere beyond Korea. President Eisenhower announced that if the Communists renewed the aggression in Korea, the United Nations response would not necessarily be confined to Korea. And the fact that the United States is the only nation which has waged atomic warfare in no small way affects the morality of such proposals.

The "let's settle it" group, or the appeasers, are not strong now, and probably only overt attack or the immediate threat of attack will draw them out. The balanced force advocates are in a very strong position politically and their strength will be reflected in the manner in which the resultant over-all military appropriation is sliced.

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The group which favors the building of a strong retaliatory force as a deterrent is an ambitious one whose followers are referred to in Congress, the AEC, the Pentagon, and elsewhere as the "Ten-X" people. They are of the opinion that perimeter continental defense is impractical, that we can't survive even the remnants of an atomic attack and that the only hope for the continuance of our civilization is a deterrent force capable of stalemating atomic, or thermo-nuclear warfare. They say that it is necessary to determine what atomic force is required to eliminate Russia's war-making capability and then to build a force of ten times that magnitude. Hence, the name "Ten-X". The main impediments to such an undertaking would be the necessity for large-scale continuous modernization and expansion of forces and facilities with resultant high maintenance costs, both of which makes the support of this effort economically unsound.

Whatever the outcome of the debate, Senator Bridges, in his capacity as chairman of the Appropriations Committee, has stated that money for the development of continental defense will not be forthcoming until military and scientific personnel can convince Congress that the job can be done. And whatever the feelings of individual members of Seminar 9 with respect to the several facets of the political debate, academic limitations preclude their full expression in this paper and require that this discussion of the problem of the defense of the United States be confined to the perimeter defense concept.

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The problem given to the Class was to analyze, in general terms, the Air Defense Program as envisaged for 1957, and to agree or disagree with the development and deployment of the defense forces. Seminar 9 has found reason to disagree with the Air Defense Command's program. While generally accepting the planned force composition, the Seminar concludes that more effective defense would be provided by a northward deployment of radar and interceptor forces from within the south and south-central United States in order to provide earlier detection, more effective surveillance of detected aircraft, greater intercept potential, and greater density of destructive forces in front of the target areas.

The following are some of the factors considered in arriving at the Seminar conclusions:

1. The enemy--or the Russian capability to attack the U.S.;

2. Our target system--or what we have to defend; and

3. Our defense system--or what we have to defend with.

For lack of better intelligence, Seminar 9 accepts the capability given the Russians by Colonel Adams and in the hypothetical attack used by the Air Defense Command in arriving at the composition and deployment of its forces. This Seminar desires to point out, however, that it feels that these estimates of the Russian capability are on the dangerously low side for the following reasons:

1. ADC gives the Russians only the capability of employing weapons which we have, and does not give them credit for developing any new weapon

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or tactic for which we have no defense. It is pointed out that popular magazines spare no effort in detailing our defensive armament and in some instances give location, time of employment, and specific capabilities. With this information available to the enemy, his probability of retaining surprise from the point of view of time, tactics and weapons is greatly enhanced.

2. The United States has consistently underestimated the Russian capability in the field of scientific development and technology, witness the case of the MIG and the Russian successes in the field of atomic and thermo-nuclear reactions.

3. The Seminar feels that, within the geographical limitations imposed upon the student-problem, the Russians should be credited with a capability for delivering a crippling surprise blow, by such means as missiles launched from submarines or A-bomb-carrying fighters catapulted from the decks of merchant-ships.

4. Another startling reaction can be had from a quote in a RAND Report to the effect that the absence of intelligence regarding the development of an inter-continental bomber may mean that Russia intends to pass up this intermediate phase and concentrate on inter-continental missiles, making our entire air defense establishment useless.

Seminar 9 does not agree with the Air Defense Command that only the population centers will be targets of a surprise attack. Sir Winston Churchill has credited SAC with being the only force that has kept the Russians in bonds. It is not believed, therefore, that she will attack the United States and leave a retaliatory force which she now fears free to launch a retaliatory attack against her homeland. It is felt that the number of bombers available to Russia will give her the capability to direct a force against the SAC bases sufficient for a reasonable chance of success, and then to divert any remaining force to population and industrial centers. In Sir Winston's non-classified memoirs, he was specific in stating that the air battle had to be won before there was any chance of success. He pointed out specifically that, had the Germans in World War II continued their air war instead of turning to the bombing of cities, Britain would have been lost. Granting the Russians the capability to read and think, it is doubtful that they will make the same mistake as was made by the Germans. Hence, Seminar 9 believes that the priority target system in a surprise Russian attack will be the SAC bases and the AEC installations.

The Seminar agreed that any discussion of an air defense system must logically consist of a discussion and analysis of its component parts. It was therefore, decided to discuss in turn each of the four accepted elements of air defense--detection, identification, interception, and destruction. Consideration of ground-to-air missiles and other anti-aircraft weapons is included in the destruction phase.

In the order of importance, detection must necessarily come first, for without it there is no identification, interception or destruction. Without detection, surprise is complete and annihilation of the target system and the destruction of our capability to retaliate are assured.

Even if nothing else is accomplished, the defense system must provide an effective detection capability in order that there may be timely warning to permit initiation of our passive defense measures and, if possible, the launching of our own retaliatory forces. It is believed to be generally agreed that the best and perhaps cheapest detection system would be to have a reliable agent in the Russian Bomber Command's operations office with appropriate equipment to give adequate warning. Lacking this direct intelligence we are forced to rely on the operational measures presently employed to provide detection. This leaves us with only ground observer nets and radar detection. And since both the sea and the Arctic areas limit the extent of ground observer participation, primary reliance must be placed on the radar system.

Analysis of the 1957 programmed radar and its deployment has led Seminar 9 to the conclusion that it is improperly deployed to meet the threat. Since the geographical limitations of the problem nullify consideration of an attack from the south, the Seminar considers that the radar sites in the south-central United States contribute nothing to the detection capability of the defense forces but serve purely operational purposes. It is considered that these stations should be redeployed to the north in Canada to extend the envisaged contiguous radar cover.

Such an extension of the radar detection and surveillance area obviously contradicts the considerations upon which the McGill Line are based. It is suggested, therefore, that the McGill Line should likewise be moved northward, if practicable, or, as an alternative, distant early warning be obtained through AEW operations across nothern Canada. AEW aircraft not only could provide early warning, but also could employ "bloodhound" tactics in following enemy formations, giving information on their track until they reached contiguous radar cover, insuring detection and early interception.

The Seminar believes that radar coverage should be continuous for at least two hours flying time of the attacker from the first likely targets and that early warning must be provided for six to eight hours flying time of the attacker from SAC bases. This will insure a higher detection capability and a higher intercept and kill probability, but most of all will provide adequate warning for passive defense measures and launching time for SAC. The Seminar feels that this condition must be met at the expense, if necessary, of other elements of the defense force.

The element of identification is closely allied to that of detection and ideally both should occur simultaneously and as early as possible. Since detection will be accomplished by means of radar, it is logical to assume that identification must also be effected by electronic means. Analysis of the composition and deployment of programmed air defense units for 1957 does not clearly point up the means of aircraft identification, but the importance of this element to the effectiveness of a defense system cannot be underestimated and merits discussion here.

Several means of identification are possible. Speakers from the platform have discussed the IFF and the problems incident to its installation on commercial aircraft. Assuming that satisfactory arrangements with

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commercial carriers could be made, the IFF system would be relatively insecure and extremely vulnerable to compromise. Sealed envelope instructions regarding "stud settings", aerial corridors, and manouvers for aircraft flying within identification zones, increase to some degree the security of the identification system, since instructions can be varied within specified time intervals. Correlation of aircraft specifications with observed speeds and altitudes, when combined with electronic identification and sealed envelope instructions add further to the reliability of identification. The forced landing technique is considered by Seminar 9 to be of no value as an identification procedure in the event of a Russian attack since it is not envisaged that any hostile bomb-carrying aircraft would appear in numbers small enough to merit consideration of this procedure. The statistical raid method may be employed, but the Seminar is of the opinion that this procedure is, in effect, merely an evaluation of detection which emphasizes the need for immediate positive identification.

To summarize the above discussion is to conclude that in the current concept of air defense there is no method of positive identification of detected aircraft short of actual interception--a most costly method from the point of view of capital investment and time-phased operations.

Generally speaking, Seminar 9 considers that the deployment of the interceptor force should be in accord with the deployment of contiguous radar. Although the principle of defense in depth is agreed to, it is considered that the defensive depth should be established outward from the target systems. Emphasizing again the geographical stipulations limiting student considerations, the Seminar believes that the interceptors located in the south-central United States should be deployed northward consistent with the proposed northward deployment of radar from the same general area. At a minimum, they should be deployed along the northern U. S. border; if operationally and diplomatically practicable, some should be scattered as far north into Canada as 300 miles south of the proposed extended contiguous radar.

It is considered that at a point outside the United States it is immaterial to an intercepting force what the ultimate destination of any intercepted enemy aircraft may be. It appears highly probable that interceptors based in the south might never have occasion to enter the air battle, for the bombers destined to destroy the targets they are defending might well be "inadvertently" destroyed or turned back by northern-based fighter pilots who fail to ascertain the enemy's intentions before destroying him. It appears reasonable to conclude, based upon individual interceptor kill-potential, that air defense interceptors now based in the south could equally effectively defend Fort Worth or New Orleans if moved to the northern perimeter of the United States or beyond, while at the same time taking advantage of the bonus protection provided by increased interceptor density. For such deployment not only will bring a greater number of interceptors to bear earlier on the attacking force, thereby raising the "kill probability" of the entire defensive force, but also will add to the effectiveness of the defense of northern industrial targets. Furthermore, it will give to some Americans the consolation of having more of the enemy destroyed elsewhere than over their own housetops. And as long as interception constitutes a primary means of identification, higher density of deployed interceptors in the north would allow more time for probable target areas to institute passive defense measures.

Recognition of the existence of augmentation forces, particularly Air National Guard Units within the Interior of the United States, adds further weight to this proposal. For pre-"D-Day" deployment of such forces may be presumed to provide a reasonably constant interior defense augmentation capability, at least in magnitude.

The Seminar fully appreciates the political aspects of this solution, but feels that it is entirely possible to convince the population of "Chitland Switch," Alabama that they are neither in as great a danger, nor of the vital importance to National security as are the cities of Detroit or Chicago.

In analyzing the destruction capability of the 1957 Air Defense Program, Seminar 9, for the sake of harmony of thought, accepts General Chidlaw's definition of "kill" as its definition of destruction. The ultimate objective in air defense is, of course, to prevent 100% of the attacking aircraft from reaching the target. All reasonable estimates of our capability to stop the enemy attack, however, fall considerably short of this goal.

It is true that our interceptor aircraft have individually a great kill potential and that, if detection identification, and interception are accurate, one interceptor would probably have at least a 50% kill capability against any one bomber. But if an attacking force should number--say--five-hundred bombers, and only one-hundred interceptors could be brought to bear on the force, the kill probability drops to 10%. It must be borne in mind, too, that the enemy bomber will undoubtedly have some means of defense such as electronic counter-measures, armament, etc., that conceivably could decrease even this low probability.

Now let us consider BOMARC and NIKE. The 1957 program envisages three BOMARC sites of 30 missiles each, to be launched into an area from 50 to 250 miles from the site where aerial combat is going on. Let us assume that the attack formation previously mentioned were to come within range of the two BOMARC sites in New Jersey, that all danger of mistakenly knocking out our own interceptors in the area is removed, and that all 60 of the missiles function perfectly. Let us further assume that the New York NIKE defenses get a crack at at least a part of this formation. It was stated from the platform that the proposed NIKE defenses of New York City have a 100% kill capability against thirty bombers. Granting NIKE its 30 kills, a formidable enemy atomic force of 360 aircraft still remain to destroy New York and other targets within their reach. And one question that never was answered was, what happens to NIKE when the first bomb strikes?

The Seminar considers it an accepted fact that all of the defensive weapons systems would, of necessity, come into play in any given area by virtue of the inability of any one system to effect 100% kill. Without more positive operational data pertaining to the relative effectiveness of planned weapons systems under actual combat conditions of air defense, comparison from this point of view was presumed to be largely academic and of secondary importance to their deployment.

In developing its solution to the defense problem, Seminar 9 assumed that mere relocation of existing forces could be accomplished with academic freedom of action and without incurring additional charges against the

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Defense Budget. The Seminar did, however, take cognizance of the fact that operations and maintenance costs increase in the northern areas and that therefore, the northward redeployment of interceptors and radar would in fact increase defense costs. Accordingly, it was felt that some elements of the total defense force might have to be sacrificed in order to remain within the Budget limitation. Priority of defense elements was, therefore, established as follows:

1. Contiguous radar coverage (two hours flying time of the enemy northward of our first likely target),

2. Early warning lines and AEW,

3. Interceptors,

4. Anti-aircraft (ground-to-air weapons).

Since the Seminar advocates increasing the potential for fighting the air battle at points remote from the target and preferably outside the continental limits of the United States, and since missile sites and their projectiles are limited to point defense, to be employed in a last ditch stand when the probability of the enemy doing damage is already too great to be offset favorably by their use, it is considered that the missiles should be the first to go if there is insufficient money to go around. And since it is felt that the Country must have sufficient warning to have time to initiate passive measures and to launch retaliatory forces, it must have the radar net even at the expense of interceptor aircraft.

Seminar 9 does not accept the high kill probability as predicted by the Air Defense Command, but considers that it is more likely to be of the order of 15 to 35%. The upper limit may be obtained by the expenditure of considerably more money between now and 1957 and in the years immediately thereafter. The lower value is more likely at the contemplated rate of expenditure.

This conclusion was reached by the mere application of arithmetic. It was assumed that, under the planned defense system, 67% of all hostile aircraft would be detected early enough to permit defensive operations and that 100% of these would be identified. The Seminar felt that 50% of those detected--or 33-1/3% of the total hostile force--would be likely to be intercepted and that we would be doing well if 50% of those intercepted were destroyed. The total kill, based upon these percentages is 16-2/3% of the original attacking force.

If this percentage seems too low to some, let us examine the kill probability that now is nothing more than a fond desire of the Air Defense Planners--that each element of defense has a 95% capability. If 95% are detected, 95% of those detected identified, 95% of those identified intercepted, and 95% of those intercepted destroyed; and if, to this, we add a not unreasonable probability of 95% that all four elements will be 95% effective, the net result is still only a 77.5% kill. If we apply even this relatively high percentage to the attack force the Russians were given the capability of conjuring up, 180 bomb-carriers could still find their targets.

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Whether we use 16% or 35% or 77%, a significant number of A-bomb or H-bomb carriers will reach their targets. If this is so, then the problem of air defense needs re-evaluation. In re-evaluating what air defense can do in 1957 for the United States, it becomes obvious that neither the capabilities of retaliatory forces nor the passive defense capabilities can be ignored. For the 1957 Air Defense Program does not provide us with a means of stopping crippling destruction, but it can be made to provide warning in adequate time to accomplish two essential acts:

1. SAC can either be evacuated from its bases or can launch a retaliatory attack, depending upon the time available.

2. Essential passive defense measures can be undertaken to increase the likelihood of survival of our population centers.

If we must adhere to a course which allows our enemy to have the privilege of a first blow before we strike, then we have to preserve that power with which to strike back. We can not do it without making safe our retaliatory force and the people to rebuild the wreck of a nation we shall have after the first blow is struck. To save the retaliatory forces and the people we must have warning. Every effort should be made, therefore, to meet fully the detection and identification requirements of the defense system.

In conclusion, Seminar 9 considers that there is no air defense system we can devise which will be a complete deterrent to enemy attack, and that the best and most useful air defense we can have is an effective early warning system plus 1/10 of that force required by the "Ten-X" advocates.

SOLUTIONS SEMINAR NO. 10

J

AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

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STUDY NO. 1954-6 **SEMINAR NO.** 10

(Scheduled dates 4 Jan - 30 Jan 54**)**

INSTRUCTOR Col Shannon Christian **STUDENT CHAIRMAN** Col Fowler

SEMINAR MEMBERS:

1. Col Bleymaier
2. Col Cochran
3. Col Hohman
4. Col Royal
5. Col Thrift
6. Col Seeley
7. Col Van Sickle
8. CAPT Moynahan

Col Zumwalt

STATEMENT OF THE PROBLEM:

In general terms, analyze the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

SPECIAL PROBLEM OF STUDY TREATED:

Instructor's Signature

SHANNON CHRISTIAN
Colonel, USAF
Study Director

(Use reverse side for remarks)

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SEMINAR SOLUTION

STUDY NO. 6

SEMINAR NO. 10

SEMINAR CHAIRMAN: Col. Fowler

SEMINAR RECORDER: Col. Zumwalt

SEMINAR MEMBERS: Col. Bleymaier
Col. Cochran
Col. Hohman
Col. Royal
Col. Seeley
Col. Van Sickle
Capt Moynahan
Col. Thrift

MAXWELL AIR FORCE BASE, ALABAMA
January 1954

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THE PROBLEM

The problem is to analyze the development and deployment of Air Defense forces as programmed for 1957 in "The Cost and EFfectiveness of the Defense of the United States Against Air Attack," published by Headquarters, Air Defense Command 16 February 1953. The problem is made somewhat unrealistic by the stated limitations, that is, that the probable budget for ADC will not be exceeded, that we ignore augmentation forces, and that only the North American continent be considered. In addition any practical solution to the problem must take cognizance of the fact that materiel programs for 1957 (particularly with respect to guided missiles and fighters) are no longer susceptible to any significant change due to development, funding, and production lead times. Finally, neither the time nor the material available to the seminar permits a technical evaluation of the equipment and weapons programmed. Therefore the following conclusions, discussions and recommendations must perforce be in general terms vulnerable to the arguments of experts.

CONCLUSIONS

Our analysis of the development and deployment of the Air Defense Forces as now programmed for 1957 results in the following conclusions:

a. That the concept of operations for air defense should be oriented around mobility, placing reliance more upon airborne early warning, than on any static concept indicated by the idea of a line such as the DEW line proposed by the Lincoln Summer Study Group.

b. That the increasing efforts planned to make the warning infallible and the interception inevitable will not improve the real defense of the United States in a manner commensurate with the cost in resources and the manpower expended.

c. That the personnel aspects of the problem are woefully neglected in both the ADC cost vs. kill study and in the material provided for study and consideration, and that in a defense system which is to be effective for a long period of time the human factor is of primary importance.

d. That the recommendations made on page III of the Cost and Effectiveness Report are sound and should be implemented, particularly those requesting better intelligence and security control of air traffic entering the United States.

Our conclusions will be supported in the following discussion of the factors we considered most pertinent. These factors are:

(1) The nature of the threat
(2) Concept of operations
(3) Detection
(4) Identification
(5) Interception
(6) Destruction
(7) Effectiveness
(8) Human factors
(9) Public attitude

THE NATURE OF THE THREAT

Air defense programs must be based, to a substantial degree, on the accepted estimate of enemy capabilities weighed against our own vulnerability. The nature of the threat described in the programming document deals in Russian capabilities only, and does not consider intentions. Even the estimate of capabilities seems to reflect maximum capability that can be extrapolated from intelligence plus our own experience. It is considered entirely appropriate for ADC to take this view of the threat since it is charged with the Air Defense of the U. S. and cannot afford to underestimate the enemy. If a less pessimistic estimate of the threat is taken by higher authority, and such a view is used as a basis for not doing all that this country can do to get an effective air defense, then, by such action, higher authority necessarily relieves the ADC Commander of part of his present heavy responsibility. If risks with national survival are to be taken, they should be taken only by the highest national authorities. Therefore, we accept the nature of the threat as stated to be reasonable and appropriate for programming purposes. In relation to this subject, it is necessary to take passing cognizance of the admittedly poor intelligence on USSR available to ADC.

We consider there are three vital target systems in the continental United States; our retaliatory force, our war industry capability, and our national will to fight. The location and identity of the first two are well known. The nature and vulnerability of the latter is indeterminate, but is directly related to the other two. Since the location of a major part of our population coincides with the vital elements of our war industry, it seems logical to identify these areas as vital to our national security and to give them priority, along with SAC, for maximum air defense protection. In other words, we agree in general with the targets chosen to be defended by ADC.

CONCEPT OF OPERATION

Our study of the Air Defense Command's program indicates that the concept upon which this plan is based is one of distant early warning and close-in defense. That this concept is prevalent in Washington is evidenced

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by a recent speech by our Vice Chief of Staff in which he referred to "last ditch defense" and "last resort defenses" for the United States. There may be reasons such as budget limitations, lack of public understanding, and others, for this philosophy, but tritely expressed, it is a Maginot Line approach, regardless of efforts to make it appear otherwise. In World War II the French, depending upon a strong but rigid defense were quickly and overwhelmingly defeated. On the other hand, the Russians, resorting to defense in depth, met the enemy at the borders, weakened the German attack by delaying actions, and stiffened their own defenses as the thrust penetrated more deeply into Russian territory. This mobile defense or defense in depth was successful against the same forces which defeated the French behind their wall. We believe, then, that our concept of air defense must be fluid and not static; it must be defense in depth, not defense at a wall.

