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SHAPE

STUDY ON AIR DEFENCE

IN

THE NATO AREA OF EUROPE

OCTOBER 1954

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SHAPE/626/54
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23 October 1954

SUBJECT: Report on Air Defense of the NATO Area of Europe

TO : The Standing Group
The Pentagon
Washington, D. C.

1. The study requested by the Standing Group in TOSHAP 569 of 19 February 1954 has been completed and is attached.

2. The importance of an effective air defense needs little amplification. The vastly increased atomic and thermonuclear destructive weapons which will be in Soviet hands by 1957 gives increased urgency to the need for defense against Soviet attack, or the threat of such attack. This necessity must not only include the measures for active defense, but must have coupled with it adequate measures for passive and civil defense.

3. The deficiencies now existing in air defense are not difficult to isolate and pinpoint. The difficulty lies in recommending measures to provide an adequate air defense. These are twofold:

a. Scientific research and development have not yet overcome, from the standpoint of the defense, the advantages which the offense possesses, particularly when these are coupled with atomic and thermonuclear weapons. It may well be that the time will come when these offensive capabilities can be successfully countered, but according to the information available to SHAPE, such a result cannot be expected prior to 1 July 1957, the limiting date prescribed by the Standing Group for this study.

b. Under present concepts, and using presently available means, methods and weapons, the provision of sufficient materiel and personnel to provide even a limited defense for all critical areas and installations, would involve a financial and manpower burden beyond the ability of the NATO nations to carry. The best that can be done under present circumstances is to take steps to insure that such defensive resources as we now have, or expect to have within the next several years, are deployed, organized and utilized in the most effective and efficient manner possible.

4. During the preparation of this study, much detailed staff work and considerable consultation with Subordinate Commands of SHAPE and with national authorities has been undertaken. This has high-lighted the lack of understanding which exists in many quarters of basic principles which are essential to effective air defense.

5. For this reason, the basic principles of air defense have been set out in Section V of the study as background to the assessment of the present situation and our capabilities as described in Sections VI and VII. It is clear that we have virtually no effective air defense at this time. We are weak in forces and resources and we are operating under a system of divided responsibilities between NATO and national forces which prevents those resources that are available being used in the most effective manner. The overriding requirement, therefore, is to evolve a form of unified command responsibility which will correct this deficiency.

6. In evolving such a system of command and in formulating plans to give effect to it, it is essential that in addition to making the best use of resources now available, we should also build a framework within which future developments can be included as they become available. I am considering in particular, new radar equipment and techniques with greatly improved effectiveness, which are now becoming available, the conception of a more forward future strategy which opens the field for a re-examination of the whole of our currently planned radar layout, and the advent of guided missiles and more effective fighter aircraft.

7. These developments all form parts of a picture which is changing current conceptions to a marked degree. Forward planning for air defense, is, therefore, a complex technical problem which must be undertaken by officers with a wide background of experience in this field, who are thoroughly familiar with current developments and who have access to the best scientific advice which our NATO nations can provide. The existing staffs within SACEUR's command are inadequate for this work. The general outline of the system envisaged is set forth in paragraphs 134 and 135 of the attached study, but the formulation of detailed recommendations must await future detailed study by experts.

8. The imperative immediate step, therefore, is to establish a small group of officers at SHAPE with ability and experience, to undertake detailed studies in this field and to prepare for SACEUR specific recommendations concerning the establishment of an air defense command organization in Europe. It is estimated that initially some 12 additional officers will be required for this task. Action to authorize an increase in the overall personnel ceiling for Allied Command Europe for this purpose is required at once.

9. A breakdown showing my proposals for rank, service and nationality for these additional officers, as well as detailed requirements for additional administrative and clerical support, will be submitted as soon as possible following approval in principle by the Standing Group. I have also asked my Commanders-in-Chief for their proposals concerning the organization of similar small staff groups at their headquarters. My recommendations in this respect will be forwarded at a later date.

10. I therefore now recommend:

a. That approval in principle be given to the concept that the successful development of an acceptable air defense capability for Continental Europe requires as a first step the early creation within my area of a system of unified command responsibility under SACEUR generally along the lines set forth in Paragraphs 134 and 135 of the attached study.

b. That the Standing Group authorize forthwith an increase in the SHAPE personnel ceiling to cover the establishment of a small group of Air Defense experts (initially 12 officers and 8 other ranks and civilians). I plan that this Air Defense Group will be headed by an officer of Air Commodore or Brigadier General rank.

(signed) ALFRED M. GRUENTHER
General, United States Army

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STUDY OF THE AIR DEFENSE OF THE NATO AREA OF EUROPE

INDEX

CHARTS

A STUDY ON THE AIR DEFENSE

OF THE NATO AREA OF EUROPE

REFERENCE: TOSHAP 569 - 19 February 1954.

I. - INTRODUCTION

1. In message TOSHAP 569, the Standing Group requested that a comprehensive study be prepared, covering all aspects of the air defense of the NATO area of Europe, on which recommendations to NATO and national authorities could be based.

The Standing Group stipulated that: "While it will clearly be necessary to make a theoretical study of force requirements, the main aim should be to produce a capabilities plan of the most effective pattern of air defense within the resources generally envisaged in the 1953 Annual Review and in consideration of available intelligence and risk estimates. The study should evaluate the efficiency of the air defense of the 'NATO area of Europe' and make recommendations for increasing the efficiency thereof. It should cover the period from now until 1 July 1957."

2. Four new factors give major importance to the problem of air defense:

a. The introduction, on a large scale, of atomic and thermo-nuclear weapons.

b. The advantages which a determined enemy could obtain by a surprise atomic attack.

c. The vital necessity that our own capabilities, and in particular our atomic offensive capabilities for SACEUR's air counter-attack, should survive.

d. The increases in speed, range, altitude of modern aircraft capable of carrying an atomic warhead.

3. In the constant struggle between offensive and defensive weapons, air defense now faces increased difficulties of detection and interception:

- A single aircraft alone at low altitude or concealed at high altitude in a coordinate diversion operation can inflict, with a single atomic bomb, more damage than a powerful formation of conventional bombers of the 1944 type.

- The area of the rear is vulnerable from all directions:

Air Defense system can no longer be compartimented by geographic fontiers, especially in the case of Western Europe.

Long range ground-to-ground, air-to-ground missiles will soon make the problem still more difficult.

4. Therefore, Air Defense is a complex problem, in which inexpert guidance could lead to enormous expenditure with inadequate returns. For example, current developments in radar and the potential developments in guided missiles may produce profound changes in air defense and our plans must therefore be sufficiently flexible to permit incorporation of such developments into the system with the maximum ease and efficiency.

SHAPE is keenly aware of the difficulty of carrying out extensive changes which would result from recommendations for the replacement of current equipment by large quantities of more modern weapons and equipment. Any air defense system proposed must make the best possible use of the facilities, means, and equipment now available or easily obtainable.

5. The present air defense system in the NATO area of Europe is seriously deficient. Its weaknesses are set out in the study, together with recommendations on the stages necessary to overcome them. The first steps toward improvement are:

a. To create proper air defense staffs at appropriate levels.

b. To obtain the maximum effectiveness at H-Hour on D-Day from the existing capabilities.

6. However, it must be understood that air defense must essentially be a part of the overall military war establishment and cannot be considered separately.

7. The arrangement of the study is as follows:

I. Introduction.
II. The Threat.
III. General Characteristics of the NATO area of Europe in respect to Air Defense.
IV. Critical Allied Targets.
V. Fully Developed Air Defense System.
VI. Analysis of the Air Defense System in the NATO Area of Europe as it Exists and its Deficiencies.
VII. Capabilities.
VIII. Recommendations, from now to Mid-1957.

II. - THE THREAT

SOVIET OBJECTIVES AND CAPABILITIES

8. SHAPE considers that for the period under examination (1955-1957) the Soviets:

a. Have the physical capability of launching a war against the West at any moment.

b. Have the initiative.

c. Can be expected to exploit surprise. Analysis shows that this would be the optimum course of action for the enemy. In this case, as warning would not be given either by mobilization or by redeployment of Soviet forces, an attack could find the Allies in a situation close to that existing in peacetime.

d. Will probably use atomic weapons in their surprise attack. Moreover, the possibility of chemical and biological warfare cannot be excluded. Whatever types of explosive or method of contamination is used, it may be transported by means of guided or ballistic missiles.

e. In the initial action against the *NATO Area of Europe, the Soviet will probably aim at the destruction of offensive Allied Air Forces and atomic resources. Simultaneous attacks will probably be made on targets of somewhat lesser importance to the initial battle, such as conventional forces, centers of population and industry, and lines of communication.

f. Will probably make a main effort in Europe against the Central Theatre.

g. Will have about 10,000 aircraft available for use against the NATO Area of Europe (the efficiency of these air forces has been estimated as relatively comparable to that of the Allies).

Chart A illustrates the Soviet air threat in terms of radius of action of the various aircraft types available to the Soviets.

SOVIET STRATEGIC CAPABILITIES - MID-1957

9. It is considered advisable to list some of the enemy's strategic air resources, in addition to the forces mentioned above. It is estimated that:

The Soviet Strategic Air Forces have some 900 aircraft facing Western Europe, of which it is assumed that approximately 10% will, in the first 15 days, be directed against targets within the *NATO Area of Europe.

The Soviets will probably earmark a substantial, though limited, stock of atomic bombs for attacking targets in the *NATO Area of Europe. Most of these bombs would be used during the first 15 days of hostilities.

The Soviets already possess aircraft capable of delivering atomic and thermo-nuclear bombs - and they will be increased and improved by 1957. These aircraft are probably equipped for navigation and bombing in unfavorable atmospheric conditions. The degree of accuracy attained would be approximate to that of Allied formations.

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* As defined in para 14. below.

SOVIET GUIDED MISSILE CAPABILITIES

10. Little is known about present Soviet capabilities and resources as regards missiles to be available during the period under consideration (1955-1957), but, by analogy with our own resources, they are a serious threat. The information available to SHAPE suggests that the following weapons might be used against targets in Western Europe:

a. Air-Ground Missiles: Slightly improved versions of German operational air-ground missiles of the HS 293 and FX 1400 types, and possibly a subsonic rocket-propelled glide bomb, with remote control and automatic steering.

b. Ground-Ground Missiles: V-1 type missiles with a range of 200 nautical miles (360 KM), somewhat more accurate than the German V-1 and possibly missiles of the "pilotless aircraft" type. It must also be expected that improved V-2 type missiles will be used; they will have a range of 350 nautical miles (650 KM) and a 2000 lb. (could be atomic) warhead, and will be accurate enough for attack within a theatre.

c. Ground-Air Missiles: Supersonic all-weather remote-control missiles with a range of about 24,000 yards and a maximum altitude of 55,000 feet.

d. Air-Air Missiles: A supersonic beam-riding missile with a range of up to 10,000 yards.