Geography of the North American continent gives the United States one great advantage over Russia. Examination of the globe reveals that the distance from the center of the United States to the outer boundary of the area which we could control is about double the corresponding distance computed for Russia. This means that, properly equipped, we could keep Russian bombers under fire over a distance twice as great as that in which Russian defense could engage ours. As speeds increase, this advantage will become more and more important. Placing our defenses close in seems to be willingly giving up one of our few military advantages over Russia.

It is technically feasible now, to erect a defense in depth over the North American Continent and its ocean approaches. This can be done by various combinations of equipment presently available or in production.

Seminar 10's concept of defense in depth consists of an AEW system having an outer perimeter extending from Hawaii to England, passing through Alaska, running along the Canadian archipelago to the northern tip of Greenland, thence to England backed up where needed by ground radars and possibly short range small AEW aircraft. This system would insure high and low altitude radar protection from Hawaii to England and in addition would provide tracking and vectoring capability which would result in continuous radar coverage from time of detection to point of interception.

DETECTION

We now propose to examine the ADC plan for 1957 under the four phases of air defense, the first of which is detection. By 1957 more than 300 low altitude radars are programmed to improve the detection of low flying aircraft; the overland portion of the McGill Line along the 54th parallel will be built by Canada and will provide considerable early warning; and additional mobile radar sites and passive detection stations are included for use in the continental U. S. These three steps are apparently needed, can be available and should be provided. The continental portion of the Lincoln Line as programmed, however, has only small utility for the active air defense system, increasing kill probability by only 2%. In addition, being fixed in position it is vulnerable to attack, sabotage, jamming, or being evaded. Instead, we believe the fixed radars of the Lincoln Line should be largely replaced by an airborne early warning system forming a mobile but comprehensive coverage in variable depth from Hawaii to England. As least one type of airplane, the C 121, now available in limited numbers can perform such a mission, and we believe a sufficient quantity of suitable aircraft could be obtained and operated for the price of the Lincoln Line. This plan would involve no new airbase construction since sufficient bases for the purpose already exist. Further, whereas the facilities of the land portion of the Lincoln Line would be largely fixed in place, airborne equipment would be recoverable for use in other places. Finally, the airborne early warning system provides complete low and high altitude coverage while the Lincoln Line leaves low altitude gaps which must be filled with some form of gap filler detection, and which by this rigidity of wave propagation patterns form a fence whose weakness can be detected before the attack.

IDENTIFICATION

The establishment of identity of any airborne object requires a "yes or no" type answer. However, if the "yes or no" is not immediately apparent, the only recourse appears to be a process of elimination. Inherent in this process is a requirement for time. The object must be held under some form of scrutiny until the yes or no is established. The optimum period of scrutiny, we feel, can be had only by an observation post which can make initial contact soonest and maintain the contact longest. Such an observation post must therefore make its initial contact as close as possible to the area of origin of undentifiable flights, and maintain surveilance along their probable flight paths until identification and interception is made. This capacity appears to be obtainable most effectively in a flexible mobile airborne system. The mere fact that an AEW aircraft can maintain the track of an unidentified flight while it is still beyond the perimeter of our intercept capability, goes a long way towards establishing identity sooner.

Friendly aircraft do not employ ECM against our own system. An unpredictable pattern of AEW aircraft coverage will force enemy employment of jamming at an early stage of his flight. This is certainly a most useful factor in early identification in addition to early warning.

Under the current TU-4 threat, a maximum range, profile type flight appears to be a necessity. Such a flight will hardly enjoy cloud cover from the optimum AEW range all the way to the United States. As a last resort the AEW aircraft could initiate an intercept procedure in a clear area for visual identification.

These are but a few of the tactics that suggest themselves not only for a positive identification of enemies by AEW technique, but also for early identification.

INTERCEPTION

Within the limits imposed by this study, particularly the funds, there does not appear to be any possibility of providing either a substantial increase in interceptors nor better positioning. The main weakness in the planned interception capability lies in the percentage effectiveness of the interceptor force available. GCI vectoring capability as planned does not utilize the full range of our interceptors, nor will the time available to the controller permit him to dispatch the optimum number of interceptors.

It is felt there is a real need for a vectoring capability further from the periphery of the U.S. than will be available from the present plan. Utilization of airborne early warning aircraft with it' built-in tracking and vectoring capability will make possible more intercepts and intercepts further from U.S. targets than the proposed ground based GCI and the ground EW. From the improved detection and identification possible with AEW employed in depth a more accurate assessment of the magnitude of threat will be realized, and thus permit optimum re-deployment of interceptor forces available in the Zone of Interior but not positioned most effectively for the particular attack which is imminent.

To further improve distant interception capability, studies should be initiated to determine feasibility of basing our interceptors on Canadian soil, aerial refueling of interceptors, or other means of getting our fighters further out from the United States, such as transport interceptor teams deployed to remote areas as proposed in the last issue of the Air University "Quarterly Review."

DESTRUCTION

Frequently in this study we have heard emphasized the necessity to destroy the first Russian bomber, or put in another way, the requirement to effect more than a 95% kill probability to save the United States from disastrous attack. Yet the ADC plan by programming more fighters and more radar promises at best only a 56% kill rate by 1957. Our seminar feels that one method of increasing ADC's destructive ability astronomically with relatively small additional cost is to use atomic warheads in our present AD weapons in lieu of highly complex and often unsatisfactory target seekers with conventi[illegible].

Because of the large area of destruction resulting from the explosion of an atomic warhead, the requirement for a pinpoint, complex target seeking device would be negated while the kill probability factor would be increased many times over. A bomber formation is particularly vulnerable to such an attack. Besides causing terrific destruction, an atomic explosion would undoubtedly demoralize the remaining bomber crews and reduce their effectiveness immeasurably. The use of atomic missiles against a single enemy bomber is justified also, particularly if we credit the Soviets with the capability of delivering a thermonuclear weapon against us.

There are many delivery vehicles available in 1957 which can be converted to carrying an atomic warhead. The matador, Bomarc, Nike B, Talos and possibly the Falcon could be so modified if the program is given proper emphasis and support. Since we will soon be in [redacted] atomic plenty the cost of the fissionable material is a simple paper transaction, a concommittant of the decision to use it for air defense weapons.

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EFFECTIVENESS

The method of evaluating the effectiveness of Air Defense as used by the Air Defense Command and by the Rand Corporation is in terms of kill probability. All efforts are devoted to its increase. But bomber kills alone, cannot and will not defend the United States from disastrous attacks if we depend on the current programmed forces, equipment and employment. Our concept must recognize that we can confuse, if not destroy the enemy bombardiers or guidance systems. We must seek to obtain warning and to minimize effects, rather than to achieve complete kill capacity, important (but admittedly impossible) as that is. With this approach to the problem we can parry the attacks which we know cannot be stopped effectively, if they are resolutely pressed, and we can accomplish what we are really after: Preservation of the U.S., preservation of our forces, not destruction of the enemy air forces in the air, is what will enable us to strike back with sufficient effectiveness to stop attacks on our country.

In estimating the effectiveness of enemy penetration of our defenses, we express ourselves in kill probability, ignoring bombing capability. We are prone to give the Soviet Union bombardiers a capability which we, experienced in long range bombing, are doubtful of attaining with the same perfection ourselves. Despite the excellent briefing possible from the vast amount of intelligence we provide the Soviets, the Soviet air crews are just as much under pressure to make their releases effective as we are. In fact, probably more so, if what we know of the unforgiving nature of the Soviet official is true. A bombardier, fatigued, cold, headed for unknown but highly touted defenses about an American industrial target is dependent upon a great degree of self confidence for the proper target identification. As he approaches the target, the pressure mounts more and more. He refers to his briefing material,

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or to his memory of it, to prepare for his bombing run. What are the consequences of a strange radar scope reflection at the time he reaches his radar aiming point? Will he see through it at once, and confidently analyse and solve the problem? Or will he wait until he is a little more sure? Or will he jettison, knowing that he does not have to return to the Soviet Union if the drop is not successful, or even if it is successful? The chances are that under the pressure of atomic bombing, where every bomb must be made to count, he will be as easy to deceive as the best of our bombardiers; in fact, it should be easier than to deceive ours, for he will not have had the benefit of combat training and annealing, which we possess, either directly or indirectly in the personal experience of our bombardiers. In other words, a technical capability, which we freely grant to the Soviet Union, solely on the basis of their acquisition of the B-29A and APQ-13 bombing radar of World War II, and probable subsequent developments, is a far cry from an actual and infallible capability to place the bombs where they will do the most good. Our failure to capitalize upon our ability to confuse the enemy bombardiers is a serious neglect of a simple, and relatively inexpensive method of preventing the bombs from landing on the right piece of real estate.

A study of the scope photographs of principal continental targets will show that some are more likely than others to be improperly identified by the enemy bombardier, particularly if he has to bomb by radar. If we persist in giving insufficient emphasis to exploiting visual camouflage, and to the possibilities of electronic camouflage by the use of corner reflectors, ground sown chaff, blinkers, mobile reflectors, repeaters and dummy radio and lighting systems, we will have little reason to complain if the R(ed) A.F. hits their targets with the infallibility we now so supinely give them.

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HUMAN FACTORS CONFIDENTIAL

Of all the documents and lecture material made available to the class for the Air Defense Problem, only one, the Air Defense Command cost vs kill study, made any reference to the human factors involved, and that reference was obscure and unemphatic. Rand reports treat the human as a variant which under certain limits of mental capacity and training, can make a contribution capable of mathematical expression. No more short-sighted approach can be imagined. Certainly if people are expected to make whatever force is established work properly, the subject of people is worthy of a concerted persistent, imaginative effort. An example is the problem of manning isolated stations in the Arctic, and sub-Arctic, a problem vital to effective early warning.

At the present time, an officer or airman who is a trained radar observer, finds himself stationed at isolated stations operated on the austere "men only" principle, a fundamental part of which is frequent rotation. Because of the urgency of using his skill, he can on rotation, have his choice of any isolated station in the country. His inclination, therefore, is to leave the service. Our current and future planning seems to follow this rotational concept. The enduring problem of early warning surely will not be successfully solved if it is not attacked flexibly and imaginatively, and the personnel part of it is foremost in its need for such an attack.

There is much experience to support at least partial use of another solution. Small communities, such as the CAA in Alaska, the Hudson Bay Co, the Anglican Church, and the Administration of Northern Greenland by the Danes, are always given stability by two fundamental and essential factors:

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First, the men are there because they want to be there. Second, they are provided with quarters such that they have their wives with them. In Alaska, the CAA stations are desirable, because the young couples see in them a chance to spend a few years while their children are small, or before they have children, in amassing a nest egg. Their pay is not required for other than their personal wants, supplied by mail order houses on the outside. Housing is provided with all utilities, and there is no place to spend the money on Saturday night. There are many families which by their own wish remain in the Arctic for many years, and at Point Barrow, Point Hope, Cambridge Bay, and Flin Flon, one will find Americans, Canadians, and Danes who would rather be there than anywhere else. Though they always talk about going "outside," they seldom go, or if they do, they return, wives and all.

At the present time, there are many officers and men in the Air Force who are drawn to the Northland. They have experience there, they like it, and they feel that there they can make their greatest contribution to whatever operations are required. The Air Force makes no attempt to identify these men, and except for the record of assignments in their 201 file, there is no way to select personnel for such duty.

The application of an imaginative and visionary approach to personnel problems is essential in all air defense fields as well as the foregoing example, if the system is to work.

PUBLIC ATTITUDE

The importance of proper Public Relations and Information must be included in any considerations of Air Defense but the subject apparently was not included in the plan under study of the United States. Although Operation Candor has been considered by the President and his staff and has apparently been postponed indefinitely, nevertheless this seminar feels that an increased number of authoritative statements are essential to the proper functioning of all phases of the Air Defense program. For example, if Americans are made aware of the threat to our homeland they will be more willing to volunteer for G.O.C. duty and military service. Also, their interest will be reflected in Congress and the Defense Department whence must come the budget increases, and where General Chidlaw said he needed a "sympathetic understanding of Air Defense problems."

An informed public must be steered on a middle course between an ignorant, do-nothing position and a false Maginot line concept. We have not known invasion since the War of 1812 and are therefore less capable than Europeans of absorbing the shock of warfare as evidenced by the hysteria on the West Coast after Pearl Harbor. Not only must we avoid panic but we must have a positive, active civil defense program. Lastly, we must prevent a false sense of security as might be produced by such articles as the "A-bomb Can be Stopped" in the recent issue of U.S. News and World Report. Here we do not advocate censorship but rather a series of statements or speeches from high government officials which within security limits will tell the people what we may reasonably expect from the USSR and how we may best prepare for it. Such a program would cost little in dollars but would immeasurably lubricate the wheels of the Air Defense mechanism. The ADC at all echelons can have a profound effect on public opinion as well as using its influence to persuade Washington officialdom to inform our citizens.

SUMMARY OF DISCUSSION

In summary, the concept of an Air Defense system as visualized by Seminar 10 would:

1. Provide a vastly superior and far more reliable system of detection.

2. Provide time for positive identification and still implement air defense plans.

3. Permit utilization of the maximum range and optimum number of interceptor aircraft.

4. Extend the area over which enemy aircraft will be under continuous fighter attack over a longer period of time.

5. Make possible the conduct of the air battle over uninhabited or economically unimportant areas.

6. Permit maximum redeployment and concentration of interceptor forces within the ZI to meet the threat.

7. Increase the capability of evacuating and or commiting retaliatory striking force.

8. Tend to reduce bombing accuracy as a result of prolonged attack and visual and electronic camouflage.

9. Engage the enemy in a radar counter measure battle earlier and over a longer period of time.

10. Provide a flexible and mobile system which can be easily deployed to more sensitive areas.

11. Offer greater potential for expansion and improvement beyond 1957.

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RECOMMENDATIONS

After consideration of the above factors in connection with Air Defense forces for 1957, this seminar recommends the following alterations of the program in order to provide the optimum defenses within estimated budget limitations.

1. Orient the air defense concept to that of a flexible defense in depth. This can be accomplished by replacing the Lincoln Line with airborne early warning.

2. Increase effectiveness of present weapons by modifying them to carry atomic warheads.

3. Concurrently with increasing destructive power, initiate a program to decrease effectiveness of enemy bombers escaping kill, by inexpensive visual and electronic camouflage

4. Establish a realistic, progressive approach to personnel problems of the Air Defense forces.

5. Encourage a national public information program to condition people to the possible consequences of present and forseeable limitations on our national security and to gain their enlightened support and acceptance of measures that may be necessary to meet future developments.

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SOLUTIONS SEMINAR NO. 11

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AIR UNIVERSITY
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MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
Date Submitted

STUDY NO. 1954-6 **SEMINAR NO.** 11

(Scheduled dates 4 Jan - 30 Jan 54 **)**

INSTRUCTOR Col Shannon Christian **STUDENT CHAIRMAN** Col Franklin

SEMINAR MEMBERS:

1. Col Bohnaker
2. Col Cook
3. Col Hoisington
4. Col Kealing
5. Col J L Parker
6. Col Tibbetts
7. Col Gillette
8. Cmdr Rumsey

Col Beauchamp

STATEMENT OF THE PROBLEM:

In general terms, analyze the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

SPECIAL PROBLEM OF STUDY TREATED:

Instructor's Signature
SHANNON CHRISTIAN
Colonel, USAF
Study Director

(Use reverse side for remarks)

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SEMINAR SOLUTION

STUDY NO. 6

SEMINAR NO. 11

SEMINAR CHAIRMAN: Col. Franklin

SEMINAR RECORDER: Col. Beauchamp

SEMINAR MEMBERS: Col. Bohnaker
Col. Cook
Col. Hoisington
Col. Keeling
Col. Parker, J. L.
Col. Tibbetts
Col. Gillette
Cmdr. Rumsey

MAXWELL AIR FORCE BASE, ALABAMA

26 January 1954

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I. STATEMENT OF THE PROBLEM.

A. In general terms, and within stated limitations, to analyze the development and deployment of Air Defense forces as programmed for 1957. Justification will be included either for accepting the force as programmed or for changes that may be recommended as an improvement to the programmed forces.

B. Factors used to analyze and evaluate the forces programmed will be identified and discussed, with primary consideration to this part of the problem.

C. The following limitations will apply to this problem:

1. The geographical area of consideration is Canada, Alaska, NEAC, and the sea approaches to the Continental United States.

2. The budget allocation for the programmed Air Defense forces will not be exceeded.

3. Active air defense forces assigned to the Air Defense Command only will be considered.

II. ASSUMPTIONS:

A. The U.S.S.R. will launch an overt attack against the United States some time near the middle of 1957.

B. Air Defense Command's mission is to defend the United States from hostile enemy air attack. Initially, its task is to prevent the U.S.S.R. from delivering an attack on the Continental United States which would be of sufficient lethality to destroy our will to resist and our ability to retaliate and recover.

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III. ENEMY CAPABILITY AND U.S. TARGETS.

A. The capabilities attributed to the U.S.S.R. by the Air Defense Command for the 1957 time period were examined by this seminar in considerable detail, since a realistic appraisal of the enemy strength and capability is the basis for estimating our own effectiveness in defending against an overt attack. This appraisal is also of great value as a guide for establishing qualitative and quantitative requirements for a suitable defense force.

B. Generally speaking, this seminar agreed with both the estimated enemy forces and with the probable enemy tactics for employment of his forces, with the following exceptions:

1. Aircraft:

a. Seminar 11 does not concur in the estimated strength of either the Soviet Long-Range Air Force or the number of aircraft that would penetrate the United States in the 1957 attack.

b. Reason: Soviet production in 1950 was estimated at 19,000 aircraft of which 4,900 were bomber aircraft. Production potential estimates for 1960 have ranged from a low of 50,000 aircraft to a high of 100,000 per year. (Aviation Age pp. 32 & 52). The TU-4 was copied and put in production far ahead of U.S. intelligence estimates. The Soviets now have 1,000 TU-4's with a production rate of 250 per year. As of this date nearly all units planned for TU-4 aircraft are in full strength and a new phase of re-equipment of newer types is probably starting. (AIS 2-2/3). While the main force of the Soviet Long-Range Air Force will probably consist of later types, great numbers of TU-4's will be available to insure complete saturation of U.S. defenses.

Secondly, since the Soviets will expend nearly three-fourths of the entire atomic bomb stockpile (which includes those used on targets outside of U.S.) there is little reason to hold in reserve a large Long-Range Air Force. The pay-off of such a successful attack is so great that it must be considered an all-out effort by the Soviets throwing everything they have to insure its success. It is our opinion that a mass attack in the eyes of the Soviet leaders would more nearly approach double the number estimated by ADC.

Considering the above, Seminar 11 believes a more probable figure of Soviet aircraft attacking the U.S. en masse would be 1,600.

2. Weapons:

a. We concur in the ADC estimate of 500 A-bombs but in addition we believe that 10 - 20 H-bombs of the 1 - 10 megaton class will be available for this attack.

b. Reason: We have found no indication that there is any great U.S.S.R. production problem in making the H-bomb. Since the Soviets exploded a hydrogen device in 1953 we believe that it is well within their capacity to produce 10 to 20 of these weapons by 1957. (Summer Study Group).

3. Targets:

a. Seminar 11 concurs in ADC's estimate that the primary targets will be the 80 key cities indicated in their Study. In addition, we believe that the Soviets will place special emphasis on centers of political and military control. (Pentagon, SAC Hq., ADC control centers, etc.).

b. Reason: Population centers offer attractive targets because of the great potential psychological pay-off, and their vulnerability to mass destruction weapons. They also provide handsome bonuses in damage to transportation, communications, and production facilities. The critical need for command and leadership after an attack will invite Soviet emphasis on those targets of political and military control.

4. Plan of Attack:

We believe ADC's concept of the 1957 attack is sound and logical except for the number of aircraft as noted above. However, in consideration of the firepower factor, we also believe that those aircraft not carrying A or H weapons will be equipped with special ECM equipment or CW and BW weapons. Crews will consist of well trained, politically reliable Soviet personnel. We do not believe that the defection of these crews while in flight offers any significant possibilities. Satellite crews will not be used for the initial attack on the United States.

IV. ANALYSIS OF DEVELOPMENT AND DEPLOYMENT OF ADC FORCES PROGRAMMED FOR 1957.

A. As stated above under Enemy Capabilities, the effectiveness of a given defense force may be estimated only in comparison with an enemy capability. With the establishment of an assumption as to this capability, we may proceed to analyze our own forces and their relative capability.

B. The major functions of an active defense against an enemy air attack are detection, identification, interception, and destruction. These functions overlap and occasionally occur almost simultaneously in point of time but are discussed in three groups here for convenience.

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1. <u>Detection and Identification:</u> CONFIDENTIAL

a. The ADC program for 1957 covering the "detection" phase was developed by enlarging the earlier existing radar coverage, and by using the same type of equipment plus some additions. The ADC assumed that in the 1957 period there would be complete low and high altitude early warning radar coverage extending from Hawaii to Alaska, across Canada on approximately the 54th parallel, and extended eastward to Greenland, Iceland, and Scotland. (This line (The McGill Line) was assumed to give a minimum of 2 to 6 hours warning against TU-4 type bombers at the line's closest point to the U.S. Additionally, for comparative purposes, there was assumed to be a lightly manned chain of early warning radar running eastward across the northern reaches of Canada (Lincoln Line) to provide the earliest possible warning of attacks over the shortest great circle routes from the U.S.S.R. Therefore, it was further assumed that a surprise attack by the U.S.S.R. against the North American continent will be denied, and that either low or high altitude attacks will be detected with sufficient warning to alert the defenses, deploy SAC, institute Conelrad, ground unessential air traffic, and evacuate critical target areas.

b. The function of identification of enemy bombers in 1957 is not considered to be a serious problem since it is assumed that (1) attack on the continental limits of the U.S. will be preceded by an attack on SAC overseas bases, thus alerting U.S. defenses; (2) all unessential traffic in the U.S. will have been grounded; and (3) all unknown flights penetrating the radar detection boundaries would immediately be classified as "unknown hostile."

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c. Conclusions: Seminar 11 agrees that the planned coverage, including the McGill Line with its flank extension will provide adequate warning of an enemy attack, and at any operationally feasible altitude. It is further concluded that identification of enemy forces under mass attack conditions will not be a problem.

2. Interception:

a. Although the programmed interceptors have a comfortable speed margin over a TU-4 type target and can probably intercept this target at any combat altitude it can reach, the performance of these interceptors against any bomber target at altitudes above 40,000 feet leaves much to be desired because of the time required for the interceptor to climb to altitude. Although the F86D performance date indicates 9.3 minutes to 50,000 feet, actual performance indicates a time to climb on the order of 14 minutes to 45,000 feet. This amount of time, plus the time from detection to scramble, makes it very problematical that a Type 31 target could be intercepted before bomb releast at altitudes above 40,000 feet. The F89 types require in excess of 20 minutes to combat ceiling, and could not intercept under these conditions. It would appear that the F102 and the Nike and Bomarc missiles offer the most likely means of intercepting a Type 31 at high altitude.

b. Conclusions: It is concluded that the performance of the manned interceptors programmed for 1957 will be adequate for interception of TU-4 type targets, but marginal to inadequate against a Type 31 or comparable bomber at high altitude. The F86D is known to have weight increases programmed that will more than offset any potential engine growth in the same period. The ground-to-air missiles and the F-102 have a capability of intercepting extremely high altitude targets but will be available in limited quantities only by 1 July 1957.

3. Attack and Destruction:

a. Individual weapon development (F-102, F-99 Bomarc, Falcon) and weapon growth (F86D, F89D, Nike) it is estimated will provide an increased kill capability in 1957 against Soviet aircraft. To provide optimum destructive effectiveness on a complementary weapon basis, for defense in depth, ADC utilized interceptors for general area defense, guided missiles and anti-aircraft guns for local area defense. Interceptor, missile, and anti-aircraft gun costs versus effectiveness were integrated on this basis to provide the highest feasible defense potential within the ADC budget.

b. Consideration of special counter-weapons to meet possible enemy employment of guided missiles was limited since weapons systems considered for 1957 have some capability against possible missiles, and in any case adequate funds had not been made available to program a defense against even the most likely type of attack in 1957, which is with manned aircraft.

c. Conclusions: The DEW line and its seaward extensions plus the contiguous continental and coastal radar coverage provides a capability for GCI that is beyond the combat radius of programmed interceptors. The unacceptably low kill capability concluded by the Air Defense Command is attributed to saturation of defenses, or inability to attack a mass raid at any altitude with a sufficient quantity of interceptors.

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major increase in the overall kill capability could be achieved if a mass attack could be brought under fire before the enemy reaches the outer perifery of continental defenses. This seminar has given serious consideration to the feasibility of recommending a suitable decrease in F86D type aircraft to provide funds for the development of a long-range two-man all weather interceptor since such a weapon would add significantly to the estimated kill capability of the forces now programmed. Although it is considered that the present state of the art would allow the design and development of such a weapon possessing a satisfactory combat altitude, maneuver capability and speed to be effective, it is concluded that it could not be available to the tactical inventory in significant numbers prior to the 1958-1960 time period. Of further consideration is the fact that to support such a program from existing funds would result in the loss of an inordinate number of F86D's due to the sum of the development costs and the difference in cost of the two weapons. It is believed that the programmed forces cannot tolerage any lesser quantity of interceptors than those now planned.

V. FACTORS AND DISCUSSION.

A. Enemy Capabilities:

1. The factor "enemy capabilities" is considered by this seminar to be in itself one of the three major factors affecting ADC programming for 1957.

2. The factors in the "enemy capabilities" area discussed in some detail in part III. Accordingly, only the major sub-factors are indicated here:

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a. Sufficient aircraft are available to the Soviet Union to attack any target so desired in the United States by 1957. This takes into consideration in-flight refueling, one-way missions, and a combination of both.

b. Seminar 11 believes that sufficient aircraft will be available over that estimated by ADC to completely saturate U.S. defenses.

c. The Soviets possess the capability of placing sufficient high yield weapons on 80 of the large key cities of the United States that will make the probability of U.S. rising to its knees and fighting back, except with forces in being, very problematical.

B. Targets in the United States:

1. The targets to be defended are considered by this seminar to be the second major factor in ADC programming for 1957.

2. In arriving at target priorities, the following are considered to be the major factors:

a. The enemy's capability to deliver A-bombs of from 40/100 k/t yield in sufficient quantity to strike at 157 stated crucial targets. Included in these 157 targets are 80 of the largest cities and SAC bases overseas.

b. Population and industrial density resulting fn high yield in loss of life per bomb expended with parallel destruction of comparatively high percentage of industry. Such high losses would probably cause a loss of political, military, and economic control, with probable loss of the ability and will to fight, except to a limited degree, using forces in being.

c. Dispersion or underground construction of industry is considered impracticable because of enormous cost (New plant construction cost, housing cost, labor movement costs, and cost of lost production during changeover).

d. The increasing lethality (yield) of available weapons.

e. The impossibility of 100% defense with forces allocated requiring decision to defend three priority areas with preponderance of population and industrial (war-making) capacity.

f. Early warning available in 1957, which obviates the necessity for priority defense of SAC in the U.S. against surprise attack.

g. The increasing possibility of the use of long and short range missiles with warheads capable of mass destruction against which ADC has no defense.

C. Defense Forces — Availability and Capabilities expected:

1. This area of consideration is believed by this seminar to be the third major factor affecting ADC programming for 1957. A discussion of this area follows:

2. <u>Detection</u>:

Major factors in this area are considered to be:

a. The early warning system now deployed will be capable of having its desirable components integrated into the system programmed for 1 July 1957.

b. The early warning system will provide sufficient warning to permit evacuation of target areas and deployment of SAC units. For a TU-4 enemy bomber this is considered to be a minimum of 4 to 6 hours, or 800 - 1000 miles.

c. The maximum distance that land-based early warning sites may be placed relative to targets and probable approach routes is limited by geography and feasibility of support and operation. (Communications, logistics, security, and quantity of programmed equipment).

d. The early warning sites will have an altitude coverage capability from 0 to 50,000 feet.

3. Identification:

a. Positive identification of airborne aircraft or objects as "friend or foe," is required to prevent the unnecessary employment of the Air Defense System. Without positive means of identifying airborne objects, either visually or electronically, it is necessary to alert more parts of the total defense system until positive identification has been established. Under present operating conditions the interceptor pilot makes contact and determines identification by visual means. This inefficient requirement adversely affects the overall system through the factors of cost and time. It is essential that the ADC have the capability of identifying any airborne object penetrating the boundaries of the United States. Upon penetration, identification as "known friendly," "known-hostile," or "unknown" must be positive, for dependent upon this determination, other actions may or may not be necessary.

b. The need for identification at the greatest possible distance and time from the probable target, is a second major factor. This factor is especially important in considering possible mass attacks since spoofing and unknowns can cause serious dilution of defending forces through false alerts.

The time required for air combat and the time required for AA kill are major factors of a relatively fixed magnitude; therefore, the time for air battle prior to BRL requires identification in excess of the sum of these times.

To be effective, the defending force must kill the bomber before it can release the bomb. To do this, in the case of AA guns, the enemy bomber must be within gun range sufficiently long for the battery to establish altitude, track, and speed, plus firing time. The totals of these times are of a fixed order. The case of air interception is somewhat similar. First, the bomber must be identified as hostile; then while his track is established, and intention determined, the fighters are scrambled; scrambled, flight to altitude follows. Interception must be effected followed by air combat. These actions are all time consuming.

The Lincoln line is proposed as the northernmost position for detection of intruding aircraft, but has not been funded. A major factor in establishing the value of this line is that it can supply information of outer perimeter detection back to command level where the information can be checked against known flight plans. Factors in considering the value of the Lincoln line for identification are:

(1) It would not provide positive identification data;

(2) However, it would provide, in addition to the detection data, information as to the number of penetrations.

The establishment of this line with its early warning capability would increase the time available to the defending forces to intercept and destroy. Further, evacuation time for SAC and target cities is increased.

ADC plans a limited number of passive detection stations on radar perimeters out to sea and to the north for the purpose of picking up radar or other electronic emissions of approaching aircraft. This information can be used for purposes of detection of penetration and, to a limited degree, knowledge of the character of aircraft.

c. A factor in the total ADC system effectiveness is the reduction caused by the present necessity to operate a war designed Air Defense System in a peace-time atmosphere.

Because present aviation activities are not restricted to war-time measures, the operations of the ADC are burdened with necessity of handling added data in their efforts to seek out information about the enemy.

The previously discussed factor of availability of the H-bomb to the U.S.S.R., with the limited number of aircraft required to devastate a smaller number of targets, should not rule out a limited SURPRISE attack. This only again points up the absolute necessity for military and commercial air flight regulation through peace-time corridorization, possible use of IFF and use of special flight maneuvers, apparent on radar screens, when challenged by voice.

4. Interception:

a. The time available for interception and attack is a function of radar range, aircraft range, and speed. The detection distance from the radar will vary as the capability of the type of equipment being used; the better equipment being that giving detection at the greatest ranges. The speed and range of the interceptor determine the distance toward the target that the attacker gains from point of detection.

b. Detection and control equipment have a built-in limit in their capacity for efficient operations. If this capacity is exceeded the resulting operations are confused. A radar set can detect and track a few targets and keep each identified. As the number of targets is increased, the identification and tracking problem becomes more and more difficult until a saturation point is reached. By the same token it is possible to saturate the directive capacity of the system by exceeding in targets the number of communication channels available to work the individual interceptor. These factors justify use of integrating computors and ADIS.

c. The AC&W system will be largely automatic, requiring evaluation at the control center. Since the radar lines will be out as far as possible many of the individual sets will be in isolated areas. These sets will be automatic in operation and will remote their information back to a central point. This will assist "command and control" by reducing time to scramble interceptors.

d. The McGill line early warning provides time to deploy and launch up to 60% of the ADC Fighters resulting in overall increase in interception effectiveness.

e. Long-range radars do not provide adequate coverage at the lower altitudes of 1 - 5 thousand feet. Low flying aircraft can come

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in quite close to these sets without detection. [illegible] gap-filler radars are essential to cover these areas to insure detection as far out as possible to give adequate timely warning and increased time for interception and attack.

5. Attack and Destruction:

a. A major factor in the analysis of efficiency of the ADC program is the requirement to kill enough enemy bombers prior to BRL to render ineffective the enemy's effort.

b. In measuring kill effectiveness, a general overall increase over previous years was noted, attributable to the factor of greater early warning time. This increased combat time is available to intercept, attack, and destroy an enemy aircraft.

c. The balance of quantities of guided missiles (Nike - Bomarc) against numbers of interceptors programmed was analyzed on the basis of tactical employment for local area, and for general defense. Weapon capabilities, and the relative cost per kill of each within its own environment was compared. The localized protective capability of Nike and Bomarc is limited when compared to their cost and the number required to protect the vast network of vital targets. The factor of proven capability of the F86D and F89D, and the added factors of their availability within the system range in excess of missiles range, mobility, and performance against anticipated enemy aircraft, resulted in our agreement with ADC's numbers of weapons systems of interceptors, and guided missiles. This was particularly so because Bomarc may not be operational by 1957. Further, it must be compatible, for use in 1957, with the new ADIS and existing GCI systems. Its high kill probability justifies its continued emphasis.

d. Added factors in weighing kill effectiveness of weapons on a comparable basis were:

(1) the proven value of the F86D, F89D, and Nike, against

(2) The Bomarc and F-102, whose kill efficiency is based on studies, and limited test data.

e. An unknown quantity, but one important to consider, is enemy capability to electronically counter, by active means, the fire control systems of Nike, Bomarc, and the interceptors, either by affecting the general control system, or the seeker, homer, or fire control system within the vehicle itself. We consider this factor to be worthy of extensive investigation, emphasizing CW radar seeker possibilities.

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SOLUTIONS SEMINAR NO. 12

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AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
Date Submitted

STUDY NO. 1954-6

(Scheduled dates 4 Jan - 30 Jan 54**)**

SEMINAR NO. 12

INSTRUCTOR Col Shannon Christian

STUDENT CHAIRMAN Col Gephart

SEMINAR MEMBERS:

1. Col Brewer
2. Col Lerche
3. Col Holloway
4. Col Leland
5. Col M. E. Parker
6. Col Evans
7. Col Huneycutt
8. CAPT Widhelm

Col Bedine

STATEMENT OF THE PROBLEM:

In general terms, analyze the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

SPECIAL PROBLEM OF STUDY TREATED:

Instructor's Signature
SHANNON CHRISTIAN
Colonel, USAF
Study Director

(Use reverse side for remarks)

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SEMINAR SOLUTION

STUDY NO. 6

SEMINAR NO. 12

SEMINAR CHAIRMAN: Col. Gephart

SEMINAR RECORDER: Col. Bodine

SEMINAR MEMBERS: Col. Brower
Col. Lerche
Col. Holloway
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Col. Parker, M. E.
Col. Evans
Col. Huneycutt
Col. Widholm

MAXWELL AIR FORCE BASE, ALABAMA

26 January 1953

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AIR WAR COLLEGE

Study #6 Seminar Requirement

Submitted by Seminar 12

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I. INTRODUCTION

The proposed U.S. Air Defense posture for 1957 within the program and budgetary limitations presents a problem of continuing evaluation at many levels by technically qualified persons. Such an evaluation requires an intimate knowledge of enemy capabilities and probable intent; the target systems to be defended; the concept of operation; the location, limitation and capabilities of organizations, their personnel, and equipment being made available, and their costs.

The air defense of the United States and of its strategic retaliatory force, of its cities, of its governing echelons, and of its industrial capacity, can never be 100% effective against a determined enemy. Mere dollars cannot buy any such insurance. But well spent, the appropriate share of a Defense Dollar can increase the present capabilities to deny an enemy any but Pyrrhic success. The air defense share, however, should not be disproportionate to the extent that the retaliatory forces suffer even minor curtailment. Nor should any other forces be denied an appropriate share of the necessary means to carry out their responsibilities in preventing or defending against possible and probable overt and covert attempts to injure our country or our allies.

Seminar 12 has carefully considered and discussed the published material made available and the expert presentations from the platform. From this frame of reference we have sought to weigh the several aspects of air

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defense, i.e., detection, identification, interception and destruction, and the apparent weaknesses and faults of the system. In the following paragraphs we discuss the factors which we considered and present our conclusions and pertinent recommendations.

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II. DISCUSSION OF FACTORS CONSIDERED

Enemy Capabilities and Intent

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A study of Soviet aircraft, take-off bases, and weapons leaves no room for doubt that the USSR has the capability of attacking the United States as assumed in the 1957 ADC Program. However, we feel strongly that it is dangerous to assume, as the program does, that the enemy will attack SAC overseas bases ten hours before striking the continental United States. Even granting that the enemy might do so, we feel that any defense planning based upon such an assumption is dangerous. We believe that planning should be based on a simultaneous or coordinated attack which appears well within enemy capability. The U.S. must prepare for the worst possible situation, that of an all out surprise attack.

Intelligence Warning

Early warning of an enemy attack from intelligence sources outside of the air defense system is possible and every effort should be made to achieve it; however, the Air Defense Command has quite properly refused to assume that any such early warning is probable.

Distant Early Warning

The proposed radar perimeter along the Arctic circle known as the DEW Line would provide four to six hours of early warning. This warning is highly desirable, but such a line is neither technically nor economically feasible by 1957. Future enemy capabilities may make the installation of this line necessary or futile. We agree that the 1957 program is sound in implementing the McGill line before attempting to establish the DEW line.

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McGill Line

This early warning line about the 54th Parallel in Canada appears to offer a fairly high degree of reliability and should provide two to three hours warning of impending TU-4 type attacks against major targets in the United States. We believe this line is being properly developed.

Seaward Extensions of the McGill Line

The overwater extensions of the McGill line is one of the most critical factors in the defense of the United States. We agree with the present changes being made in Atlantic extension of this line from Newfoundland to the Azores rather than from Greenland to Scotland. The Pacific terminus at Kodiak is sound only if the gap between the Alaskan System and the McGill line is closed, say along the Alcan Highway. These changes makes the the line less vulnerable to "spoofing" and reduces the "dead space" after penetration.

The effectiveness of these overwater lines could be increased by utilizing aircraft capable of carrying air to air missiles and/or all weather fighters which could be launched to destroy or keep under surveillance the attacking planes. In addition, sufficient overlap radar coverage should be provided to make possible the detachment of individual AEW aircraft to maintain surveillance of hostile planes and to provide fighter intercept control if required.

Electronic Identification of Aircraft

A dependable means of electronic identification of aircraft is an immediate "must" for the defense of the United States. The fact that it is difficult to develop a system which will not be susceptible to countermeasures or compromise, is not considered justification for further delay in

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the development of an acceptable system. Identification, to be effective must be almost simultaneous with detection and since this can only be achieved electronically, all other means of identification can only be considered expedients.

Operational Identification Procedures

Pending the installation in all aircraft of a reliable electronic means of identification, every practical operational procedure must be established. These procedures include instrument flight plans, approach corridors, identifying maneuvers, and prearranged signals. In establishing approach corridors along the Atlantic coast, this seminar considers it essential to forbid aircraft approaches from the sea between Cape Cod and Cape Hatteras. This area appears to offer the most lucrative targets with least available warning.

Fighter Interception

Within the time period being considered it is apparent that only the manned all-weather interceptor can accomplish interception.

Intercept fighters are vulnerable to the possible overloading of the surveillance and guidance systems. This vulnerability may be reduced with the use of the Lincoln Transition System. The Lincoln system will also reduce the time required from detection to interception, and while it will not be fully effective by 1957, it is assumed that we are progressing in that direction as rapidly as possible.

At the present time there appears to be two ways in which we may be able to decrease the time required for interception and thereby increase the effectiveness of the proposed defense system. One is by the use of the Systems Training Program suggested by RAND, and the second is by relocating fighter squadrons as close, time-wise, to the contiguous radar perimeter as possible in consonance with the desired density at key targets.

Fighter Destruction

Enemy bombers should be kept under maximum attack from the moment of identification until they reach the bomb release line. To achieve maximum kill, fighter squadrons should be located with maximum density close to the defended area; however it may be worth some sacrifice in density to bring enemy bombers under heavier attack as soon as possible.

As a last resort, fighter aircraft must be prepared to ram an enemy bomber if necessary to insure its destruction prior to the bomb release line.

If, however, a fighter fails to destroy a bomber prior to crossing the bomb release line, it should disengage and seek another target rather than pursue a bomber that has triggered its load.

Anti-Aircraft Guns and Missiles

Ground to air weapons, particularly missiles, have a very high destruction capability and maximum use should be made of these weapons. The present programmed development and deployment of these weapons is considered to be sound and promises to afford the maximum point defense possible within current cost and production limitations.

Atomic Weapons

If by 1957 the era of "Atomic Plenty" has arrived, the employment of nuclear weapons in defense of major cities and other critical targets may be a possibility. The ADC program appears to have ignored this possibility.

Electronic Countermeasures

The 1957 Program, while recognizing the vulnerability of many of its components to electronic countermeasures, appears to discount this enemy

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capability in its planning. We believe that enemy countermeasure capabilities present a very serious threat to every phase of the defense system and that active steps to prepare countermeasures should be taken as a matter of urgency. The RAND studies include many suggestions for reducing the vulnerability of the defense system to ECM that could be available by 1957 if undertaken at once.

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CONCLUSIONS

Seminar 12, after carefully considering the factors discussed above, agrees that the Air Defense Program proposed for 1957 is inadequate, in that it cannot provide complete security for the United States. The program nevertheless is soundly conceived and does reflect nearly the maximum security possible with the weapons and equipment available under the limitations of cost and time.

The primary problems of air defense are prompt and positive identification, detection and destruction of low flying aircraft and the susceptibility to mass saturation of sectors of the control and warning system.

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RECOMMENDATIONS

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This Seminar submits the following recommendations which it believes would increase the effectiveness of the system. It is recommended that:

1. The Atlantic over-water extension of the McGill warning line be changed to extend from Newfoundland to the Azores; and that Kodiak be the North Pacific Terminus. (It is understood that this change is currently being made.)

2. Aircraft selected to provide AEW also have the capability of carrying, launching, and recovering all-weather fighter interceptors. (Modified B-36 aircraft as they become surplus to SAC requirements might be available for this task).

a. One or more fighter squadrons must then be redeployed to Newfoundland and to Kodiak for the purpose of operating from AEW aircraft and from ground bases in defense of the early warning line.

b. AEW aircraft be operated with sufficient overlap radar coverage to permit detachment of an individual aircraft to maintain surveillance of hostile planes and to provide fighter intercept control if required.