POSSIBLE FORMS OF ENEMY OFFENSIVE ACTION

11. The enemy capabilities are characterized by:

Total initiative (surprise and choice of moment).

A highly developed Intelligence System (facilitating precision of attack).

Considerable resources for attack (with the possibility that an attempt will be made to swamp the defenses).

Personnel and equipment that can be used on "no return" missions if this form of attack proves advantageous.

12. It is likely that the enemy would try to obtain the utmost benefit from these various possibilities. He may therefore mount his attacks in the following ways:

Medium and low level attack by aircraft and ground-ground missiles on troops and fixed installations in the combat zone.

High-altitude attack on targets in the rear. This might be made either directly or by by-passing at varying altitudes the areas covered by Allied control and reporting installations.

Offensive "no return" missions made in order to use the range of his light aircraft to the maximum. For example, there probably are a large number of MIG 15's which, in two or three years from now, will be obsolete for interception and which could be equipped to carry atomic projectiles to the end of their endurance, the pilot bailing out after his attack.

These various offensive capabilities would be combined in time and space in order to:

Saturate the Allied warning radars and ground control installations (control of friendly interception forces) by attacks carried out by a large numer of small groups of aircraft or isolated aircraft.

Hamper and mislead the defenses by a diversity of routes, varying the altitudes and time.

Jam control and reporting radars and command channels by using air and ground radio and electronic jamming equipment.

Exploit the difficulties of the defense by making the maximum use of penetration routed to circumvent Allied warning and through areas with poor watch and warning coverage, e.g., by flying over Norway or Turkey, expecially in the event of a surprise attack.

13. The examination of enemy capabilities and of Allied resources for defense and counter-attack emphasize the difference between the opening hours of hostilities (in the event of surprise attack), and the subsequent operations. In peace, the Allied control and reporting system cannot be regarded as effective in detecting hostile activity beyond the Iron Curtain; but in war its effectiveness is immediately extended to its physical range. The state of alert of personnel and readiness of equipment, the deployment of the forces, and the state of alert of the radar zones, would be very different at the time of a surprise attack from their state later on. Moreover, it is obvious that on both sides some decrease in effectiveness must develop as the result of the first attacks. The defense must therefore be organized with due regard to two very different situations:

a. An attack on D-Day.

b. The operations following the initial enemy attack.

Of these, the D-Day surprise attack gives rise to the most critical situation.

III. - GENERAL CHARACTERISTICS OF THE NATO AREA OF EUROPE CONSIDERED IN RESPECT TO AIR DEFENSE

14. The Standing Group requested "a comprehensive study covering all the aspects of the air defense of the NATO area of Europe".

The NATO area of Europe includes the United Kingdom, Portugal, French North Africa, as well as SACEUR's command area (Allied Command Europe). The sea areas of Channel Command and SACLANT, both NATO Commanders, are also of importance in considering the air defense of the NATO area of Europe.

While it is obvious that close coordination must exist with SACLANT and Channel Command in the interest of mutual support, no attempt has been made to study in detail the air defense situation in the areas of the other NATO Commanders.

The defense of the United Kingdom is a national responsibility and as such has not been studied in detail; nevertheless its importance and the necessity for its coordination with Continental air defense is obvious. General conclusions to this end are included, and discussions with the United Kingdom defense authorities are in progress.

Portugal, lying in SACLANT's area, is isolated from the location of SACEUR's greatest threat. A close study of this problem has not been undertaken at this time.

In addition, the air defense of the NATO area of Europe invelves a careful appraisal of the situation in such non-NATO areas as Sweden, Switzerland, Yugoslavia, the Levant, and Spain. The importance to an adequate air defense of these non-NATO areas has been noted and commented upon but the status of air defense in these areas and the practicability of obtaining assistance to NATO has not been examined in detail, although the importance of these areas to the defense of the NATO area of Europe has been recognized in the study.

Therefore, while the necessity for coordination with adjoining NATO and national commands, and the desirability of cooperation with certain adjoining non-NATO areas has been examined and commented upon where appropriate, the study has paid particular attention to and has laid its main emphasis upon the following area:

> Norway and Denmark (including their coastal waters); the Skagerrak; the Kattegat; the Sound and Belts; the Baltic (including its southern littoral); Western Germany; France; Belgium; the Netherlands; Luxembourg; Italy (Sardinia and Sicily); Greece; Turkey; the whole Mediterranean and Black Sea; the approaches to the Straits of Gibraltar eastward of Longitude 5° 26' west.

For this reason the term "NATO area of Europe" has been used throughout this study with reference to this limited area only.

Chart L shows in graphic form the areas of air defense responsibility in Europe.

15. Northern Europe Command

a. Norway: Norwegian territory forms the left wing of the Allied layout. Geographically, the main feature of this territory is its length and the slight depth which it allows for a defensive organization, especially in the north. The geographical and political position of Sweden makes the problem complicated, particularly in case of a surprise attack. As regards climate, Norway is characterized by an Arctic climate in the North and by atmospheric conditions which are often unfavorable in the South.

The terrain also makes the spotting of low-flying aircraft more difficult. A carrier-borne air effort from SACLANT has been planned in support of operations in Northern Command. Although this adds depth to the air defense system in this area, it will probably not be available during the first fifteen days of operations. This may well be the critical period during which the enemy makes an all-out effort to overwhelm the air defenses of Northern Command.

b. Denmark: The essential point as regards the Danish land, sea, and air space is its proximity to the sources of the enemy offensive threat. In the event of a surprise attack, warning of the attacking forces would be given at too short a distance for the alert to be implemented in sufficient time to be effective. A detailed study of the defense of the Danish peninsula and islands shows that, even with interceptors of very fast climbing speed, the forward interception lines would be behind the essential enemy objectives in this theatre. In later operations, the reporting and ground control installations on the island of Bornholm could play a decisive role, but the survival of these installations is problematical. Therefore, the first point to be stressed in regard to Denmark is the necessity for setting up at the earliest possible moment an effective Control and Reporting organization and in particular "Y" service. Moreover, the situation of the Danish territory in the face of the enemy threat makes necessary a review of the forces responsible for its defense. Some of the first batteries of ground-to-air missiles should be considered for deployment there, as soon as they are available in Europe.

c. Considering the Northern Theatre in relation to SACEUR's entire area of responsibility, it is necessary to provide, not only the requirements for the protection of that theatre against direct attack, but also those which could assist in covering the rear areas, namely the coastal area of the North Sea and Channel, and provide warning for the British Isles and the Central European area. The warning obtained from the radar installations situated in the Northern Sectors should contribute to the detection and interception of enemy strategic air formations which might use this route to reach objectives in other Allied theatres of operations

d. The general characteristics of the Northern Europe Command may be summarized as follows:

(1) There is a lack of depth in Norway and the enemy offensive threat is poised on the threshold of Denmark.

(2) The depth in Norway can be considerably increased by using the Swedish control and reporting system.

(3) The control and warning system covering the British Isles can contribute to the detection of enemy aircraft using circuitous routes to other Allied theatres.

(4) It requires all-weather interceptor aircraft of high climbing speeds.

16. Central European Command

a. The Central Theatre is characterized by a certain degree of depth, which should facilitate its air defense. The full depth of the theatre can, however, only be exploited when the forces there are strong enough to adopt a forward strategy. The present strategy does not permit the permanent deployment of our permanent radar system towards the eastern limits of SACEUR's command area.

b. From the topographical point of view, the Northern Plain of Europe offers good possibilities for the detection of enemy aircraft at medium and high altitudes. On the other hand, the terrain of the southern part of the Central Theatre, and the neutral position of Switzerland, may create a gap in the early warning and cover system.

c. From the climatic point of view, the prevailing atmospheric conditions of the Central Theatre make necessary a combination of day and all-weather interceptors.

d. The Central Theatre is also characterized by the territorial divisions which result from its political structure. At the present time, its defensive system is based more on the adding together of the national defensive organizations than on their integration. Better coordination is necessary. Moreover, the size of the land forces deployed in this zone makes necessary the assignment of a large number of fighter bombers, which can, with severe restrictions, be used for air defense. Depending on the combat situation, adjustments must be made between fighter forces assigned to destruction of the enemy in the air and those allotted to ground destruction.

e. The general characteristics of the Central Theatre may be summarized as follows:

(1) It has considerable depth if a forward strategy is adopted.

(2) Its territorial compartmentation adversely affects the efficiency of its defense and this factor should be progressively reduced in order to increase the overall effectiveness.

(3) It requires interceptor aircraft of very fast climbing speeds and also all-weather interceptor fighters.

(4) It contains a strategically important forward area (troop deployment area), the protection of which cannot be ensured by aircraft alone, but which requires the employment of anti-aircraft and missiles for active defense.

17. Southern Europe Command

a. The Southern Theatre constitutes the right flank of the Allied position. It is characterized by its length of more than 4,000 kilometers (2,500 miles) and the nearness to the enemy of its essential targets.

From the standpoint of climate, its atmospheric conditions are generally more favorable to air operations than in the other zones.

The study of Air Defense for this theatre is complicated by a number of unknown factors and deficiencies. For example, the protection of the Italian territory does not have, at the present time, the advantage in depth which it could derive if the Yugoslav defense organization were directly associated with the defense of Western Europe.

The vital areas of the Bosporus are near enemy bases and hence cannot be effectively defended by active conventional means. The enemy could also adopt a "rear strategy" and circumvent the Turkish warning net by flying over Iran, Iraq, and Syria.

Because of the great length of this zone and the number of adjacent territories which could contribute to its protection, a great deal of coordination is necessary.

b. Italy: Both geography and the political situation are unfavorable to air defense of Italy. The mountains on the north, the narrowness of the Italian territory in its central and southern parts, and the absence of any defense coordination with Yugoslavia and the possible threat from Albania, are all causes for concern. In the event of a surprise attack, it may be feared that enemy formations would approach the eastern shore of the Italian peninsula before active defense measures could be put into operation..

c. Greece: In the face of the enemy threat, Greece is in a position as unfavorable as that of Denmark. The whole northern part of Greece's territory is situated beyond the advance interception line. The deployment of the land forces required to meet an enemy thrust from Bulgaria cannot be effectively protected by active air defense methods. The existing signal equipment is inadequate.

d. Turkey: The most important key-points of the Turkish territory are located in the northwestern and western parts of the country. The Straits are in such proximity to the enemy air bases that they cannot be effectively protected by interceptor fighters, whose most forward contact lines pass south of the Bosporus and the Dardanelles.