3. Identification of airborne aircraft be improved by:

a. Giving the highest priority to the development, procurement, and installation in aircraft of a reliable and secure means of electronic identification.

b. Requiring aircraft approaches from seaward only through a limited number of and carefully controlled corridors.

c. Require aircraft that are off course, or whose location is not accounted for, or who have not obtained clearance from the corridor terminal, to land at a point of aerial entry located well out on the defense perimeter and away from any sensitive area.

4. The Systems Training Programs suggested by RAND be utilized to reduce the time required for data handling and transmission and thereby increase the effectiveness of interception.

5. Interior fighter squadrons be relocated to place them as close as possible (time-wise) to the contiguous radar perimeter, in consonance with the desired density for key targets

6. If 1957 will be an era of "Atomic Plenty" and nuclear defense of selected targets proves feasible, funds be allocated to Atomic weapons for air defense deleting weapons of lesser effectiveness.

7. High priority be given to the development of counter electronic countermeasures along the lines suggested by the RAND studies.

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SOLUTIONS SEMINAR NO. 13

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AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
Date Submitted

STUDY NO. 1954-6 SEMINAR NO. 13

(Scheduled dates 4 Jan - 30 Jan 54)

INSTRUCTOR Colonel Shannon Christian STUDENT CHAIRMAN Colonel Getz

SEMINAR MEMBERS:

1. Col Brandon
2. Col Crockett
3. Col Houck
4. Col Kneen
5. Col Kruzel
6. Col Sheridan
7. Col Jeffrey
8. W/CMDR Bloxam

Col Childs

STATEMENT OF THE PROBLEM:

In general terms, analyze the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

SPECIAL PROBLEM OF STUDY TREATED:

Instructor's Signature
SHANNON CHRISTIAN
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Study Director

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SEMINAR SOLUTION

STUDY NO. 6

SEMINAR NO. 13

SEMINAR CHAIRMAN: Col. Gotz

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MAXWELL AIR FORCE BASE, ALABAMA

25 January 1954

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INTRODUCTION CONFIDENTIAL

In accordance with SEMINAR REQUIREMENTS this study analyzes, within budget allocation, the development and deployment of Air Defense forces as programmed for 1957, considering the geographical area of Canada, Alaska, NEAC, and the sea approaches to continental U. S., and utilizing active U. S. forces. No Canadian or augmentation forces were considered. In this study the following assumptions were made:

1. Enemy capability was a surprise attack in any weather, any time, with 800 sub-sonic bombers at altitudes from 50 - 50,000 feet utilizing 320 eighty KT bombs in a simultaneous drop.

2. The cost figures are as given in cost vs kill tabs.

3. Most probable targets will be SAC bases and urban industrial areas as determined by RAND studies.

Basically an Air Defense System is a weapons system, a part of the National weapons system but nevertheless complete in itself. It therefore lends itself to evaluation, and in this study the system presented by Seminar 4 in study Number 4 was used as a guide. The following factors were applied:

1. EFFECTIVENESS

   a. Firepower
   b. Mobility
   c. Deployment
   d. Vulnerability
   e. Deliverability
   f. Reliability
   g. Recuperative ability
   h. Enemy capability
   i. Intelligence

2. FLEXIBILITY

   a. Application (where, when, how much)
   b. Expansibility
   c. Type of threat

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3. SUPPORTABILITY

   a. Will of People
   b. Producibility
   c. Cost
   d. Simplicity

4. COMPATIBILITY (Coordinated Effort)

These factors were applied to the four main elements of the Air Defense system; Detection, Identification, Interception and Kill, as programmed. Appendix I shows in tabular form the application of these factors against the various weapons making up the defense forces. Grading was assigned (from zero to four) in relation to the amount the weapon contributed to the factor concerned. Caution must be exercised in interporting this tabulation as no weighting multipliers were assigned to the factors.

CHAPTER I

DETECTION

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1. In evaluating the detection portion of the Air Defense Weapons System we find that the following classes of intelligence are involved:

a. Intelligence gathered by governmental agencies of possible enemy intentions and capabilities.

b. Ground based radar including the permanent, extension, mobile and automatic low altitude types of stations.

c. The McGill line being established near the 54th parallel in Canada.

d. Over water coverage.

e. The distant early warning line proposed by Lincoln Laboratories.

f. The Ground Observer Corps.

2. INTELLIGENCE:

ADC can and does utilize in its operations intelligence information fed to it from other governmental agencies. The methods utilized were explained to the study body by Brigadier General W. M. Burgess in his presentations. Proper evaluation of this information is of utmost importance in providing long lead time and detection of pending hostile intentions. The only suggestions Seminar 13 has in this respect are listed as follows:

a. Efforts should be continued to provide better intelligence both quantitatively and qualitatively.

b. Continuing efforts should be made to improve the methods of evaluating this intelligence so that danger symptoms can be easily detected.

c. Close cooperation between the central Intelligence agency, State Department and the Defense Forces are mandatory if the greatest possible protection is to be provided the United states. Actions taken by these agencies must compliment each other.

3. GROUND BASED R.D.R:

In discussing this portion of Air Defense, the various programs under this will be taken together, and separate comments will be made on the individual aspects as appropriate.

a. Effectiveness:

(1) Deployment: The original 75 stations with the exception of some individual stations were deployed in a fairly reasonable manner by concentrating on island type defense from primary industrial target areas out ward and in depth. The so called mobile program has been primarily deployed to provide protection for the SAC bases and to fill existing gaps. The radar extension plan in Canada in reality was a cooperative effort between Canada and the U.S. Its use paralleling the U.S., Canadian border materially increases the warning to the north except in the vulnerable area north of Montana and the Dakotas. The line along the North East Coast is of doubtful value as it is too easily by-passed in possible enemy approaches. The automatic low altitude radars will provide the much needed low coverage. The Alaskan system provides a great deal of coverage for the number of stations involved and is located very strategically near a possible enemy striking base. Due to the nature of the terrain in Alaska it is doubtful if much effort should be expended on low altitude coverage. The complex should be considered primarily as Island type protection. The Iceland Complex can provide a

detour in normal routes of approach. CONFIDENTIAL

(2) Vulnerability: It is doubtful if Soviet efforts would be directed against the individual stations other than perhaps the control centers, especially when the inter-communications of the stations are so vulnerable to sabotage. The greatest vulnerability to the entire system is from its almost complete reliance on land wire communications facilities. Concerted effort must be made to correct this deficient. Being the closest to enemy territory, Alaskan sites are the most vulnerable to direct attack.

(3) Reliability: The permanent radar stations in the ZI have been steadily increasing their reliability to a very satisfactory level. Recent ADC figures indicate that unscheduled off air time due to failure is approximately 1.7% of operating time. (Scheduled maintenance periods are 2 hours per day, plus 3 hours weekly.) The greatest contributing factors to outage are insufficient training or experience of personnel and long supply lines in remote locations. The reliability of mobile equipment is less than that of permanent installations due to its design specifications. New equipment introduced into the field usually requires a reasonable debugging period before good reliability can be expected.

(4) Enemy Capabilities: Until the installation of the Lincoln Transition system heavy enemy concentrations may well overload the traffic handling capacity of the system. CHAFF and ECM will decrease the efficiency of the system but not completely destroy its effectiveness. In this connection continued efforts should be pushed to modify existing equipments to meet this threat.

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b. Flexibility

(1) Application: The permanent radar network including Alaska, the mobile stations and parts of the extension, can be used for commercial air traffic applications and can provide greater air safety. Most of the other programs are useful only for their original design use.

(2) Expansibility: The entire system is extremely flexible as far as expansion is concerned.

(3) Type of Threat: The system is designed to meet the threat in being or expected by 1957. It must be modified or improved to meet future threats especially by developments in the following areas:

(a) Higher altitude capabilities,
(b) High speed, high density detection and control techniques,
(c) Detection of super-sonic speed up to Mach 20.

c. Supportability

(1) Will of People: The existence of defensive forces and means of detecting enemy threats can have a two fold psychological effect on the people of this country. In one respect it can, if properly handled, give them a sense of security for their homes and way of life. It can be a constant-in-being reminder of the necessity for an alert attitude and the need for support of the military effort.

(2) Productibility: Many of the complex items of equipment being utilized in detection require extremely complex manufacturing processes and techniques. Delivery schedules are long, however, the requirements are usually moderate and within acceptable limits of industries' capabilities. Close tolerance on component values limits the mass production methods which may be employed.

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(3) Cost of permanent stations represent an initial investment of 2 to 4 million each. Mobile, approximately 1/2 this cost. It should be pointed out, however, that as stations are moved into the northern areas, costs for equivalent facilities multiply rapidly. Installation cost ratios of 4 to 1 are not uncommon with yearly support sometimes going as high as 10 or 20 to 1. The bulk of support costs being consumed by transportation.

(4) Compatibility: All items are complimentary to each other.

4. THE MCGILL LINE:

a. Effectiveness:

The deployment of the McGill line near the 54th parallel will materially increase the warning time received. It is located sufficiently close to interceptor forces to provide effective pressure being brought to bear on enemy attacks. It is sufficiently far from possible enemy bases to prevent ease of spoofing. It will be less reliable than ZI located sets but this may be some what overcome by decreased complexity. The very nature of this type of equipment greatly reduces the possibility of jamming it. Even if it is put out of action the void can be taken as a probable penetration.

b. Flexibility:

Its flexibility is limited, being of very little value for anything but its intended use. It can readily be expanded both in coverage and capabilities to provide additional intelligence, such as asmuth and range. It can handle the type of threat presented and, within the technical state of the art, can be improved to cover future threats.

c. Supportability: CONFIDENTIAL

Difficulty will be experienced in manning the remote type sites and in providing logistic support. The equipment is easy to produce, comparatitively simple and inexpensive. The greatest difficulty appears to be in the reliable establishment of inter-communications tie-ins.

d. Compatibility:

The equipment is compatible with other elements of the system and compliments them.

5. OVER-WATER COVERAGE:

Over-water radar coverage off the east and west coasts of the United States will be provided in 1957 by a system employing both AEW and picket ships. This system envisions the use of AEW to furnish low altitude coverage, with high altitude back-up coverage being furnished by the picket ship. In this program 60 RC 121 C & D AEW aircraft are to cover four stations on each coast. In addition, 25 destroyer escort picket ships will cover six stations on the east coast and four stations on the west coast.

a. Airborne Early Warning

(1) Effectiveness:

(a) Mobility - AEW represents an extremely mobile type of radar coverage. The natural flexibility inherent in the RC 121 C or D provides a means of rapid deployment to any location within effective range of the aircraft. It is capable of operating over land or war, with almost equal effectiveness.

(b) Reliability - The availability of AEW depends upon

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two distinct factors: the in-commission status of the aircraft itself and the proper functioning of the radar equipment located in the aircraft. The reliability is considered to be high, since 1.5 aircraft are programmed for each station.

(c) Vulnerability - AEW aircraft are comparatively invulnerable to enemy attack. However, it's radar is susceptible to normal jamming by enemy ECM.

(d) Enemy capability - Enemy bombers can easily circumnavigate the scanty coverage provided by four AEW stations in either coast. Adequate coverage to prevent penetration by enemy bombers will require a greater number of AEW aircraft than presently programmed.

(2) Flexibility:

(a) The ADC program for 1957 provides only four AEW aircraft for each coast of the U.S. for the purpose of furnishing low altitude coverage. The RC 121 C or D is capable of detecting TU-4 type bombers out to a range of 80 miles at 200 feet. Against B-47 type bombers the low altitude coverage decreases to approximately 70 miles. With only four AEW aircraft the total continuous coverage for either coast is only 300 miles. This coverage can be increased by the addition of a greater number of AEW stations, but the cost involved becomes a prohibitive factor.

(b) AEW is capable of providing low, medium, or high altitude radar coverages. However, due to operational limitations it cannot furnish more than one type of coverage effectively at any one time. It is best suited to furnish low altitude coverage, with high altitude coverage being furnished by picket ship.

(c) AEW coverage is poor against high-speed, small jet bombers. Against missiles it has almost no capability.

(3) Supportability: The cost of AEW is extremely high relative to the results which can be expected. Each RC 121 C & D will cost approximately $4,500,000. The capital investment of the program in 1957 will be $355,443,000. Added to this must be the annual operating costs involved in support of aircraft and maintenance of necessary base installations.

b. Picket Ships

(1) Effectiveness:

(a) Mobility - Although not as mobile as AEW, the picket ship possesses a high degree of mobility, which makes rapid deployment possible.

(b) Vulnerability - Picket ships are vulnerable to enemy action in the form of submarine, surface vessel, and air power. In addition it's search radar is susceptable to normal ECM jamming.

(c) Enemy capability - The enemy can easily by-pass the small number of picket ships provided in the 1957 program, due to the limited coverage provided.

(2) Flexibility:

(a) The 1957 program provides for a total of six stations on the east coast and four on the west. Since 2.5 picket ships are required for each station, a total of 25 ships are programmed. Radar to be used by picket ship will probably be the AN/SPS-6B. This low performance radar gives a maximum coverage of 115 nautical miles at 20,000 feet, and above, against the TU-4. Against the B-47 type bomber the range

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is further decreased.

(b) The picket ship system is easily expansible by the addition of a greater number of ships. However, full coverage would require a large force of picket ships, one which could not be supported economically.

(c) Like the AEW, the picket ship provides poor coverage against high-speed, small jet bombers. Against missiles it has almost no capability.

(3) Supportability: To convert the required number of destroyer escort ships for picket duty will cost $4,500,000 a piece, with a total capital investment in 1957 of $127,600,000. This does not include the initial cost of the destroyer, which if added, would present a more accurate picture of the actual expense involved in this type of coverage. In addition the yearly operating cost for the picket ship system is 197 million.

6. DISTANT EARLY WARNING LINE

a. Effectiveness:

The deployment of the duplicate DEW lines in the opinion of Seminar 13 leaves much to be desired. If such lines were reliable, easy to install and support they would provide additional warning time. As shown in the kill effectiveness study, they would not be backed up to an acceptable degree by identification, interception, or kill capabilities. From cusory investigation it appears doubtful if suitable sites could be established on the west and southeast coasts of Greenland. Intercommunications in the artic have not been as simple or as reliable as glossed over in the "Summer study Group" report. The line or lines would be

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vulnerable to "spoofing" by the Soviet air Force within the range of their present aircraft capabilities. If, however, conclusive evidence of enemy penetration or attack could be established by the line and administrative channels put in motion immediately to initiate this country's retaliation effort, the line would be most worthwhile. As mentioned previously reliability would be a function of remoteness from logistic support agencies.

b. Flexibility:

The DEW lines might be used as weather observation stations or as established bases for equipment developed in the future. Expansibility and capability against targets is the same as that of the McGill line.

c. Supportability:

Supportability will be low and extremely costly. The equipment fundamentally is the same as utilized in the McGill line.

d. Compatibility:

Compatibility is questionable when weighed against other components or the air defense system expected in the time period involved.

7. GROUND OBSERVER CORP

This function is considered essential until such time as adequate low altitude radar coverage is in being. It has the additional advantage of integrating civilian components into an active defensive organization. It is suggested that this corps might be profitably utilized to perform organizational periodic maintenance and attendance at the altitude radar sets employed.

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CHAPTER II

IDENTIFICATION

1. The problem of Identification is inextricably interwoven with the problem of detection. In certain circumstances, the means of detection may also provide the means of identification, either simultaneously or after an interval. Therefore, in evaluating the means of identification programmed for 1957, the border of evaluation in some instances will fall equally on the detection system.

2. It must be noted at the outset of this phase of the evaluation that no clear definition is available of the exact method of identification which will be employed in 1957. However, for the purposes of this study, the following means of identification will be considered:

a. IFF
b. Flight Matching
c. Recognition
d. Forced Landing (Fail Safe)
e. Statistical Plateau.

3. Evaluating the foregoing means of identification, will involve their consideration under four main categories, effectiveness, flexibility, supportability, and compatibility. These categories can be further subdivided into numerous criteria, but not all of these criteria are applicable to the particular phase of identification. Therefore, each element or means of identification will be considered only with respect to those criteria which appear appropriate.

4. <u>IFF</u>:

We have assumed that by 1957 all military aircraft will be equipped with a form of selective identification IFF, either of the Air Force or Navy version.

a. Effectiveness:

(1) Vulnerability: IFF of the type programmed appears to be vulnerable in two respects, jamming and security compromise. Although jamming of IFF frequencies would reduce the effectiveness for identification, it would at the same time appear to negate their original aim of jamming by providing an uniquivocal warning of an impending attack. Vulnerability of selective identification IFF to security compromise is difficult to assess from available source material. However, it appears that this factor of vulnerability can be overcome by technical and procedural means.

(2) Reliability: IFF as programmed should be reliable within acceptable technical limits.

(3) Summation: IFF as programmed appears to be sufficiently invulnerable and reliable, and its automatic features make it a most effective means of identification.

(4) Flexibility: In this category it appears that IFF could be applied to all military and commercial aircraft of the types which could be expected to penetrate the identification perimeter. Therefore, it can be considered to have maximum flexibility.

(5) Supportability: In this category three criteria were applied: productibility, cost and simplicity. From material available, it appears that the IFF equipment is relatively simple and cheap, and could be provided for both military and necessary civil aircraft within the budget limits. In this respect it should be noted that IFF is already stockpiled for these civil reserve aircraft planned for use in support of the emergency war plan. Therefore, IFF is considered to be completely supportable.

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(6) Compatability: In this category it is obvious that use of IFF will require complete coordination among the three services and appropriate civil air agencies. As a first step it will require resolution of the impass between the Air Force and the Navy on the type of selective identification to be adopted. The overall coordination required can be effected without extreme difficulty. Sufficient priority must be given production of IFF to provide it in sufficient quantatitive by 1957. This does not appear to be a limiting factor. IFF appears to be a compatible means of identification.

5. FLIGHT MATCHING:

This form of identification involves the matching of observed aircraft with known flight plans.

a. Effectiveness:

(1) Vulnerability: Flight matching is vulnerable to spoofing and to deception by means of false flight plans, and snock attack by planning individual flights to coincide with real flight plans. All these methods of confusing the flight matching system could only be effective with small numbers of enemy aircraft.

(2) Reliability: This syten of identification is negative only, that is, it identifies only friendly aircraft. It is subject to considerable unreliability due to human error on the part of pilot and operating personnel. Weather can alter flight plans considerably. Errors can result from cross-coorelation and a high traffic level. Actually the flight matching system currently in use appears to be more than saturated. This problem could be alleviated by the use of the composite technique - including multiple corridors and expanded IFF.

(3) Flexibility:

(a) This system requires fixed check points, and good reliable communications. Flexibility is reduced accordingly.

(b) Although the flight watch system as a whole can be expanded fairly readily by the addition of new routes and corridors, expansion of radio facilities and the provision of necessary bases along new routes may be difficult and expensive. Expanding traffic rates along existing routes does not appear feasible in light of the fact that the system is only moderately reliable even at low traffic levels.

(4) Supportability: Production is no problem, and the cost of establishing and operating this system is negligible. However, it is a relatively complex method of identification which is substantially why it breaks down under a heavy traffic load.

(5) Compatibility: This type of identification system is completely dependent on cooperation among all services and agencies which use the airways. It can therefore be considered to be compatible, at least within the armed services.

4. RECOGNITION:

a. Effectiveness:

(1) For want of a better word recognition may be used to denote a method of identification. By recognition is meant the positive act of identification by (a) actual visual observation from the ground, (b) visual observation by the pilot of an interceptor, (c) identification by recognizing the "character signature" in the acoustic spectrum of radar.

(2) The reliability of the visual ground or air observer is low. Weather and darkness render this method almost worthless. The

reliability of the recognition by character signature depends upon the radar system and the skill of the electronic operator.

(3) The possession of proper and adequate intelligence regarding the enemies equipment, motives, and possible actions are most important to even the meager success this system offers.

b. Flexibility:

(1) This system does not have the flexibility to cover all types of threats. For example, a high flying bomber can escape a visual ground observer entirely. The pilot observer is also limited by his ability to always intercept a particular unknown aircraft. The flexibilight of the radar character signature method appears to be good.

c. Supportability:

(1) The ground observer system depends to a large measure on the will of the people. The willingness first of all to train and then to perform the often time thankless and lonely job of observing and reporting.

(2) The cost of these methods of recognition are not excessive except for the use of the interceptors for this task. The dissipation of our fighter power for recognition work is another cost which must be considered.

(3) These systems of recognition will require an elaborate coordination between all agencies - civilian as well as military.

5. FAIL SAFE SYSTEM:

Another method of identification is the "Forced Landing" or the "Fail Safe" system. This may be defined as a composite system requiring perimeter identification lines, air corridors and landing fields removed from critical areas. This method places the responsibility of identification on the individual aircraft commander, not on the defense forces. Any aircraft must properly identify itself prior to crossing the perimeter line. If the aircraft does not or cannot identify itself, it is required to land at a "safe" airfield - or it is shot down.

a. Effectiveness:

This system, though cumbersome, is quite effective. It is as reliable as the strength of enforcement.

b. Flexibility:

It is a flexible method. It may be used any where and it is easily expanded to cover the entire country if desired. This method covers any type threat because it treats all unknown aircraft as enemy until proved friendly.

c. Supportability:

The cost of the system is beyond the preview of this paper but it is obviously not prohibitive. The will of the congress, however, to support such stringent civil air traffic regulations short of an emergency is another matter. To be a success any regulations envoked by the United States would have to be accepted by the governments of foreign air carriers flying through identification lines.