Western Turkey's port area is also difficult to defend, both against enemy air action and against ground-to-ground missiles.

In Central Turkey, the Black Sea facilitates the organization of both high and low altitude radar warning.

In the East, the mountains make early warning more difficult, but the targets located in that area are of comparatively limited military importance.

In the event of a surprise attack, it is probable that most of the key targets could be reached before the active defense could get into action.

Turkey is separated from the air forces based in the Middle East by countries whose air space could be traversed without any alarm being given. Close coordination between defense systems existing in Turkey and Cyprus should be organized in order to reduce the enemy's possibilities of penetrating the Turkish position from the rear.

e. Summary

The general characteristics of the Southern Theatre as regards air defense may be summarized as follows:

(1) The protection of the areas most directly threatened, because of their proximity to enemy air bases (Northeastern Italy, Northern Greece and the Turkish Straits, is not ensured. This protection should be made possible by the installation of anti-aircraft defenses and surface-to-air guided missiles with priority concentrations around the key points of these forward areas.

(2) The insufficient depth available to most of the territories of the Southern Theatre indicates the need for interceptors whose performance includes a very fast climbing speed.

(3) Coordination of air defense is especially necessary in the Southern Theatre - coordination between the defense system of Northern Italy and the French area of Marseilles; coordination between Greece and Southern Italy for threats coming from Albania; coordination between Greece and Western Turkey for the protection of AFMED convoys; coordination between CINCSOUTH, CINCAFMED and North Africa; and, finally, coordination between the Turkish defensive organization and that of the British in the Middle East.

The above measures relating to the land-based defense organization should be reinforced by all possible measures tending to improve the air defense capabilities of the convoys at sea in the Mediterranean.

18. Mediterranean and Black Sea

AFMED is responsible for the lines of communication through the Mediterranean and the Black Sea. From the air defense point of view, these communications are particularly vulnerable in the Eastern Mediterranean. The main responsibility for air defense lies on neighboring national air defense systems plus Gibraltar (UK), MEAF (UK), and national systems covering the convoy terminals. The main adjustments requiring attention are:

a. Closest possible tie-in of arrangements with CINCSOUTH and national air defense forces.

b. CONSHIP/CONSHORE procedures perfectly agreed and understood between AFMED and all NATO and national agencies. This implies complete agreement on communications and on routing of aircraft. Fighter direction facilities are necessary in cruisers at least.

c. Provision of jet fighters for carriers.

d. Installation of improved anti-aircraft equipment aboard ships for the protection of convoys at sea.

IV. CRITICAL ALLIED TARGETS

Priority Targets for the Enemy

19. The enormous destructive power which one single aircraft can carry over long distances has changed the conditions governing offense, and as a result, also those governing defense.

However, the enemy's stock-pile of atomic weapons is not unlimited, and he must lay down an order of priority in his selection of targets.

20. The known Allied determination to strike an immediate counter-blow to any act of aggression leads to the conclusion that the enemy, considering that the conflict would be waged on an atomic basis, will, in initiating hostilities, endeavor to deliver an extremely powerful surprise attack, utilizing all means at his disposal.

On this likely, and in any case most dangerous assumption, the enemy's No. 1 target would necessarily be the elimination of the Allied atomic forces.

21. It is possible that the enemy might find it politically wise and adequate to intimidate, by threats, those capital cities and centers of population in Western Europe which he would later hope to occupy and absorb.

Similarly, as long as the enemy only has atomic weapons in limited quantities, he might at the beginning neglect certain secondary port installations or those which are not initially sheltering convoys.

22. Following on the above considerations, it would appear that the military targets which would initially seem to be the most probable ones for the enemy in a surprise atomic attack against the NATO area of Europe can be broken down as follows:

- Atomic Potential (in a first priority).

- Major Command Posts, Signal Centers, and Combat Forces.

- Strategic Centers, Lines of Communication. and Major Ports.

Restrictions on Enemy Capabilities

23. A quantitative study of targets vital to the whole of the NATO area of Europe shows that, in order to obtain by surprise a decisive result, the enemy would need to possess a large stock of atomic weapons.

It would seem that, during a period from 1954 to 1957, the enemy's atomic capabilities would not be adequate to attack the number of Allied targets the destruction of which would be essential to ensure him rapid success; but his atomic capabilities may increase. It is therefore absolutely necessary that an ever-increasing number of installations and areas vital to the Allied war effort be afforded at least a measure of protection.

24. As has been demonstrated by the analysis in SACEUR's Capabilities Plan (SHAPE/330/54), it would be difficult, if not impossible, for the enemy to carry out his attacks against all Allied atomic delivery forces simultaneously without at least one of the sectors of the Allied theater receiving advance warning of attack. Therefore, there is a requirement for a system for immediate exchange of information to be set up, not only at the SACEUR theatre level, but in respect to the entire Allied atomic air deployment.

25. Mobile forces must depend for their protection largely on their mobility and dispersion.

Static targets can only be defended by a forward defense system, but they must be given a strict order of priority.

The Importance of Passive Defense

26. Whether mobile or static targets are considered, their passive defense will henceforth assume increased importance in this atomic age.

V. - A FULLY DEVELOPED AIR DEFENSE SYSTEM

27. Air Defense is an integral part of the overall air campaign. The aim of those forces and resources specifically allocated to air defense is to prevent interference by hostile air action with the conduct of the war. This is achieved by.

Active measures which aim primarily at destroying the enemy in the air and so prevent attack, and

Passive measures to minimize the effects of the attack.

28. An active air defense is an integration of specialized air forces, anti-aircraft guns, and guided missiles, radar, radio, landline communications, radio counter-measures, and skilled ground observers working in the closest possible harmony.

29. The Control and Reporting system in the ideal air defense must consist of a continuous radar chain along the entire boundary of the area to be defended and must cover the area in depth with reserves.

a. Reporting. This radar, in conjunction with the Ground Observer Corps, provides the maximum period of warning of enemy air attack at all heights and must also contain the radar intelligence component to classify the enemy air build-up. The information obtained must be filtered to sort out hostile from friendly plots and so enable the commander to meet and destroy the enemy and to hand on warning of air raids to the Civil Defense Organization and to industry. This constitutes the reporting component.

b. Control. The radar system must then provide the control capability to enable the IDF and AWX aircraft to intercept the enemy raids and return to base.

30. Time Factor. Time is the most important factor, e.g. for enemy aircraft every second means a penetration of at least 200 yards. Some minutes are needed before a fighter can be sent off or a gun or missile fired. Therefore, every effort must be made to reduce this time lag to a minimum.

31. Low Cover. Generally speaking, at the lower altitudes, the value of radar for detecting and tracking high-performance jet aircraft is unsatisfactory. In view of this fact, it is essential that some method of detecting and tracking low-flying aircraft must be available. The most efficient system for this operation still depends on the Ground Observers who pass their information through a filter system to the Sector Operations Center (SOC).

32. The air traffic control organization has to be tied in very closely with the air defense system.

Electronic Counter-Measures Organization

33. The threat from enemy jamming of radar and radio, though of a different kind from the low raid, is an equally serious one. The Electronic Counter-Measures (or Defensive Radio Warfare) Organization is designed for:

a. Identifying the enemy "jammers" from among the total enemy raiding forces, singling them out, and destroying them.

b. Active jamming of enemy radar and radio.

c. The use of decoy and "spoof" navigation aids combined with interceptors and anti-aircraft.

34. Layout of the System. Radar siting must be such as to obtain the

best results from the equipment and in addition must be arranged on a plan which is interdependent with the siting of aircraft bases. The layout of the system must cover all key-points and important vulnerable areas, and these must be adequately defended both from air and ground attack. Centers of command and control must be adequately protected, and, if possible, underground.

35. Interception lines. The aim must be to produce effective interception at the maximum distance ahead of the target area.

36. The deployment of interceptors to fix a forward interception line is an important part of the planning of an air defense system. It is regulated by the following main factors (see Chart B):

a. Range and capacity of radar.

b. Performance of enemy bombers.

c. Performance of our interceptors, particularly time to height and forward distance covered in the climb.

d. Time from first warning to scramble (identification, filtering, appreciation, transmission of orders). This is generally several minutes at best. See Chart C for a graphic presentation of this problem.

37. This time, considered in miles of enemy penetration from the position of first warning, plus the forward horizontal distance covered by the IDF to reach the bomber's height, plus the additional enemy penetration during the IDF's climb, plus a small margin for interception and first attack, gives the ideal distance of the IDF base from the point of first warning to intercept a given raid at a given height. The line joining these ideal IDF bases is called the base line.

38. Preparedness. Efficiency of an air defense system depends on its ability to operate on a 24-hour basis per day, at short notice. It is particularly important that the system be capable of meeting the first enemy attack, which may well be a surprise attack or attack with very little warning, and of inflicting the maximum destruction on it before the target is reached. Therefore, those components which cannot be fully manned in peacetime to meet this requirement must at least be so manned as to be able to keep the whole system working effectively until manning deficiencies are made good by mobilization. This demands a high standard of mobilization efficiency and of training of the regulars and reservists involved.

39. Command. The essential principle for efficient control of air defense forces is to have an air defense headquarters and an air defense commander controlling the largest area that communications, equipment, and the range of warning systems and weapons makes it practicable to control from one headquarters. Air defense forces are operating against an enemy who has the advantage of strategical and tactical flexibility in time and space. The wartime responsibility of this headquarters is to ensure the closest coordination between the various elements of air defense, to ensure economy of forces in meeting any particular attack, to ensure quick reinforcement of heavily engaged sectors and to coordinate radio warfare and radio counter-measures. In peacetime this headquarters would be the principal source of advice and planning in the building up and training of the component parts of the air defense system, and of associated passive defense measures throughout the command area. This command headquarters would require an air defense operations center.

40. The Sector and the Air Defense Command. The control system or chain is based upon the "sector" which forms the basic building block and constitutes the largest space over which one commander can exercise operational control of the minute-to-minute air defense battle. This is the basic consideration. Other considerations that affect planning are the

size of forces, their radius of action and performance, and especially the efficiency of communications. Broadly speaking, there should be sufficient depth in a sector to allow the control and reporting system time to operate and to allow the interceptor fighters enough horizontal distance to suit their performance in reaching the height of the enemy raid. The boundaries of sectors will take national considerations into account as far as possible. The sectors in the NATO area of Europe are at present grouped within geographical areas which conform closely to the command area of Allied Subordinate Commanders-in-Chief, now already set up within Allied Command Europe. (See Chart G for the present sector arrangement.)