6. STATISTICAL SYSTEM:

Another method of identification is called the "Statistical System". This is a negative type method wholly ineffective for single aircraft identification. This system merely calls attention to something unusual when the number of "unknowns" exceed the established norm. It is

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vulnerable to spoofing as well as the filtering in of small numbers of aircraft. It is also subject to faluse alerts, as for example, an unpredicted weather change may cause a large number of "unknowns".

The system is flexible, it is easily expanded and it is easily supported.

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CHAPTER III

INTERCEPT PROBLEM

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1. An analysis of the intercept problem is made on the basis of the following assumptions.

a. Enemy aircraft have been detected and identified.

b. The target system in the United States is SAC bases and selected urban-industrial areas.

c. Russian threat is:

(1) 800 sub-sonic aircraft of the following types and with performance characteristics as indicated.

TU-4 type	300 mph
TU-28 Type	500 mph
Type 31	400 mph
4 Jet type	500 mph

(2) Attack capability from 50 to 50,000 feet.

d. That fighter radius of action and radar cover cannot be improved beyond that of projected types.

2. Interception of the enemy for the purpose of this problem has been broken down into two major categories which are as follows:

a. Fighter Intercept.

b. Ground to Air Missile Intercept.

The various components of these categories are discussed below.

3. FIGHTER INTERCEPT:

The objective is to intercept the enemy at the greatest possible distance from the target. In achieving this object three major factors must be analyzed - these factors are:

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a. Identification to Scramble Line.

b. Control and Guidance.

c. Fighter Capabilities.

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7. IDENTIFICATION TO SCRAMBLE LINE

a. Effectiveness:

(1) Vulnerability: The possibility of sabotage of the vital land lines of communication is to a great extent off set by the provision of alternative radio links. Sabotage against communications within the airfield and against aircraft and supporting equipment can and must be dealt with by normal internal security action. It is also vulnerable through its over land low altitude effectiveness.

(2) Reliability: The reliability of the lines of communication and airfield facilities is related to the capability of maintenance personnel. There can be no reduction in the quality of such personnel.

b. Flexibility:

(1) Application (where, when, and how much): as has already been stated the time factor is of paramount importance. The alert state of the fighter squadrons must be carefully assessed at all times and a compromise effected between standby air crews comfort and time to get aircraft into the air. This time should not be extended beyond five minutes.

c. Supportability:

(1) Simplicity: On one hand, the lines of communication remains simple whereas the aircraft and ground to air weapons become more and more complicated. Base facilities therefore must match the request

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for maintaining maximum serviceability. Refueling and rearming must remain as simple as possible and top level inter-service decisions must be made for direct support to be provided, if necessary, from other bases.

(2) Cost: The cost of providing and maintaining its facilities under discussion does not reflect their direct importance to the Air Defense System and consequently a big return is achieved for a comparatively small outlay.

5. GROUND CONTROL INTERCEPTION:

a. Effectiveness:

(1) Vulnerability: Enemy ECM has the capability of jamming not only the peaking radar but also the radio link between control station and aircraft. The provision of 20 Channel VHF and VHF radio links will safeguard the latter while selectivity of current radar will permit sufficient use of the former.

(2) Deliverability: The designed equipment represents the best that can be scientifically achieved and produced by 1957. It is considered essential that all items of hardware planned are in fact available to the users by that date.

(3) Reliability: There are sufficient alternative means planned for the system so as to answer maximum reliability.

b. Flexibility:

(1) Application: (where, when, how much) The ground controlled fighter interception is, when financial considerations are taken into account, the most efficient and flexible way of intercepting widely separated targets. For maximum effect the radius of action of the fighter should match the range of the radar cover. The proposed deploy-

ment does in fact support this, with the exception that, since it is assumed that enemy aircraft will not approach from the south, fighter squadrons at present deployed in the South, should be redeployed to the north and east and west.

(2) Expansibility: This is dependent on the number of fighters that can be controlled by one ground control station at any one time. The Lincoln Transition data handling equipment will, when available, be capable of increasing the capacity of the system planned.

(3) Type of threat: The Russians are most likely to attack by night or in bad weather. Ground Control Intercept coupled with air intercept capabilities are an essential team in successful mission accomplishment. Therefore, the system is limited to daylight clear weather.

c. Supportability:

(1) Producibility: The availability of items planned is not limited, number wise by difficulties of production but by budgetary limitations.

(2) Cost: The basic contiguous radar net is used to control this type of interception. The aircraft does not require complex airbase radar nor additional crew members.

6. AIR TO AIR INTERCEPTION:

a. Effectiveness:

(1) Mobility: Within limitations it can be operated outside ground radar coverage. Fighter aircraft possesses day/night all weather capability.

(2) Vulnerability: Is vulnerable to enemy electronic countermeasure.

(3) Reliability: The effectiveness of the all weather fighter is dependent on the serviceability of its AI radar.

(4) Enemy capability: The enemy is able to choose the time and weather to attack, therefore, all weather capability is essential.

b. Flexibility:

(1) Application: Remarks as in previous paragraph apply.

c. Supportability:

(1) Cost - The cost of the AI fighter is high, however, it does provide the greatest flexibility in effectiveness.

(2) Simplicity: Radar gear in aircraft is complex and difficult to maintain. Additional weight is added to the fighter.

7. FIGHTER CAPABILITIES:

The Air Defense interceptor force programmed for 1957 totals 61 squadrons. These squadrons are equipped with all weather fighters of the following types with performance characteristics as indicated.

TYPE	RADIUS	SPEED
F-86D	332 mi.	485K
F-89D	396 mi.	425K
F-102	485 mi.	518K

No attempt is made to evaluate the fighters, one against the other, since they all have the same objective, and the performance figures above partly will reflect their relative value. The fighter will be analysed, for the purpose of determining its value as a defense weapon.

a. Effectiveness:

(1) Mobility: The all weather interceptor is a weapon of great mobility. Its speed, range, and altitude provide the capacity to operate under many and varied conditions. Its course to intercept --

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altitude of interception may be changed while in flight. It is not tied to any one location and will operate as effectively from one place as another. It has the capacity to attack successive targets and does not expend itself after attack. It can be brought quickly into battle from remote locations.

(2) Vulnerability: The fighter in its intercept capacity is not a very vulnerable weapon. It is most vulnerable however while on the ground and in large concentrations. This undesirable condition has been taken care of in the proposed program through dispersion. The prepared force is scheduled to be located at 52 separate stations and in no case will there be more than two squadrons on any one base. Another factor influencing the low vulnerability is the short time required for fighter aircraft to evacuate in case attack seems eminent.

(3) Reliability, Recuperation Ability and Enemy Capability

The interception is a reliable weapon. In event of damage it can be repaired. The major enemy threat is contained in his ability to sabotage the force, or parts thereof, while on the ground.

(4) Deployment: Interceptor force deployment should be such that the enemy can be intercepted as soon as possible length of time with the largest force consistent with the size of the area to be defended and fighters available for defense purposes. The ADC deployment of fighter seems to fulfill the above requirements. Fighter stations are so located that there would be a minimum lapsed time between detection and intercept. The defenses are staggered in depth to a greater extent than is considered wise. The overall available fighters to bomber ratios based upon an 800 bomber raid is calculated to be about 1.2 to 1.

It would appear that fighters located far to the south might not be available for combat. This fact could appreciably alter the fighter bombers ratio.

b. Supportability:

It is well within the industrial capability to produce the all weather interceptor. The cost of the weapon seems high but viewed in light of its versatility, life expectancy and the fact that it is the only thing available to provide even some defenses to the country, it is not excessive. The interceptor has been made as automatic as possible to ease the work of the pilot and to eliminate human error. This of necessity has produced a more complex device than would be necessary if such great precision were not required.

8. GROUND TO AIR MISSILE INTERCEPT:

The ground to air missiles programmed for the Air Defense Force in 1957 consists of:

	Missile	Range	Ceiling
a.	Bomark	250 miles	60,000 ft.
b.	Talos	50 miles	60,000 ft.
c.	Nike	25 miles	60,000 ft.

The planned program is broken down to three sites of 30 Bomarcs each, and unspecified number of Talos units, 60 battallions of 120 Nike missiles each, and 6 battallions of Skysweeper units.

a. Effectiveness:

(1) Mobility: In comparison with fighter aircraft ground to air missiles are comparatively immobile. Of the three types NIKE, because of its associated ground radar tracking and control units, is the least mobile.

(2) Deployment: It is considered that the deployment as planned, makes the greatest use of the limited number of missiles available.

(3) Vulnerability: All missiles are susceptable to enemy ECM.

(4) Reliability: As these weapons are now coming into service it can be assured that, by 1957, they will be technically reliable.

(5) Enemy Capability: It is considered that Russia will have the capability of using ECM against these missiles.

b. Flexibility:

All the missiles are limited in their capability to intercept from medium to high altitude only. Their speed ranges are matched with the forecast enemy capability; however, with the exception of Bomarc, their range is extremely limited.

b. Supportability:

The missiles proposed in the 1957 program can be considered within the capability of the country to support. It must be remembered that missiles are required in large quantities to be effective due to their lack of mobility, their expendability and extremely limited range.

CHAPTER IV

KILL

1. Having considered the problems of detection, identification, and interception, we turn to a consideration of the final step in the four-part problem of air defense. This step is to assure a kill once accurate interception has been made.

2. Because of the lead time necessary for design, development, and production of new weapons, it has been assumed that any significant alterations in the 1957 air defense program must, in general, be limited to changes in emphasis between the various kill weapons already programmed.

3. EFFECTIVENESS:

a. In considering a change in emphasis between kill weapons programmed for air defense in the 1957 period, certain factors relating to weapon evaluation appear particularly applicable. Since all of the weapons which have been programmed can be produced, have acceptable reliability and can be employed by trained personnel, such factors as producibility, reliability, and simplicity are not of primary concern to this study. Those weapon characteristics which appear particularly applicable to the problem of increasing kill effectiveness within present budget limitations are:

(1) Firepower
(2) Mobility
(3) Cost
(4) Deliverability
(5) Vulnerability

b. An analysis of the interceptors, ground to air missiles, and anti-aircraft artillery programmed for the 1957 period indicates

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certain limitations or potential weaknesses. Conventional warheads for the rockets and missiles available are effective in the instance of hits or near misses but are vulnerable to certain countermeasures, such as towed reflectors to detonate warheads at safe distances from the bomber, evasive action, and massing to saturate the defense in time and space. Ground to air missiles appear particularly ineffective against low altitude targets, and skysweeper bns, having an effective altitude limitation of approximately 15,000 feet, are ineffective against high altitude attack. These weapons (guided missiles and skysweeper bns) are not scheduled for such deployment as would allow complementary coverage of high and low altitude for any defended point.

c. Firepower:

The employment of A-explosives will largely overcome the limitations inherent in HE warhead weapons. The requirement for a high degree of accuracy to insure kill by HE weapons is overcome. Use of A-explosives will insure several kills against an enemy formation or area of closely spaced bombers. At worst, A-explosives will deny this tactic to the enemy. From the standpoint of firepower, then, the weapons programmed for 1957 are considered adequate.

d. Mobility:

From the standpoint of mobility, fighter interceptors have a large advantage over the ground to air missiles and anti-aircraft artillery. They can be massed at any point within a range of approximately 500 miles of their bases, and at greater distances under conditions of very early warning or use of refueling bases near the attack area. Fighters also have the advantage of offering a greater area coverage capability than other weapons available.

e. Cost:

A consideration of costs factors immediately indicates a wide variation between the weapons. It is obvious from cost figures contained in the Cost vs Kill study used as a guide in this problem, that a NIKE is cheaper to produce than an all-weather fighter by a factor of 25 to 1, with smaller, but substantial differences between the NIKE, BOMARC, TALOS, and anti-aircraft artillery.

f. Deliverability:

When the characteristics of deliverability is considered, it becomes apparent that the range of the fighter is such that it is vital to coverage of the majority of the area to be protected. Also to be considered is the fact that, with their ability to mass at many points, fighters offer protection to a great number of targets for which the cost of adequate point coverage with missiles and anti-aircraft artillery would be prohibitive. Reliance on a greater degree of point coverage at the expense of fighters would also allow the enemy to evade a substantial portion of the defense.

g. Vulnerability:

Applying the factor of vulnerability to the defense weapons under consideration, it is apparent that all are vulnerable to enemy countermeasures. The elimination or substantial reduction of some of the weapons because of such factors as cost, mobility, or deliverability would render the enemy countermeasure capability more effective, since he could then concentrate on those measures most effective against the fewer types of defense weapons opposed to him.

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A large deficiency in our kill capability appears to exist at low altitudes. This area naturally warrants exhaustive study. The seminar was not able, however, to suggest constructive methods of improvements in this area within the budget and weapons programmed for 1957.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

1. DETECTION

a. Ground based permanent and mobile radar are in general properly deployed and utilized to the maximum possible advantage. The development has followed a logical pattern of coverage from primary target areas outward and in depth.

b. The low altitude coverage program is essential to cover an extremely vulnerable feature of the network.

c. The extension plan violates the principle of expansion in depth to a noticeable degree in that it provides peninsular coverage which can be by-passed.

d. The DEW lines proposed are not considered completely conpatable to the detection system unless backed up with suitable identification, interception, and kill capabilities. (If, however, programs after 1957 visualize the introgration of this capability our objections are withdrawn.)

e. The inter-communications network within the detection complex based almost entirely on land lines is extremely vulnerable and should be supplimented by other means.

f. Data handling methods must be improved. The Lincoln Transition system should do much in this direction and should be expedited.

g. The limited capability of AEW as programmed does not permit a high degree of contingious radar coverage of either coastline of the U. S. In view of the huge expense involved in this type of coverage it does not appear to be economically feasible to plan for any appreciable increase in the AEW force. Optimum coverage would require 28 AEW stations on the East coast and 36 AEW stations on the West coast, with a total requirement for 275 C-121 aircraft. Obviously, this amount cannot be supported. The limited coverage presently available is spoty at best. Considering the limited effort and capability available, it appears that ADC is making satisfactory use of its AEW.

h. The limited coverage given by each picket ship using the AN/SPS-6B radar provides inadequate coverage in view of the total force allocated under the 1957 program. In view of the staggering cost involved, it is difficulty to envisions an additional number of picket ships being provided with a resulting high increase in the budget. The use of destroyers instead of liberty type ships which require a greater complement of personnel is difficult to understand. It is equally difficult to determine the need for 2.5 picket ships for each station. This ratio is exorbitant, andmore effective utilization of available resources would dictate that a twenty station complex be provided for picket ships coverages, with five ships for spare back-up. This syton would double the coverage now planned.

2. IDENTIFICATION:

a. IFF appears to be a highly desirable means of identifying friendly aircraft when evaluated in the four general categories listed. The more aircraft equipped with IFF, the simpler the other problems of identification become. This is particularly true with regard to the flight matching, recognition, and statistical methods.

b. The flight matching system of identification reveals that it is relatively vulnerable to enemy efforts to confuse, it is not very flexible or reliable, and it is extremely complex. On balance it is cheap and supportable. The net outcome points to a conclusion that flight matching should only be a part of a composite identification which would permit the matching to be conducted only in areas of low traffic levels.

c. An evaluation of the identification problem shows that all the systems in use or contemplated have good and bad features. The simplest, least expensive may not be effective or the effective system may be impalatable to the general public. Certain conclusions can be made however, within the boundries of feasibility and acceptability.

(1) Trite as it may be, it must first be stated that identification follows detection.

(2) A composite system using several methods of identification is indicated.

(3) IFF for all military and commercial planes operating outside the ZI must be part of the composite system now in use.

(4) Formation of plans and forces must be completed to make possible the immediate implementation of the "forced landing" technique.

3. <u>INTERCEPTION</u>:

a. The identification to scramble link appears to be adequate with the possible exception of its vulnerability to sabotage. This particular link is considered to be a highly critical component of the entire air defense problem.

b. Within the state of the art the fighters appear to be the best available for the time under consideration.

c. The Air Defense Command's scheme of fighter deployment seems questionable in that approximately 20 squadrons are located far to the south of the actual location where they can be most effective in event of attack. This comment is based upon the premise that no attack will be forthcoming from the South.

d. The missile defense programmed for the period is undoubtedly the best that can be expected within the state of the art. It is not considered that the programmed ground to air missile on the AA Defenses will be as effective as the numbers of all weather fighters that could be provided at the same cost. This observation is made on the basis of defense against sub-sonic aircraft.

4. <u>KILL</u>:

a. The kill weapons programmed for U.S. defense in 1957 are basically proper in types, relative numbers, and in deployment. The defenses could be improved somewhat by deletion of the 8 Skysweeper Bns, replacing them with NIKE. The NIKE's thus withdrawn from critical point targets would be replaced with Bomarc missiles, if the Bomarc program could be accellerated with the savings from the elimination of the Skysweeper Bns. While a substantial number of Bomarc missiles could not be produced from the savings resulting from elimination of 8 Skysweeper Bns, a slight improvement in the defense appears possible from such a change.

b. A strong case for the use of stockpile weapons in air defense (i.e., in Talos, Nike, Bomarc as well as in manned interceptor aircraft.) is recognized, particularly as to their use against enemy formations of two or more aircraft. Their use should also be considered against single enemy aircraft even though methods are currently under development which might improve the effectiveness of the missile within

HE head to a degree equal to that of one equipped with an atomic warhead and at considerably less cost within the 1957 time period.

c. If the atomic stockpile is such that our requirements for strategic warfare is fully met to the extent that they will be made available to the Army, Navy and Air Force for tactical warfare, then they should be used in the air defense weapon systems.

5. GENERAL:

a. Except as noted in the above stated recommendations, Seminar 13 agree with the development and deployment of the air defense forces.

b. Although technically outside the primeters established for this seminar study requirement, Seminar 13 feels compelled to point out a few actions it feels must be accomplished if an effective defensive weapon system is to be realized.

(1) Complete defense requires intregration of all components utilized. Responsibility must be assigned in a manner which will assure this integration. The answer then appears to be a single command agency which is constantly aware of the job to be accomplished, the resources available to do the job and has the absolute authority to control those resources.

(2) Weapons developments must be intregrated to preform a definite function in the defensive system with a minimum of duplication and a maximum of technical advancement.

(3) The military services must, by proper control, eliminate the problem created by failure to file and maintain proper flight plans. Such irresponsibility must be eliminated if our detection and identification system is to function properly.

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(4) The submarine threat within the defensive areas must be given greater emphasis and solved.

(5) Research should be encouraged and fostered which will solve the ballistic missile threat of the future. Research defensive technology must look to the future instead concentrating in the present.

(6) Greater emphasis should be placed on all aspects of electronics activities.

(7) Team work between the elements of defense is essential and must operate in careful coordination. They must not be used independently or without ready accessability to each other.

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APPENDIX I

<u>RATING SYSTEM</u>

4 - Item fully meets this factor

3 - Item effectively meets this factor

2 - Item is satisfactory on this factor

1 - Item is questionable on this factor

0 - Item is unacceptable on this factor

\- - Factor does not apply to this item

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APPENDIX I

RATING SYSTEM

4 - Item fully meets this factor

3 - Item effectively meets this factor

2 - Item is satisfactory on this factor

1 - Item is questionable on this factor

0 - Item is unacceptable on this factor

\- - Factor does not apply to this item

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FACTOR	EFFECTIVENESS: Firepower	Mobility	Deployment	Vulnerability	Deliverability	Reliability	Recuperative Ability	Enemies Capability	FLEXI-BILITY: Application	Expansibility	Type of Targets	SUPPORT-ABILITY: Will of People	Producibility	Cost	Simplicity	Logistic Support	COMPATA-BILITY: Coordinated Effort	
DETECTION																		
Intelligence																		
Perm Radar	-	1	4	3	3	3	-	2	3	3	3	3	3	3	2	4	4	2.93
Extension	-	1	3	3	2	2	-	2	2	3	3	2	3	2	2	3	3	2.04
Mobile	-	2	4	3	3	2	-	2	2	3	3	3	3	3	2	4	4	2.87
Low Alt	-	3	4	3	3	3	-	3	2	3	3	3	4	4	3	4	4	3.27
McGill	-	0	3	3	2	2	-	3	-	3	3	3	3	3	3	3	4	2.53
Picket Ships	-	3	3	1	3	3	-	2	1	3	2	2	3	1	2	3	3	2.33
AEW	-	4	3	4	2	2	-	2	0	3	2	2	2	2	2	3	3	2.40
DEW	-	0	1	0	1	2	-	1	0	3	2	1	2	1	2	2	2	1.33
GOC	-	3	3	3	3	3	3	3	2	3	3	3	4	3	4	4	4	3.18
																	Total	2.54
IDENTIFICATION																		
IFF	-	3	3	3	2	3	-	2	2	3	-	-	3	3	2	3	4	2.76
Flt. Match	-	-	2	1	-	2	-	1	2	2	2	2	2	3	2	3	2	2.00
Recognition	-	-	2	3	4	1	-	3	2	3	3	2	2	3	1	2	2	2.36
Forced Landing	-	-	1	4	4	4	-	-	2	2	-	2	-	3	3	-	2	2.70
Stastical	-	-	2	3	2	2	-	3	2	3	-	-	3	3	3	-	-	2.60
																	Total	2.48
INTERCEPTION																		
Data Handling	-	-	3	3	-	2	-	2	3	4	3	-	3	3	2	2	3	2.75
Fighters	-	4	3	3	3	3	3	2	3	4	3	4	3	3	2	2	3	3.00
Bomarc	-	2	3	2	3	2	0	2	2	4	2	-	2	3	1	1	1	2.00
Nike	-	0	3	1	3	1	0	1	1	4	1	-	2	3	1	2	1	1.60
Skysweeper	-	1	3	2	1	3	1	0	2	4	1	-	3	3	2	3	2	2.67
																	Total	2.40
KILL																		
AA	1	1		2		1		1	1	1	2		4	4	3	4		2.08
NIKE I (HE)	2	2		2		2		2	1.5	2	2.5		3	3	2	3		2.25
NIKE B (Atomic)	4	2.5		2		3		3	2	3	2.5		3	3	2	3		2.75
TALOS (HE)	3	2.5		2		2		2	2	3	2.5		3	3	2	3		2.50
TALOS-A (Atom)	4	2.5		2		3		3	2	3	2.5		3	3	2	3		2.75
BOMARC (HE)	3	3		3		2		3	2.5	3	3		2	2.5	2	3		2.66
BOMARC (ATOM)	4	3		3		3		4	2.5	3	3		2	2.5	2	3		2.91
FTR (ROCKETS)	2	4		3		2		1.5	3	3	3		2.5	2	2.5	2.5		2.58
" (MISSILE)	3	4		4		2.5		2	3	3	3		2.5	2	2.5	2.5		2.83
" (A-Bomb)	4	4		4		3		3.5	3	3	4		2.5	2	2.5	2.5		3.16
Jet Bomb (A-bomb)	4	4		4		2.5		2.5	3	3	2		1	1	1	2		2.50
																	Total	2.63

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SOLUTIONS SEMINAR NO. 14

N

THE AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
DATE SUBMITTED

STUDY NO. 1954-6 SEMINAR NO. 14

(Scheduled dates 4 Jan - 30 Jan 54)

INSTRUCTOR Col Shannon Christian STUDENT CHAIRMAN Col Gillem

SEMINAR MEMBERS:

1. Col Branneck
2. Col Crow
3. Col Howard
4. Col Crimmins
5. Col Perego
6. Col Simons
7. Col E C Orth
8. W/CMDR May
Col Loomis

STATEMENT OF THE PROBLEM:

In general terms, analyse the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

PHASE OF STUDY TREATED:

INSTRUCTOR'S SIGNATURE
SHANNON CHRISTIAN
Colonel, USAF
Study Director

(Use reverse side for remarks)

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SEMINAR SOLUTION

STUDY NO. 6

SEMINAR NO. 14

SEMINAR CHAIRMAN: Col. Gillem

SEMINAR RECORDER: Col. Loomis

SEMINAR MEMBERS: Col. Brannock
Col. Crow
Col. Howard
Col. Crimmins
Col. Perego
Col. Simons
Col. Orth, U. C.
W/Cmdr. May

MAXWELL AIR FORCE BASE, ALABAMA

26 January 1954

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PROBLEM

To analyze, in general terms and within certain specified limitations, the development and deployment of the Air Defense Command as programmed for 1957. [The specified limitations are -

a. The geographical area of consideration is Canada, Alaska, NEAC, and the sea approaches to the continental United States.

b. The budget allocation for the programmed air defense forces will not be exceeded.

c. Forces considered include active U.S. forces only. No consideration will be given to Canadian forces or augmentation forces.]

ASSUMPTIONS

1. Between now and 1957 there will be no change in the international situation which would simplify the air defense problem by permitting the U.S. to strike first should war appear imminent.

3. By 1957, the USSR will have at least the capability for aerial assault on the U.S, which the ADC estimates indicate it will have. (We say "at least" because we feel that by 1957 Soviet missile capabilities may prove more potent than presently forecast)

4. Priority target complexes for Soviet attack will be (a) large cities combining industry and population, (b) SAC bases.

DISCUSSION

1. Introduction

Prior to getting into more detailed discussion of the various aspects of the ADC program, it is appropriate to set forth Seminar 14's

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approach to the problem. Briefly, we regard ADC as a weapons system - a weapons system designed to carry out the four primary functions of air defense, namely, detection, identification, interception, and destruction. These functions, as provided for in 1957, we have analyzed in the light of certain key factors, such as capability, feasibility, and vulnerability.

These analyses, coupled with impressions and/or convictions derived from guest speakers, research, and personal experience, form the basis of our conclusions and recommendations.

2. Detection

a. Mission

The mission for the function of detection is to perform early warning and surveillance. In order to properly exploit the capabilities of the air defense system the earliest possible detection of a hostile threat to the United States is necessary. The minimum time required is based upon the time required to identify the threat, intercept it, and destroy it before it reaches its bomb release line. Consideration of the ADC detection system first necessitates examination of what is to be detected and what is to be defended.

b. Soviet Threat

Best available information indicates that the Soviets will have both the weapons and the capacity to deliver them by 1957. A-weapons available are estimated at 500. Attacking aircraft, consisting of TU-4's, Type 31's and B-47 types, will number about 800 according to ADC estimates. Rand estimates vary only slightly as far as the aforementioned types are concerned; however Rand foresees the added possibility of some 200-400 wing - coupled IL-28's and 25-50 submarine launched missiles, either V-1's or V-2's.

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The Soviets must be given the capability of in-flight refueling and it must also be accepted that one-way missions are "on". These possibilities afford a variety of routes to U.S. targets and the threat may emanate from the sea approaches to the U.S. rather than - or as well as from over Canada.

c. Target Systems

The probable target systems are examined in the A.D.C. study and in Rand Report No. 1076.

The Rand Report came up with these probable target systems:

(a) Population centers and urban-industrial concentrations

(b) Selected war and war-connected industries

(c) Military forces in being.

This examination concluded that primary emphasis should be placed on air defense of selected military targets and major concentrations of industry and population. It listed some 30 SAC bases and 53 metropolitan areas. Regionally, 40 of the 53 metropolitan areas lie in the northeastern, north central region running from Chicago to Boston and New York, extending roughly as far south as the Ohio River. This region accounts for nearly 85% of the war industry in all the 53 areas. Another 6% is in the Pacific states of California, Oregon and Washington and a further 7% in Illinois, Iowa, Missouri, Wisconsin and Minnesota.

The ADC study estimates that due to advance early warning the SAC bases lose their importance and concludes that the principal targets will be the population of the large U.S. cities.

Seminar 14 considers that the priorities will be (a) large cities combining industry and population, (b) SAC bases.

d. Detection Systems (McGill and Lincoln Line)

Cornerstone of the detection program is the so-called McGill Line. The line, with its programmed extensions, will extend from Hawaii to Scotland via Canada, Greenland, and Iceland. The overwater links will be covered by AEW&C aircraft and picket ships. Across Canada - where the line follows the 54th parallel - there will be some 208 automatic radars.

Under most conditions this line will provide 2-4 hours warning, sufficient time to alert ADC and enable appropriate active and passive defense measures to be initiated, including the evacuation of SAC bases and other potential target areas. It will also provide time to bring in sufficient augmentation fighter forces to raise the probable day kill 14% and the night kill 6%.

A particularly attractive feature of the McGill Line is its low altitude capability which, if it performs as it's supposed to, may permit dispensing with the Ground Observer Corps, at least in some areas.

In addition to the McGill Line, there is presently under consideration a Far Distant Early Warning Line, otherwise known as the Lincoln Line. The Far Distant Early Warning Line (Lincoln Line) would extend from Hawaii to Alaska utilizing the same AEW&C aircraft squadrons as the McGill Line, then from Alaska along the Canadian archipelago to the northern tip of Greenland and down the west coast of Greenland to a point joining the McGill Line. From South Greenland to Iceland and Scotland it would utilize the same equipment as the McGill Line (15 FPS-8 type radar sites and 6 picket ship stations). It would have a back up line running from Amundsen Gulf in northern Canada to the northern tip of Labrador composed of 26 lightly manned radar sites. It is estimated to cost 775 million dollars including 1 year's operation and would provide about 4 hours more warning time.

As a result of the Lincoln Line only a few (135) additional day fighters from augmentation forces could be brought to bear against high altitude day attacks. A rough estimate of the additional day kill is 2%. There would be no increase for night low altitude attacks because all available night interceptors can be utilized on warning provided by the McGill Line. While having only small utility for the active air defense, consideration must be given to its value for passive air defense. The additional four hours more warning time would certainly be useful to SAC, TAC, Navy and Civil defense. Off setting this is the enemy's "spoofing" capability against this line. And the vulnerability of related stations to destruction by sneak attack.

e. Summary

In summation, the detection function as programmed for 1957 by ADC appears fairly well in hand. The system - thinking primarily of the McGill Line - is feasible. It is - or will be - capable of furnishing true low altitude coverage. It will be capable of furnishing what would appear to be sufficient warning to prevent disaster. It is vulnerable to spoofing but this vulnerability should be confined to the extensions. It may prove vulnerable to very high flying aircraft, i.e., in excess of 50,000 feet provided the Soviets have such aircraft by then. Also, the system - again thinking of the McGill Line - might be circumvented but this doesn't appear likely in the next 3 or 4 years. The most serious deficiency in the overall system is the seeming lack of adequate measures for countering submarine-launched missiles, which may well be a threat by 1957.

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As for the Lincoln Line, it is apparently capable of furnishing a few hours more warning. It is also extremely vulnerable and incapable of surveillance. We do not regard it as feasible.

Both lines, are "dated" now. Their life expectancy is dependent upon the advent of the long-range ballistic missile and/or the very high flying supersonic aircraft.

3. Identification

a. Mission

The mission of the function of identification is to determine whether an aircraft is hostile or friendly so a decision can be made to: apply combat forces, control traffic, instigate deceptive and preventative measures, or just to furnish information to air raid warning facilities.

b. Means Available or Programmed

At present we have no fool-proof means of positive and immediate identification. We do have aids to identification such as corridors, flight plan correlations, visual checks, etc. Under wartime conditions the effectiveness of these aids is increased by the implementation of CONELRAD and SCAT.

What we need is a reliable and uncompromised IFF installed in each and every friendly aircraft. Until we obtain this "little black box" (and General Bennett held out some hope that we might have it by 1957) identification represents the weakest link in our air defense system. Further, until we get it we will be plagued with the necessity of using our interceptors as identifiers, an extremely unsatisfactory practice.

c. Summary

We have nothing at present capable of providing immediate and

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positive identification. The deficiency is the subject of the highest priority attention and should be remedied by 1957. Certainly, it appears technically feasible, not only to build such a "gadget" but to install and operate it in civil as well as military "friendless."

In the absence of a reliable IFF, we are completely vulnerable in the identification field.

4. Interception

a. Mission

The mission of the function of interception is to so coordinate the disposition and operation of the components of the Air Defense Weapons System that fire power may be brought to bear on a hostile weapon prior to BRL.

b. Discussion

In order to review the ADC program as it pertains to this function of interception in the 1957 posture the following assumptions must arbitrarily be made.

1. Technical aspects of GCI are sufficiently developed to insure a high rate of interception within the areas covered by GCI radar.

2. The programmed fighter interceptors, GCI equipment, EW radar, and data processing equipment are the best that technology will be able to produce by 1957.

3. Training programs in ADC are such that a high degree of performance can be expected from the ADC operational and technical personnel by 1957.

With these assumptions in mind a review of the program indicates that certain major factors related to the problem of interception should be considered. These are:

(a) Estimated probable plan of attack by the enemy.

(b) Estimated enemy aircraft characteristics.

(c) Disposition of air interceptor forces.

(d) Disposition of AAA forces.

(e) Conservation of forces.

(f) Flexibility of forces.

(g) Sustenance of defense capabilities.

(h) Command relationships of defense forces.

Estimated enemy aircraft capabilities appear to be the absolute maximum based on available intelligence and educated guesswork. It is believed that these estimations are reasonable and represent acceptable departure points upon which to base hypothetical plans of enemy attack. Such an approach will provide the worst possible situation for theoretical judgment of defense capabilities. Hypothetical enemy attack plans have apparently been made on the assumption that: 1. The enemy has precise knowledge of our defense plans and installations. 2. He will launch an all out mass surprise attack. 3. That he will saturate our defenses. It is believed this approach is correct in order to estimate our minimum defense capabilities and minimum kill rate. However, to make all defense plans on that hypothetical situation may lead to over-estimation of the enemy and may be detrimental to planning for other than "one shot" attack. Specifically, the ADC program give the Soviet Air Force a 1957 attack capability of 1000 TU-4's

250 Type 31
900 Med. Jet Bombers
250 Heavy " "

Of these the program calls for approximately 800 assorted types to attack

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key U.S. cities with coordinated timing. CONFIDEN

An analysis of the disposition of interceptor forces indicates that in general these forces are disposed in the most probable target areas but that the disposition is weak in the sense that it is too shallow to permit sustaining attacks on enemy aircraft prior to BRL. It is believed that fighter defense units should be moved out to the farthermost points on the perimeter. There is no positive indication in the ADC program of a concept of defense in depth.

Conservation of the limited forces is of prime necessity if the ADC is to come up to the estimated kill rate, even under the circumstances of attack. Conservation depends to a great extent upon positive identification by means other than interception.

An extension of this factor of conservation of force points up perhaps the greatest vulnerability of the interception function. This factor is the size of the force of interceptors. While the forces at hand can probably achieve the anticipated ADC kill rate of 50% - 60% by 1957 against certain types of enemy attack, we believe that the interception function is vulnerable to either a large scale mass attack in one specific area or to an attack which saturates the system in detail. Under either circumstance we believe that we would quickly run out of interceptors. This is further complicated by lack of immediate, positive identification. Specifically the ADC program for friendly interceptor forces for 1957 gives 61 U.S. squadrons of 25 aircraft each. Even 100% of the forces available falls for below the estimated 4-7 to 1 fighter-bomber ratio which would be necessary to turn the attack. To make matters worse we have only 12 squadrons of F-102's which would be capable of intercepting 359 Soviet jet bombers of 50,000 ft. Therefore, we immediately see that this fighter interceptor program cannot provide adequately for the function of interception.

Flexibility as used here involves the principle of mass, and is interpreted to mean for this paper the capability of concentrating forces as needed. It is believed that equipment and bases provided by the ADC program are not sufficient for this purpose. The air base complex and necessary support facilities required for this capability are non-existent.

Sustaining of defense capabilities, pilot wise, is sufficient if the USSR carries out the hypotehtical plan of attack devised by ADC. However, the ratio of 1.5 pilots per airplane for a continuing air battle over a period of days or weeks instead of a "one shot" attack should be doubled or the defense may collapse.

Although not mentioned in the program, one factor which has a direct bearing on the ADC program is unity of command. This is not necessarily a budgetary matter but one of jurisdiction and unity of command.

The interception and subsequent kill ratios may not be sufficient to stop all enemy aircraft from reaching the BRL. However, if one single enemy aircraft does reach the BRL because of lack of definitive command relationships between the military and civilian defense elements, then the DEF Department has indeed been derelict in establishing its command organization.

c. <u>Summary</u>

We conclude that the interception function is vulnerable as a component of the air defense system. We are short in total numbers of interceptors and also, in detail, numbers of high performance fighters of the F-102 family. Further, we do not have an air-base complex from which to adequately deploy our fighters for defense in depth. However, we conclude that the ADC program for 1957 is a reasonable compromise between these difficiencies and budgetary limitations. We also feel that it is not feasible to build the necessary ratio of fighters during this period because it would necessarily take funds from our strong offensive posture. Further, in light of Soviet potential capabilities in high speed guided and ballistic missiles during the latter part of this period, our friendly fighters quickly become absolute.

5. Destruction

a. Mission

The mission of the function of destruction is to prevent or reduce the effectiveness of the air attack by bringing to bear against the attacking vehicle sufficient fire power to destroy it piror to release of its bomb load. Destruction presumes prior successful accomplishment of detection, identification and interception.

b. Discussion

(1) General

There are several factors which make up the whole of the destructive effort. These are - the delivering or attacking vehicles, the defending or intercepting vehicles, air-air missiles, surface-surface missiles, aircraft armament, sighting and firing mechanisms tactics, bomber-fighter ratios, performance characteristics, state of training of crews, and reliability of equipment.

The weapons available to us during the period under consideration are interceptor aircraft, guided missiles, and anti-aircraft guns. Fighters

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programmed are the F-86D, F-89D, and the F-102. The first two will rely primarily on 2.75" rockets. The F-102 will carry the Falcon rocket. All three aircraft will use the electronic fire control system. Guided missiles in the program are the Army's Nike 1 and Nike B and the Air Force's Bomarc, all air-to-surface missiles. Anti-aircraft guns consist of conventional 90's and 120's plus the new Sky Sweeper, a 75 mm. weapon.

(2) Aircraft and Aircraft armament

In considering the destruction phase using fighter aircraft we must focus our attention on the performance of the aircraft its armament, and its fire control system. Fighter-Bomber ratios must also be considered. In this analysis, we are basically concerned with effectiveness, which in turn introduces reliability and vulnerability.

By 1957 we will have only one fighter, the F-102, with superiority in performance over jet bombers operating at 50,000' or above. The F-86D will be barely able to match estimated enemy bomber performance at 50,000'. The F-89D cannot operate at such altitudes and would be out of the battle should it develop there. Obviously, as the enemy attack lowers in altitude our capability improves. All these fighters are armed with the 2.75" rocket, capable of utilizing the proximity fuse. Also, the F-102 will carry the Falcon missile, with missile guidance by pulse radar and a semi-active radar target seeker. Rocket fire control will be electronic.

One of the most important factors in determining bomber kill probability is the fighter-bomber ratio. We find that while a 4-1 ratio is required for a reasonable kill probability, by 1957 we will have a ratio of only 1.34 - 1 for low altitude night attacks, and 1.21 - 1 for high day attacks. With these ratios the kill probability over-all in 1957 would

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range from approximately 60% on TU-4 and T-31, to approximately 25 to 30% for jet bombers, using both rockets and missiles. With Falcon armament only, the probability drops to approximately 30% for TU-4 & T-31, and approximately 15-17% for jet bombers.

In his lecture Brigadier General Bennet has stressed the present unreliability of the electronic gear in our fighters. This weakness would appear to be the greatest hazard to the destruction phase of air defense. ADC has noted this and has called for a program to provide improved interceptor armament and associated fire control systems. We believe that this program should produce the necessary reliability in the equipment by 1957.

By 1957 the Soviet bombers are expected to be equipped with 23mm guns mounted in one to five turrets, with fire control radar directed and automatic. With the fighter armament available in this period it should be possible for the fighter to attack from some distance, and to have considerable success in avoiding the bombers effective field of fire. By using the Falcon's long range (max 5 naut miles) the fighter should be well out of bomber gun range, and the Falcon itself should be relatively invulnerable once launched because of its speed and short time of flight.

There seems little reason for concern over the destruction of the bomber once hit by rocket or missile. Tests would indicate that the armament is effective if it finds its target.

The fighter program appears to be as good as could be devised within time, money, and science limitations, with possibly two modifications which should receive serious consideration. The first is the availability of atomic warheads in air defense weapons. The Rand study would indicate that on a dollar basis these warheads should be feasible for single bombers as well as for formations. While ADC has a priority lower than several other defense elements, if the nuclear material can be made available it would appear wise to possess air defense weapons with atomic warheads as a threat. Enemy tactics could be greatly influenced by this threat, even if never used, and perhaps help to relieve the saturation of our defenses to some extent. Its use with the Falcon would appear to have great possibilities. The second point that should receive some consideration is the fighter-bomber ratio. Not enough information is available to make a recommendation possible on this point. However, the F-89D has limitations which lower our overall fighter-bomber ratio at high altitudes. It might be possible to raise the fighter-bomber ratio by phasing out the F-89D's and with the same resource outlay provide more F-102's and F-86D's. If this matter has already been determined, as is suspected, then the use of an atomic warhead is the only point to be pursued.

. Missiles - As regards the prospects of Russian guided missiles which could be used in an attack against the U.S. during the time period under consideration, there has been no concrete evidence of development in this area and no significant reports of any testing. It would be fallacious to assume that she was sitting idly by, however, and we are forced to calculate our defensive requirements on the basis the USSR does have a capability equal to our own. The ADC report does make specific mention of an air-to-surface missile, but no characteristics are given on which to judge our ability to intercept and destroy. There is evidence in the program for 1957 that our R&D agencies are planning tools which will combat all known types of this missile, but again no particulars are given.

On the subject of U.S. missiles for air defense purposes the NIKE weapon possesses, according to reports, an effective range of 30 miles and a maximum effective altitude of 60,000'. It has the command guidance system, which necessitates ground control by personnel taking indications and directions from ground radar. The reported speed of the Nike is 2.5 Mach and contains a warhead of either #300 or #1100, depending on the style, I or B. It is believed to be an effective weapon and can be launched with sufficient rapidity to serve its purpose against bomber formations of 13 or more aircraft. The principle limitations of Nike are its vulnerability to jamming of control radar; jamming of air-ground communications insofar as identification of friendly or enemy aircraft; and the operability factor of 75%.