41. Main Responsibilities of the Sector Operations Center. The Sector Operations Center is the organization responsible for:

a. Plotting, recognizing and passing information on enemy raids from minute-to-minute to all concerned.

b. Operational control of air defense forces of all kinds and coordination of all measures necessary within the sector area to destroy the enemy raid before it reaches the target.

An attempt has been made in Charts D, E, and F to show diagrammatically the functions performed by the Sector Operations Center and its components.

42. The Sector Operations Center, with its ancillaries, contains all the facilities for plotting and display of information; the controllers and communications for controlling air interception within the Sector; the facilities for coordinating the activities of the anti-aircraft units in the Sector; the Ground Observer Liaison; and other means of air defense both active and passive. Everything is arranged for speed in assessing the threat of an incoming raid and speed in countering such a threat. The Sector Commander has full authority to request assistance from neighboring sectors; if necessary, through the Air Defense Operations Center. Thus, it is the Sector Commander and his organization in which the communications, Control and Reporting System, Intelligence service, etc., are all brought to a head so that he can actually conduct the air battle in the area for which he is responsible.

43. One of the greatest difficulties facing an air defense system is that of continuous plotting and controlling of IDF on to low-flying raids. The low-flying hostile aircraft is a very serious threat since it is operating below effective radar height and continuous plotting becomes very difficult. For this reason, the Sector Operations Center and the Air Defense Operations Center should contain separate internal organizations for dealing with this problem.

44. The organization to fight the low-flying raid depends on the following:

a. An efficient Ground Observer Corps, or electronic detection methods if these can be developed by the scientists.

b. Very high frequency (VHF) "carpet cover" or high-power VHF transmitters to control our IDF at low altitude.

45. Communications. In order to effect smooth functioning of the system, communications must be complete, thoroughly efficient and, as far as possible, automatic, to avoid human error and difficulties of language.

46. Anti-Aircraft Defense. Definition: Anti-Aircraft defense is taken to include all surface-to-air projectiles, whether free or guided. In view of the development of surface-to-air guided projectiles, the anti-aircraft defenses will take an increasingly important part in the whole pattern of air defense. This may necessitate far reaching changes in Command Structure and organization.

47. Command Structure with Existing Equipment. The anti-aircraft command should be integrated at every level into the general air defense command structure. Anti-aircraft commanders at every level should have direct command of anti-aircraft units allotted to them and of their technical support.

48. There will seldom be sufficient anti-aircraft forces available to defend all key areas or key-points which require anti-aircraft defense. This is the reason that key-points in each air defense region must be listed at the highest level in order of absolute priority for anti-aircraft defense. The deployment of the anti-aircraft defenses depends on the priorities allotted to key-points on agreed key-points lists.

49. Once the key-points for defense by anti-aircraft artillery have been established, each key-point must be the subject of a technical study to ensure the best deployment of the defenses.

50. Generally speaking, a balanced anti-aircraft defense based on the probable lethality of each particular weapon against each anticipated type of attack is required for every key-point to be defended, consisting of:

a. Light anti-aircraft guns for attacks at heights below about 4,000 feet.

b. Heavy anti-aircraft guns with modern electronic fire control equipment for defense against aircraft attacking at medium altitudes.

c. Surface-to-air guided weapons for defense against aircraft attacking above the effective AA gun range and for reinforcing the AA gun defense at all altitudes.

51. It is important that all anti-aircraft units be fully provided with modern equipment capable of effectively engaging any type of enemy aircraft within its height and range limitations.

52. Every key-point or key area which is allotted anti-aircraft defenses is organized into an anti-aircraft defended area (AADA). Once the anti-aircraft defenses have been deployed, the AADA's thus formed must be delineated, classified and promulgated to all Allied air commands interested.

53. Mobilization and Deployment of Anti-aircraft Defenses. All preparations should be made in peace so that the anti-aircraft defenses may be deployed and fully ready to go into action effectively before the first enemy air attacks develop.

54. Recognition. In view of the expected increase in efficiency of surface-to-air guided weapons, the problem of the recognition of raids must be fully solved; otherwise the anti-aircraft defenses will risk shooting down friendly aircraft and allowing hostile aircraft to pass through unengaged. Unless a full solution is found the effectiveness of the anti-aircraft defenses will be greatly diminished.

55. Training. If the full effectiveness of the anti-aircraft weapons is to be obtained, the men who man these weapons and the men who maintain them and repair them must be highly skilled; that is to say, fully trained. If reservists have to be used to man anti-aircraft defenses, a system must be found by which the standard of skill of these reservists is constantly kept up, so that the reservists may be able usefully to man their weapons to engage the first enemy air attacks. This entails a system of reservist training in peace.

56. Communications. Good communications are essential for the efficient working of any anti-aircraft defense system.

57. Technical Support. This includes:

a. Repair and maintenance services.

b. Ammunition supply.

58. Furthermore, it is essential that sufficient supplies of ammunition and of spare parts and equipment exist within reach of the defenses.