The Bomarc is a weapon with an effective range of 20 miles at 60,000 feet. This item is estimated to have a speed of Mach 2.0, with a kill probability of 50% within 50 feet of the target. Limitations are its vulnerability to jamming of its target seeking radar and its lack of low altitude capability. The 1957 program provides for two squadrons by 1957 and implies a questionable state of training in its use. This item is capable of carrying the atomic warhead, which improves its effectiveness against concentrated enemy bomber formations by forcing them into spread type tactics, thereby reducing their concentration of firepower and perhaps increasing the potential kill of our defending fighters.

There is practically no information available on the 120mm, 90mm, and 75 mm guns, however it can be assumed that with the training and experience the AAA Command has had with these weapons, firing would be quite accurate and effective within the range of the guns.

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c) Summary

In summation there appears no doubt that our programmed implements of destruction are and will be in 1957 capable of effecting the kill if successfully placed on the target. Further, the "hardware" appears withid our technical financial, and manpower capabilities for 1957, i.e., it is feasible. However, in two particular areas of the destruction phase we appear vulnerable - (a) numbers of interceptor aircraft available to convey the destructive firepower to the target and (b) shortcomings in the control systems of our surface to air guided missiles which may preclude proper target identification and/ or which may render the missiles susceptible to enemy jamming. Indications are that this problem of missile control will be overcome by 1957. If it is, then for the 1957 period, at least, the destruction function would appear to be the strongest link in our air defense system.

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CONCLUSIONS

1. Of the four functions which it must perform effectively, ADC is least capable of carrying out the identification function.

2. ADC's 1957 program represents the best possible utilization of <u>presently available</u> or <u>programmed</u> resources.

3. Closer integration of the strategic offensive and strategic defensive programs is mandatory.

4. The Air Defense program as a whole appears inadequate as borne out by the unacceptable end product, i.e., the relatively low maximum kill rates envisaged.

5. Insufficient consideration is given the threat of submarine-launched missiles.

6. Present TO's provide insufficient crews for interceptor aircraft.

7. The apparent disadvantages of the Lincoln Line outweigh the apparent advantages.

8. Atomic warheads in air defense weapons seem to possess definite potential and their possible use should be seriously considered.

9. The entire program, as we have been exposed to it, has a somewhat limited life expectancy, i.e., until the advent of long-range ballistic missiles and/or supersonic aircraft.

10. The best defense is a good offense.

RECOMMENDATIONS

1. That every effort be made to expedite a fool proof "little black box" which will permit immediate and positive identification.

2. That SAC and ADC integrate their operational programs as closely as is appropriate.

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3. That more consideration be given the problem of countering submarine-launched missiles. (The Navy speaker was reasonably reassuring on this matter but he seemed to be speaking solely from the standpoint of Navy efforts. ADC is very vague about coordinated efforts or plans.)

4. That interceptor crews be increased from 1.5 per aircraft to 2 per aircraft.

5. That the Lincoln Line not be implemented.

6. That interceptors presently based in certain key areas, i.e., Chicago-Detroit, be moved further north, into Canada if possible. (This will not appreciably alter the somewhat "token" status of our air defense, but it will represent better deployment of interceptors.)

7. That the possibilities of atomic warheads in air defense operations receive serious consideration.

8. That no funds be diverted from ADC to SAC.

9. That the 1957 ADC program be implemented. (Despite its inadequacies, it appears to be as good as can be expected, and it may develop - on the not unlikely chance that we have over-estimated the enemy - that it will see us safely through the time period under consideration)

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SOLUTIONS SEMINAR NO. 15

THE AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
DATE SUBMITTED

STUDY NO. 1954-6 SEMINAR NO. 15
(Scheduled dates 4 Jan - 30 Jan 54)

INSTRUCTOR Col Shannon Christian STUDENT CHAIRMAN Col Glawe

SEMINAR MEMBERS:

1. Col Bowie
2. Col Lyle
3. Col Humbrecht
4. Col Long
5. Col Phillippi
6. Col Sladek
7. Col Rinker
8. W/CMDR Toyne
Col A F Tucker

STATEMENT OF THE PROBLEM:

In general terms, analyse the development and deployment of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

PHASE OF STUDY TREATED:

SHANNON CHRISTIAN SIGNATURE
Colonel, USAF
Study Director

(Use reverse side for remarks)

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SEMINAR SOLUTION

STUDY NO. 6

SEMINAR NO. 15

SEMINAR CHAIRMAN: Colonel Glawe

SEMINAR RECORDER: Colonel Tucker

SEMINAR MEMBERS: Colonel Bowie
Colonel Lyle
Colonel Humbrecht
Colonel Long
Colonel Phillippi
Colonel Sladek
Colonel Rinker
Wing Commander Toye

MAXWELL AIR FORCE BASE, ALABAMA

28 January 1954

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OUTLINE OF ANALYSIS

I The Problem.

II Basic Assumptions.
The Threat or Enemy Capability.

III Discussion of Factors Bearing on the Problem.

IV Recommendations.

V Conclusions.

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ANALYSIS OF "COST VS. KILL"

I. THE PROBLEM:

To analyze the development and deployment of ADC forces programmed for 1957, as contained in the "Cost Vs Kill" document, to determine within the budget limits prescribed whether:

(a) The force composition and disposition is the best obtainable under current technical capabilities, or

(b) A more adequate defense can be obtained either through utilization of different types equipment, a changed deployment, or a revised concept of defense.

II. BASIC ASSUMPTIONS:

The enemy capability and threat. Seminar 15 accepts the enemy capability in his long-range Air Force as out-timed in Annex A of the assigned study document. Much consideration has been given to calculating what the enemy must do in order to achieve a round-trip capability in the TU-4, Type 31, and others under production. Some comment was made by A-2 representatives that there was no evidence of development of tankers for refueling in spite of our published details at ten cents a copy. We are prone to believe that if the Kremlin considers the world situation right before they have a round-trip capability, they will not hesitate to make a one-way trip out of it and consider it a "bargain basement grab sale" if they lay sufficient A Bombs in the vital areas. Besides, Hollywood, and many other spots will be more desirable than Amsk and the CPA will be prepared to receive Soviet crews on the end of

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the one-way ride. However, in evaluating the threat no one, at least up to now, will dare to evaluate the enemy intention with the result ADC must continue to operate on the promise of the war may come tomorrow with no more warning than the surveillance net will provide. We have analyzed the problem under these assumptions in order to stay on the same reference plain as the authors of "Cost Vs Kill". However, we would like to depart slightly on these assumptions for the sake of making our thoughts known on this subject as well as basis for some points in our conclusions. First, we assume (since this is labeled assumptions) that the enemy will not launch a long-range air strike against the United States without thorough preparations for all out war using all of the weapons in the Soviet and Satellite arsenal. Such preparations must show unmistakable signs which cannot be completely shielded from our Intelligence. Assuming we collect these signs and assuming again we can properly evaluate them, we should have a fair indication that war is imminent sometime in the not too distant future. We conclude such evidence should allow at least five to fifteen days' warning, without knowing precisely where, how, or in what magnitude will the first blow fall. However, that warning should be gravy time allowing detailed preparations in both the active and passive defense forces. These preparations would place air traffic in and around the United States under much closer supervision and channeling so that identification would be immeasurably facilitated. A system of air patrols and an increased alert status for the entire Air Defense system would greatly increase the kill probability.

Another factor which we believe should be seriously considered is the future threat which will supersede the current TU-4 threat. Certainly the TU-4 threat must be considered first; but if too much attention and cost are lavished on this threat, which Intelligence tends to place toward the "possible but improbable" end of the spectrum, a more serious threat such as the ballistic missile may drop on our outdated system prepared basically for the TU-4. It might be that a calculated risk should be taken to place more emphasis on the future, more serious threat.

III, FACTORS BEARING ON THE PROBLEM:

Concept.

This seminar adopted a basic concept for air defense in order to properly analyze and discuss the various factors bearing on the problem. This concept is (a) All parts of the warning and detection system must be closely coupled with the destruction capability; (b) The contiguous detection belt will cover the approaches from the West, North and East; (c) The enemy kill must be made as far from the vital areas as possible.

A. Detection.

Our destruction and warning system should be developed and positioned so as to be effectively coupled with the interceptor and destruction capability of the various defense weapons. Under our concept a detection system must be more than a simple warning indicating an unspecified number of objects has passed a distant line which would

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therefore require the defense to await a re-contact and follow-up detection. In such instance, only the follow-up detection, provided it has a tracking capability, can give magnitude and direction of attack. We feel that once contact is made with the enemy, continuous tracking and control capability must be maintained right up to the B.R.L. in order to provide the maximum possibility of kill. A simple early warning for ______________ from a tracking detection system is a "worry system" that does not permit the defense commander to take positive and rational action. Warning and detection of unknowns must enable the defense commander to take follow-up action to identify and initiate destruction with his interceptor forces. This means then, his detection must be such as to enable him to place his interceptors in contact with the unknowns at the earliest moment. This requires, under our concept, the positioning of detection equipment to give continuous tracking within the maximum radius of our longest range interceptors (or vice versa, locating fighters within the maximum coverage of the detection system). We have not ignored the importance of a warning lead time required to place interceptors and other functions into action, but such warning time must be within the above pattern of tracking detection.

Within the terms of our concept we then analyze the detection factor under two main considerations: (a) Type of equipment needed; (b) Location of equipment for maximum defense.

The type of detection equipment employed must have a tracking capability coupled wherever possible with height finders to provide the GCI function. This tracking and GCI capability should reach to the outward edge of our first detection of the enemy. Under these terms we have serious reservations about the 208 Doppler radar sets programmed for the McGill line. The capability of these sets are unknown. Their value in our system is only to alert radar scope operators who might otherwise go "monotony blind" and miss clear warnings on their scope. We assume the Doppler Radar has a capability similar to the "________ system" being examined by the Canadian RCAF. Under these assumptions, we propose leaving the 208 Doppler radars in the line principally for warning to FPS-8 radar operators and not as a warning to the defense commander. However, without a tracking capability as in the FPS-8 radar, we consider the Doppler radar to be the "worry warning" over which no rational action can be taken and as such of little value. Therefore, our recommended equipment for the McGill line is 32 FPS-8 along the line with 18 FPS-8 for coverage in depth down to Northern boundary of the United States where a contiguous GCl capability coupled with height finders to give GCl capability in order to provide the necessary positioning of the destruction force.

For the extension of the detection and warning system off shore, we have examined the programmed equipment of the Picket ships, and the AEW&C function utilizing the RC-121 and believe there are ways of achieving this coverage cheaper and perhaps more effectively. In the function of a Picket vessel, as suggested by the Navy speaker recently, it appears advisable to utilize some of the many Liberty vessels currently in "moth balls". Although other useful services could be performed simultaneously, we limited our interest to the surveillance aspect which we conclude can be performed adequately and only at the capital cost of modification. The examination of AEW&C function as envisaged for the RC-121 aircraft, leads this seminar to conclude that a 24-hour coverage of the areas cannot be maintained on a ratio of 7 A/C per station. Although commercial airline utilization on this type A/C runs up to 9 hours per day, the electronic equipment on board the RC-121 along with the limited technical maintenance ability in the USAF, we believe will make the utilization drop far below that envisaged in the program. Also the hoped for AEW&C capability is subject to much test and proving. In view of these considerations we recommend cutting RC-121 program in half subject to development in this role. To augment this reduced RC-121 program, we propose utilizing Blimps on a development basis. If the Blimp proves satisfactory from the all weather aspect, it appears to be much more economical than RC-121 and perhaps more reliable and efficient for the purpose, especially when considered in conjunction with the Picket vessel. None the less we recommend the combined approach until the Blimp or the RC-121 proves its merits.

In treating with the positioning of the detection system, we accept the general location of the McGill line across Continental Canada. As previously stated, we reject a narrow line warning concept as present in the 208 Doppler program, and advocate detection in depth with continuous tracking back to the interceptor location and on to the vital target area. Therefore, we propose the coverage in depth Southward from the McGill line using type FPS-8 radar. We reject the coverage provided by the extension of the McGill line from Canada to Hawaii.

It appears that the western half of that coverage is beyond our capability of positive action, and falls outside our concept of coupled warning and destruction. We propose relocating that over-water coverage on an arc from the 54th parallel to San Diego, the arc being rel tively closer to the shore on the southern half. In this line, we propose a combination of Picket ships coupled with Blimps and backed up by AEW&C or RC-121 to give continuous cover to the shore. The Picket ships and airborne coverage should be roving or oscillating patrol, according to a mobile coverage plan rather than a static or fixed orbit plan. This should preclude or limit the enemy's ability to determine the weakest part of the coverage which would aid his penetration capability. Carrier equipment for coverage would require 10 Libertys on patrol coupled with 10 Blimps, and backed up by two squadrons of RC-121's.

On the Eastward extension of the McGill Line, we consider coverage by Picket ship from Iceland or Greenland to Scotland as being outside our intercept and kill capability and thus providing "worry warning" that does not allow for rational follow-up action. We propose maintaining over-water coverage between Newfoundland and Greenland by 3 Picket ships on patrol (backed up by 5 additional Picket ships). We concur in Greenland-Iceland radar coverage only if the interceptor and kill capability is moved out to utilize this detection under our concept of "kill as far from vital areas as possible".

In analyzing the coastal detection system for East and West Coast off-shore from the vital Boston to Philadelphia area, and San Francisco-Los Angeles area, we recommend the Liberty ship-Blimp combination, backed up by the RC-121, AEW&C A/C. However, we recommend reducing the RC-121 program to three squadrons pending test and evaluation of capability. Owing to arc concept of detection from the 54th parallel down to San Diego in lieu of the line to Hawaii, we conclude we can reduce the Picket ship and AEW&C using RC-121 to the half that Programmed to serve as detection in depth covering the portion between the outer arc and the shore coverage. We recommend using these additional two picket ship stations with its back up to be employed in extending East Coast coverage on a similar arc of the vital area with the RC-121 as depth to provide continuous tracking coverage to meet shore coverage.

B. Identification:

This study provides no basis for analyzing identification except intercept and possible interpolation, using tracking and detection information. For this reason, we have insisted on our concept of keeping the surveillance and detection within range of our interception and kill capability. However, the dilemma caused by unknowns and the necessity of "getting the first one" makes it mandatory to provide some method or equipment to reduce the problem to manageable proportions even if we cannot resolve it completely. It appears therefore that coding equipment for the Mark X IFF should be improved and this equipment placed on all United States military aircraft and the trans-oceanic United States Airlines. The experience thus gained may lead to a more complete and satisfactory solution and in the meantime reduce a great number of unknowns in the background traffic caused by military traffic. Since many IFF interrogators already exist, the effort and cost of improving the mark X airborne transpondor appears logical and useful. Certain calculated risks regarding the possible recurring security compromise ought to be accepted. We anticipate that after the first hostile act the identification problem will be greatly reduced because responsible persons will have the courage and necessity of enforcing the kind of air traffic discipline required plus accepting a few friendly casualties as more than fair exchange for several hundred thousand lives in vital areas. Since identification is the weakest link in the air defense system, it warranted concentrated effort for resolution.

C. Interception:

After reviewing the various types of interceptors available to our defense forces by 1957, those programmed appear to have greatly improved capabilities; however, we feel that the all weather problem of interception, identification and destruction places too great a burden on a single individual, even with all the automatic devices. Therefore, we recommend that for the foreseeable future while manned interceptors are still an important part of destruction, the development of a two place interceptor be included in the defense program.

We recommend locating the fighter squadrons on the outer fringes of the defense area as close to the initial detection zone and probable approach routes as feasible in order to engage the enemy at the earliest moment and to keep him under continuing attack all the way into the vital areas. The maximum attrition must be effected prior to reaching the area of BRL. Once the enemy has closely approached the BRL, we believe the ground to air defense should have clear and unlimited freedom to fire. In accordance with this concept, we propose relocating the AD fighters squadrons programmed for the Southern and Central portion of the United States to the external areas of the United States to be at the earliest point of probable intercept. We believe we must take the calculated risk of penetration to these scattered internal point targets such as the southern SAC bases in order to concentrate all the defensive capability from the outset. These point defensesfrom which we withdraw fighter squadrons should be defended by augmented ground batteries. Also if the enemy has been engaged heavily from the outset, sufficient warning will have been provided for placing a major portion of the SAC forces in the air, thus following the best possible defense in "not being there".

D. <u>Destruction</u>:

The destructive weapons currently programmed have sufficient wallop to make the required kill. The 2.75 rocket and the Falcon missile have sufficient range and power to do the job if the interceptor can be put into position to fire. Under the current enemy threat we do not foresee any great defensive capability on his bombers that should seriously limit our interceptors in pressing the attack sufficiently to effect the kill.

The Nike has sufficient destructive power and range for its mission of point defense of vital target areas. Its limitations we see in the identification and control. Electronic countermeasures appear to be the major problem in this field, as well as in our several previous factors. We do not propose any relocation of the programmed Nike battalions. The Skysweeper does not have sufficient range for the probable

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mission of ground to air defense, and should be augmented by Nike fire-power. Therefore, we recommend additional support to the areas defended by Skysweeper in the form of Nike Battalions. We envisage the ground to air defense as the last line of destruction prior to the BRL and should have freedom of fire whether the interceptors have carried their attack to that point or not. Lack of identification or separation between the interceptor and the enemy must not hinder the ground battalions freedom to fire as range permits. We believe under those circumstances, GCI and the interceptor must take these chances of avoiding destruction by our own ground batteries.

IV. SUMMARY OF RECOMMENDATIONS:

We must make the kill as far from the vital areas as possible with our current capability. We must have the consistent and close coupling of the detection system and the interceptor forces.

Our surveillance force must be placed as near to the enemy jump-off point as possible, but must not be positioned further out than can maintain continuous tracking and control to our interceptor forces. Our interceptor forces must be placed as far out on our defense perimeters as possible commensurate with their range in order to initiate and maintain attack effecting maximum kill before the enemy approaches critical areas. While the trend is toward automatic data processing, we believe that complete reliance on such equipment is an unacceptable risk. The system should permit manual intervention in the event of failure to avoid the entire system being voided by technical failure. Greater simplification

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in our equipment is required to make it consistent with the maintenance and operating capability of the personnel available to ADC. Additional approaches to the airborne method of surveillance must be developed to lower the cost and assure round-the-clock coverage of the over-water approaches. Liberty ships should be used for Picket vessels to lower cost of this phase of operation. Interceptor squadrons should be placed on the defense perimeter, rather than held in the south and central portions of the United States, if we are to achieve the maximum attrition. The over-water surveillance to Hawaii should be rejected in preference to arc patrol off the West Coast within range of our interceptors. The over-water surveillance from Greenland to Scotland should be rejected for suveillance within range of our Northeast interceptors. The skysweeper does not have sufficient range for effective ground defense of vital areas. It should be replaced by Nike battalions. Identification is the weakest link in defense and the one with no real possibility of solution. The Mark X IFF coding device should be improved as a means of reducing the identification problem even at the possible risk of future security compromise. Long-range-beyond the period of this study: A two-place interceptor should be developed to relieve the overload now placed on a single pilot; interceptor forces should be developed and positioned so as to utilize the surveillance capability being developed in Greenland and Iceland.

V. CONCLUSIONS:

Although the Defense Commander cannot rely on getting warning of an impending attack prior to the crossing of his surveillance lines,

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we believe that the preparations for a surprise air attack against the United States must necessarily be coupled with immense preparation for all out war, utilizing all of the Soviet weapons. Such preparations must become apparent, placing us on an alert of impending attack and allowing us to take actions that will greatly increase the defense effectiveness, especially in disposition of forces and availability of all hands, plus minimizing the possible effect of the attack by alerting SAC and other forces whose policy must be "Absent at the Bell". Should the JCS level decide to make such an evaluation and take the calculated risk, greater preparations and effectiveness could be generated for the period when the attack will more probably materialize. We believe the TU-4 is not the real threat and may be the bluff that will gain sufficient time to develop a more modern threat that under our current preparations we will be unable to effectively counter. That modern threat does not necessarily mean skipping all other forms and going to the intercontinental missile, but if it does we will be found wanting by a much greater margin. In substance we conclude that more of the current budget should be used against an improved defense of the future and less for the day to day stand-by alert which by this study's own confession can not reduce the attack to acceptable limits. The current forces indicate a greater intercept and destructive capability than the detection and identification can bring into play.

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SOLUTIONS SEMINAR NO. 16

THE AIR UNIVERSITY
AIR WAR COLLEGE
MAXWELL AIR FORCE BASE
ALABAMA

9 August 1954
DATE SUBMITTED

STUDY NO. 1954-6 SEMINAR NO. 16

(Scheduled dates 4 Jan - 30 Jan 54)

INSTRUCTOR Col Shannon Christian STUDENT CHAIRMAN Col Gould

SEMINAR MEMBERS:

1. Col Britt
2. Col Curtin
3. Col James
4. Col Crowell
5. Col Poage
6. Col Sliker
7. Col Shepardson
8. G/CAPT Troop

Col T W Tucker

STATEMENT OF THE PROBLEM:

In general terms, analyze the development and deploymen t of Air Defense forces as programmed for 1957. Identify and discuss the factors you considered in this analysis.

PHASE OF STUDY TREATED:

INSTRUCTOR'S SIGNATURE
SHANNON CHRISTIAN
Colonel, USAF
Study Director

(Use reverse side for remarks)

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SEMINAR SOLUTION

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STUDY NO. 6

SEMINAR NO. 16

SEMINAR CHAIRMAN: Col. Gould

SEMINAR RECORDER: Col. Tucker

SEMINAR MEMBERS: Col. Britt
Col. Curtin
Col. James
Col. Crowell
Col. Poage
Col. Sliker
Col. Shepardson
Gp/Capt Troop

MAXWELL AIR FORCE BASE, ALABAMA

26 January 1954

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ANALYSIS OF AIR DEFENSE FOR 1957

Introduction

The ADC study on "Cost and Effectiveness" of its air defense structure contemplated for the U.S. in 1957 is essentially a plan view of a defensive weapons system, its calculated effectiveness, and its indicated cost. Such being the case, our seminar problem assignment is nothing more than to evaluate this weapons system in terms of its projected cost and effectiveness to determine if, on the basis of our system of measurement, we agree or disagree with the scope and conclusions of the study and to make recommendations accordingly.

The first essential step toward making an analysis of the weapons system contemplated in the ADC study is to apply some yardstick of measurement to the elements of the system, separately or as a whole. Such a measurement should reveal the weak and strong points of the system, divulge ambiguities and facilitate final determinations. As a method of measurement our seminar will, we wish to acknowledge, make use of the criteria selected for measurement of the value of a weapons system as developed by Seminar No. 4 in Study No. 4. (You will recall the very able presentation made by Col. Crow, one of our distinguished class-mates). The criteria for measurement, as established by that seminar, are four in number - effectiveness, flexibility, supportability, and compatibility.

The substance of these criteria is presented in outline form in order to provide the pattern for the analysis which follows:

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A. Effectiveness

(1) Intelligence
(2) Firepower
(3) Mobility
(4) Vulnerability
(5) Deliverability of weapon
(6) Reliability
(7) Recuperative ability

B. Flexibility

(1) Growth potential
(2) Allow for changes in strategy
(3) Application where, when, and in amount needed
(4) Defensive and offensive capabilities
(5) Application to different types of targets
(6) Expansibility

C. Supportability

(1) Will of the people
(2) Cost
(3) Producibility
(4) Simplicity

D. Compatibility

(1) International
(2) Between national elements
(3) Between Services
(4) Between Air Force elements
(5) Between elements or components of system

This outline contains factors that are taken from the Seminar 4 Solution and, as such, require no discussion in this paper. The application of these factors to the Air Defense problem will be discussed in the course of the analysis. Accordingly, this seminar solution is not divided into two separate parts. The logic of this approach, we hope, will be evident as this presentation continues.

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EFFECTIVENESS

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Let us now consider the ADC defense system in terms of effectiveness. Effectiveness considerations are a test to determine the efficiency or fitness of the system to do its job, namely; to provide air defense for the U.S. in relation to the contemplated enemy capability for attack. To measure effectiveness of the ADC system we will, in accordance with the aforementioned Seminar No. 4 solution, treat with seven elements of consideration - intelligence, firepower, mobility, vulnerability, deliverability, reliability, and recuperative ability. Now let us consider the elements in that order.

Intelligence, as to the enemy offensive capability to strike this country, is the key to our problem. The best available information on the Soviet Union reveals that she does have both atomic and thermonuclear bombs, and she has air carriers which are capable of delivering these bombs upon the United States. The USSR is motivated and guided by a doctrine of communist expansion leading to eventual world domination. She recognizes that the United States is the country which, today, she will have to knock out in order to achieve her insidious aims. With such capability and motivation being reasonably established, it becomes readily apparent that the United States, in the interest of her security or perhaps survival, must take defensive measures to nullify or reduce the weight of an enemy attack. This seminar recognizes the importance of accurate and reliable intelligence as a factor in the air defense problem. Present weaknesses in this connection require no elaboration. With the present inadequacy of intelligence information, it is evident

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that the details of any intelligence estimate will be as varied as the number of agencies compiling them. We therefore decided to accept the ADC intelligence estimate of Soviet attack capability. It is against this estimated capability that the remaining elements of effectiveness will be measured. However, we believe that only appreciable variations in the estimate would have any significant effect on this analysis.

Firepower, in the air defense system, is the total of destructive forces which can be brought to bear on the enemy aircraft prior to their reaching the bomb release line. The desired firepower is that which is sufficient to insure a 100% kill rate prior to reaching the bomb release line.

The ADC study contemplates a kill probability of approximately 50% in 1957, assuming that the McGill line with its sea flank augmentation is operational. This means that the enemy can deliver an order of magnitude of 200 bombs on targets. There are few, if any, who would argue that this does not represent a devastatihg blow. It is evident that there is a deficiency in firepower.

What are the factors involved in getting maximum firepower on the target? First of all, the available time is short and concentration of firepower is necessary. This is nothing more than another way of expressing that aged principle "concentration of force." Secondly, in order to make the most of the time available, defense in depth is required. The programmed system is deficient with respect to both of these factors. This system not only fails to maintain continuous tracking after initial detection, but loses the target completely for appreciable periods of time.

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Some improvement in the amount of firepower that can be brought to bear could be obtained through a more specific commitment of augmentation forces and by an increase in the warning time.

Mobility of a weapons system suggests the very essence of the age old principle of concentration in time and space. The United States is a vast area, and to attempt to cover it with radar and anti-aircraft defenses is too expensive; therefore we must adopt the principle of defense of selected objectives. This is also known as the island defense concept. With a weapons system partially immobile, such as our radar stations and anti-aircraft defenses, we must select the most vital areas and concentrate our defenses around these areas. The fighter forces are a mobile force that can be concentrated in time and space, but our defense system depends on all components working together; therefore the system must be classified as immobile. This is a limitation from which there appears to be no reasonable method of escape.

Vulnerability is that element of effectiveness which haunts the air defense system night and day. To begin with, the extended area and air frontiers of the United States makes it particularly difficult and costly to provide even a low measure of air defense. This in turn confirms the fact, in the face of the Soviet air capability, that the United States is extremely vulnerable to Soviet air attack.

Vulnerability also resides in the condition stated by Major General Smith, that "our system must be designed upon the premise that the enemy will achieve tactical surprise, that the first warning of impending attack will be generated by the system itself." He further stated that "early warning, so significant a factor in the past, becomes even more essential for the future." A reasonably acceptable early-warning capability does not now exist and will not exist in the ADC perspective in the United States air defense system in 1957. The radar coverage that will exist in 1957 will be inadequate because of limited radar return at very high and very low altitudes. Also the McGill radar line and the seaward extensions, though designed to extend the perimeter warning line outward from the United States' frontiers, are not to be backed up in depth for continued tracking from the time of first detection. Again quoting from General Smith:

> "We must not only detect his (the enemy) penetration of our sytem but must track him consistently throughout his approach to the target. This dictates that elements of our detection system must be employed in depth back of our perimeter warning screen, so that the enemy can be tracked at all times. In this regard our air defense system is particularly deficient."

Another extremely vulnerable feature of our system is the almost complete deficiency in our identification capability. Numerous speakers who hold key ADC positions have repeatedly warned that the lack of an identification capability is one of the weakest links in the air defense system. We feel than an automatic system of identification is essential to the solution of this problem.

The system is susceptible to enemy electronic counter-measures. Detection radars could be jammed to cause unreliable detection in many respects. Air-to-air and air-to-ground voice and electronics communications could be interrupted or perhaps denied us. Gun laying, missile guidance and aircraft control radars could be made to respond erratically and thus give little or no result. It is quite true that we cannot know the ECM capability of the Russians in 1957; however, we would be prudent to recognize that a considerable ECM capability is not beyond them and we should, therefore, contemplate its employment with some degree of effectiveness. The successful employment of ECM to any degree against our electronic operations and communications would tend to decrease the effectiveness of our system to a similar degree and thus increase our vulnerability.

Sabotage is another feature of vulnerability. Communications facilities, electronics or other equipment, air base facilities and even people could be sabotaged to some degree by enemy action.

A saturation of our defense forces would also increase our vulnerability. The chance for saturation is made more likely by other features of vulnerability such as the use of ECM.

The extent of vulnerability is likewise conditioned by the considerations which will be discussed subsequently under "deliverability" and "reliability".

As stated in the Seminar No. 4, Study No. 4 paper, "the principle of self-preservation, which may be applied to an individual, to a nation, or even to a system, is without doubt a matter of primary importance." Indeed, the short-comings in being able to enhance or even maintain the operational integrity of the air defense system of the United States determine the vulnerability of that system and, in turn, of the nation.

<u>Deliverability</u> of the weapon, as viewed in the air defense sense in this paper, concerns factors directly related to the interception

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phase. Our interceptors must have high enough performance for them to meet the conditions imposed by the enemy's air fleet. It appears that our aircraft will meet the requirements with one possible exception; maximum operational altitude. At 50,000 feet our capability will be reduced, but if the enemy should develop the capability of coming in at a somewhat higher altitude, say 57,000 feet, he can change the order of magnitude of our defense capability.

Our delivery capability must be effective in all directions. In other words, the defense must be able to intercept the enemy from whatever direction he chooses to attack. Col. Carlson, in his lecture, refers to this principle as "comprehensive defense." The programmed system for 1957 has this capability with respect to the selected areas.

Reliability in our air defense system is a determinant of the end result which will be obtained, i.e., the kill ratio prior to bomb release line. The air defense problem is complex as is the equipment which makes up the system. These are conditions which are condusive to unreliability.

Against the measure of reliability the air defense system must blush because of wanton deficiencies. There is the matter of too many gaps in our radar coverage and not enough of such coverage; therefore, our detection capability is not reliable. Our identification capability is practically nil and we are likely to be spoofed by the enemy. We do not know the extent to which our ground-based control will be able to measure up to the high track-handling capability required to control the air action. Present data transmission techniques could be over-loaded and thus bring chaos into the system. Our communications are too susceptible to sabotage and other interference. Our system may not keep pace in capacity to cope with bombers flying higher and faster. A further feature is, again as stated by General Smith, that "as additional capabilities are afforded the air defense system, the complexity will also increase, continuing the demand for increased skill and training of our personnel." Increased complexities could thus serve to increase the probability of unreliability.

As a whole the air defense system possesses a heavy potential of unreliability, a realistic measure of which cannot be determined. Only a true test would reveal the real answer. However, in the absence of such a test, prudent judgement derived from the most impartial observations upon the system will recognize areas of real or possible unreliability and will establish (within means) and execute measures to minimize reduced effectiveness which may be brought on by unreliabilities in the system.

<u>Recuperative</u> ability within the air defense system is expected to be relatively limited. It will, of course, be dependent to a large measure upon the extent to which elements of the system may be knocked out, and the preparatory measures which will have been taken in advance, such as; availability of standby equipment in alternate locations, establishment of alternate lines of communications, reserves in fighters and missiles, and the extent to which damage will have been inflicted upon the production capacity and transportation of the nation.

FLEXIBILITY

Let us now turn to the second criteria in this analysis, flexibility. The first yardstick which we will apply concerns growth potential.

Growth Potential is defined as the ability of the system to increase in capability through the addition of newly developed items, without having to discard significant portions of the accumulated capital investment. In this connection Col. Carlson made this statement in his lecture: "A flexible air defense should be able to deal with low altitude as well as high altitude attacks and guided missiles attack as well as aircraft attack." The system which is programmed for 1957 does possess growth potential for use against manned bombers. However, there is no apparent capability potentially available to meet the threat of long range supersonic missiles. Intelligence estimates give the Soviet Union such a missile capability in the 1960's. This could mean anytime between 1960 and 1969. If in fact, the time period is the early 1960's, it is not too early for our scientists to be aggressively searching for countermeasures.

Changes in strategy should not cause unacceptable degradations in system effectiveness. The limitations here are the same as in the case just discussed. Against manned bombers, the system should have reasonable response to strategy changes, but not so in the case of missiles.

Application where, when, and in amount need. Previous discussion has pointed up the deficiencies of the system with respect to delivering enough firepower where, when, and in the amount needed for mission accomplishment.

Offensive and defensive capability. The system is specialized to meet a defensive requirement. While there are elements of the system which could be employed in an offensive operation, the system as a whole must be considered as defensive in character.

Application to different types of targets. The applicability of the system to different types of targets has been adequately discussed.

Expansibility of the system refers to the ability to improve effectiveness by adding additional items of equipment. It is evident that the system can be expanded within the limits of supportability.

SUPPORTABILITY

The third major criteria which must be considered in the evaluation of our air defense weapons system is that of supportability. To be supportable a weapons system: (1) should be acceptable to the will of the people, (2) it must not be excessively costly, (3) it must be produceable in the quantities required, and (4) it should be as simple as possible.

Will of the people. The advent of the long range bomber, weapons of mass destruction, and continued Soviet aggression are facts which have made the public realize more than ever before, that they, and not only the military, are in the front line. Further, they are more educated as to what Soviet aggression means to them and realize that the country must be prepared for attack. As they become increasingly aware of the threat, they demand more and more that protection be provided for their homeland. They are prepared to accept and support essential measures advanced by our national leadership.

Cost is always a predominant factor in analyzing a weapons system. It is evident that our air defense system, comprising all of the elements essential to accomplishment of the four phases; detection through destruction; will carry a high price tag. Whatever defense we buy must be within the nation's ability to pay, and must not be disproportionate to the extent of penalizing our offensive capability. Whatever air defense we buy should certainly have a reasonable probability of success.

There is no question in our minds that this nation can afford the system that is programmed for 1957. However, we are concerned that the people of this national think that they will buy effective air defense for 15 billion dollars. If an effective air defense is possible, no one has indicated when it could be available, how long its useful life would be, and what it would cost. The talk is about a linear relationship between cost and kill effectiveness, but always with respect to a system that will not do the job. General Smith says: "There appears to be no leveling off of the curve of cost versus capability which would require the expenditure of enormous sums of money for a small increase in kill." If this is true, you can project the ADC curve and find out what a 90% kill effectiveness will cost. We do not believe that this is true. Rather, we think that the cost versus kill curve will take a sharp increase in slope for kill probabilities much above 60%.

<u>Producibility</u>. To be produceable in the quantities required is the third requirement of a fully supportable weapons system. Considering the limitations of our industrial base, technically skilled production personnel, our financial structure and our available raw materials, can we make it?

Our industrial base is our biggest national asset. It is the world's largest, and about twice that of the USSR. Production of the 1957 program items will not impose an undue burden on it. In fact, expanded World War II production facilities, not now being full utilized, would allow doubling the current program without imposing any undue strain upon our industrial capacity. Our national production is down about one third from the 1944 peak, and increased capacity has been made available.

The financial structure of the nation will not suffer any difficult impacts in absorbing the 1957 program, or any considerably increased 1957 program. Plant expenditures for World War II and post-war aircraft and radar development and production facilities have provided us with ample facilities.

World War II liberty ships are readily available for the installation of detection, identification, and control equipment for use as offshore radar sites.

There are no special raw materials problems which can seriously interfere with this or any expanded program. The shortage of titanium need not continue nor seriously affect the program.

There is no shortage of skilled workers in this country. Any shortage of trained production personnel in the electronics field could be quickly met by augmented worker training courses and specialized production-line techniques. In the aircraft production field, employment is approximately half what it was in 1944. In some areas, for example the Ft Worth-Dallas area, there are actually surpluses of skilled aircraft production workers.

In other words, if this nation wants a bigger air defense system, the limitation is not in ability to produce the desired quantities.

Simplicity. To be ideally supportable, a weapons system should be simple. This is a highly desirable characteristic, but the one that is most often lacking in our modern weapons. The Bazooka represents the

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ultimate, the B-36 probably represents the other extreme. Unfortunately, the Bazooka is not very effective against the B-36.

Complexity of design and construction involves more skills, additional lead time, longer testing, and additional training for operators and maintenance personnel. A complicated device or system is generally more unreliable and more susceptible to enemy action than a simple system.

The air defense system programmed is complex. It depends heavily on centralized control and complicated electronic equipment. The problems of detection, identification, interception, and control have resulted in an unavoidably complex system with complicated weapons and equipment.

COMPATIBILITY

The weapons strategy, and concept of employment of our air defense system should be compatible with our international and national strategy, within the Department of Defense, between the various commands of the Air Force, and between the elements and components of the system itself.

International. The international strategy does embrace defense and does not bank entirely on the offensive. Recognizing that slow attrition of enemy attackers cannot be part of an acceptable defense strategy, and realizing the unacceptable devastation inherent in "A" and "H" bombs, the construction of a formidable defense to hostile attack has been accepted as part of the strategy of our international planners. Since the defense of the western world is dependent upon the United States as an industrial base, effective defense of the continental United States is compatible with international strategy.

On the international level the major problems incident to the system are: (1) the location of detection installations in adjoining or nearby countries; (2) location of airbases and fighter forces in adjoining countries; (3) the interception and destruction of enemy forces over friendly nations and (4) the integration of intelligence and reporting systems with that of adjacent countries. Since the defense of the western world is dependent upon the survival of the United States as an industrial and military base, the aims of our neighbors seem to closely parallel to those of the United States insofar as defense of the western hemisphere is concerned. This is especially true of Canada in that her areas of heaviest industrial concentration are in close proximity to ours.

National. Our posture as a non-aggressive democratic nation means that the enemy will, in all probability, strike the first blow. To prevent a serious crippling of our retaliatory force, as well as to prevent excessive civilian casualties, the nation must have positive warning of the approach of hostile aircraft. The development of an effective and timely early-warning line as envisaged in the 1957 program is in full accord with our national requirements.

Department of Defense. Within the Department of Defense, the air defense system programmed has achieved a measure of compatibility by a process that might be compared to a domestic arrangement, i.e., "cohabitation without benefit of ceremony". At the present time, the Navy has no responsibility to furnish any forces, no matter how urgently needed, to the air defense organization. Since the air defense of the United States is not a primary mission of the Navy, only those forces for which it has no other immediate use need be made available to the air defense commander, and this on a day to day basis. The lack of high level guidance and directives seriously reduce the effectiveness of the naval augmentation forces.

The weapons system employed by ADC is, from a materiel or logistical standpoint, quite compatible with those of the Army and Navy. The warning network is of value to everyone and employs radar, picket ships, radio and telephone which are integral pieces of equipment in the other services. Although the fighter aircraft are designed for air defense operation, they are suitable for employment in the tactical phase of attack once the long range offensive of the enemy has been blunted.

Air Force. The failure of the Air Force to successfully integrate available defensive forces of other Air Force commands into the air defense picture does not mean that our Air Defense Command mission is incompatible with our other Air Force missions. The problem of augmentation forces offers tremendous opportunities for obtaining more defense per dollar within the framework of the programmed air defense system.

The System Itself. Within itself, the present concept of the Air Defense system permits complete compatibility. Only proper planning can result in the achievement of this goal however. The mutual tolerance of interceptors, missiles and guns must be increased. The time phasing and capabilities of the components must be balanced. For example, aircraft numbers and capabilities must not be permitted to outstrip the capabilities of the detection and control equipment.

CONCLUSIONS

It is evident that the type of analysis that has been made does not go into the details of deployment around each selected target area. We feel that any juggling of forces that we might suggest could not have any appreciable effect on the total probability of kill. Our approach is, therefore, to see what major deficiencies the analysis points up, and to examine the broad concepts involved in the system development.

The major deficiencies, in our opinion, are as follows:

1. In terms of the USAF air defense mission concept, the system cannot do the job. The kill rate is too low.

2. The stated kill effectiveness of the system must be considered as optimistic and used with prudence. We believe the assumption that measures by the defense will offset enemy ECM capability is unrealistic. Further it appears to us that the gravity of the ECM problem is not fully appreciated outside of the circle of electronic specialists.

3. Obtaining and maintaining system reliability is a serious problem which will require continuing assessment and anticipatory actions.

4. An all out effort is needed towards obtaining an automatic system of identification.

Now let us examine some of the broad concepts. First of all, we believe that some amount of air defense is needed. This is a concept which we fully accept. Any questions must therefore concern the nature of that air defense.

The basic approach to air defense is the same today as it was in World War II. Equipment improvements have been made but the techniques have remained substantially unchanged. In World War II the objective was to get a kill rate which would make the raid unprofitable to the enemy. That is, in effect, our objective today, but atomic weapons have completely changed the magnitude of the problem. Stated as a concept, success or failure of the air defense mission is predicated on kill effectiveness.

Unfortunately, the kill effectiveness required by the mission is not a static function, but increases with the increase in enemy capability. Using General Smith's criteria, we must then produce four interceptors for each enemy bomber produced. Additionally, we must improve other parts of our system to offset enemy improvements in bomber performance. The net result is that we end up in a numbers racket approach and we are losing at the game. Further, we are building up a system that has no apparent capability to deal with the long range missile problem.

As has been pointed out, we feel that a cost vs kill curve which deals with a system that will provide the necessary kill effectiveness, would not be linear. It would more probably take the shape of an exponential. The question in our minds is, can we afford the cost of maximizing all four parameters in the total kill probability equation? The record shows that, at our present rate of progress, we will never get there. Perhaps our approach is too obvious. It may be that a fallacy exists in the concept of trying to maximize total kill probability. If this reasoning has any merit, it appears that we should settle on a carefully arrived at kill probability, and maximize warning time. We believe that this is an approach which merits study.

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