Passive Air Defense

59. Passive defense measures in a nuclear age are essential for survival. They are complementary to the active measures necessary in any successful air defense system. They include organization and equipment to minimize casualties and damage after an enemy attack. Passive defense measures to be examined in connection with SACEUR's forces are considered in the Capabilities Plan (SHAPE/330/54) and in the Program Recommendations (SHAPE/384/54) and are not further dealt with in this Chapter. The passive air defenses in the rear areas of the NATO area of Europe, including those areas under civil control in war, are also of very great importance.

60. The main passive air defense measures are the following: dispersal, camouflage, black-out, smoke, deception, fire fighting, gas warning, and de-contamination.

Civil Defense

61. Objects. The objects of Civil Defense are:

a. To keep open the essential supply routes and logistical installations which are vital to the conduct of the military operations.

b. To sustain the morale of the civil population under air attack in order to maintain their will to war.

c. To ensure that no assistance is given inadvertently by the civil population to the hostile enemy air forces in navigation or in locating targets which they wish to attack.

62. Organization. Civil Defense is a government matter and the organization should stretch down from government level to the smallest civil administrative units.

63. Cooperation with the Military Authorities. At every level of the Civil Defense organization, there should be close and continuing liaison between the civil and military authorities on all matters of Civil Defense.

64. Legislation. It is necessary in every country that legislation should exist to enable the creation and the maintenance of the Civil Defense organization in peace and in war.

65. Component Parts. The organization should include the following:

a. An air raid warden system.

b. A rescue service.

c. A fire service.

d. An organization for the control of refugees and evacuees.

e. Mobile columns which may be dispatched to the assistance of any vital center which has received such heavy air attack as to be unable to deal itself with the d mage.

f. Heavy repair organization ready to re-establish as quickly as possible vital communications and logistic installations which have been damaged by air attack.

VI. - ANALYSIS OF THE PRESENT AIR DEFENSE SYSTEM

IN THE NATO AREA OF EUROPE

66. The organization, role, and measures for command and control vary considerably between the various air defense forces in NATO area of Europe. Although a basic sector organization has been set up, linking these different commands (see Chart G), many of these sectors are only planned; and in many of those now in operation, because of the differences in organization and defiencies of forces in most respects, there are important discrepancies which should be corrected. (See Charts H thru R.) These are covered in the detailed examination which follows:

67. Before the air defense capabilities of the NATO area of Europe can be assessed, it is advisable to conduct a broad qualitative analysis of the existing air defense system. This will serve to illustrate the main weaknesses and will assist in developing a capabilities plan. In this analysis, the general pattern of the Fully Developed Air Defense System in Section V has been followed.

68. Control and Reporting System. The Control and Reporting System should be considered under three heads, as follows:

a. The system as actually on site, deployed, and manned.

b. The system on completion of the SHAPE 1956 Radar Plan. This plan is in an early stage of implementation.

c. The 1956 planned radar system as it might be improved by certain changes of sites and radars and re-appraisal of the type of cover required in certain areas.

Until the system planned for 1956 is completed, therefore, the Control and Reporting systems of the nations within NATO area of Europe and those of SACEUR's assigned tactical air forces do not meet the requirements of a properly developed air defense system. In the North, there is little radar, despite the importance of this area, and in the South, although an excessive number of radar units appear to have been planned, there is only early warning radar and little or no continuous cover.

The Ground Observer Corps organization for detecting and tracking low-flying aircraft is inadequate; in some areas, non-existent.

69. The filter and identification process within the planned control and reporting system will be slow and inaccurate since it depends on verbal information and manual displays. Further difficulties may arise through the apparently excessive number of planned reporting sources.

70. The planned method of high frequency broadcast will not meet the operational requirement for passing control and reporting information to shipping.

71. The existing communications for the exchange of information on plots between commands are inadequate.

72. In general, as outlined above, substantial improvement in the Control and Reporting System is feasible by the re-arrangement of currently planned facilities and by other means within our capabilities, which can be achieved without additional expense and perhaps at some reduction in cost.

73. Electronic Counter-Measures. Most NATO countries have neither the installations and equipment for electronic warfare, nor the corresponding training installations; further, they have no operational experience of these measures. This weakness may have far reaching effects in the future, because of the value of electronic counter-measures against enemy navigational aids, communications, radar, and remote control systems.

74. Interception Lines. The current inability to adopt a forward strategy in the Center, which would enable the permanent radar system to be established in depth extending close to the Iron Curtain, brings the base and interception lines so far westwards that certain areas of great importance such as land combat areas, main lines of communication, and ports, are exposed to hostile attack. Furthermore, in some areas, the lack of suitably located airfields precludes the establishment of ideal fighter baselines, while in the Center the planned deployment of fighter aircraft is such that ideal baselines for the various operating heights cannot be formed.

75. Preparedness. NATO forces are unprepared for sudden attack. The manning of the radar warning net varies from 24 hours in certain parts of the Central Sector to 8 hours in the North and 4 in the South.

76. Command. The current command organization is totally inadequate. Current and future developments of the enemy capability, both in air forces and modern weapons, emphasize the importance of placing the command organization on a broader basis.

77. The current Air Defense Command is characterized by the following weaknesses:

a. Lack of experienced and specialized Air Defense Staffs at major echelons of command.

b. Lack of regional defense commands with their communications and operational structure.

c. Lack of Air Defense Operations Centers.

d. Lack of coordination between Tactical Air Force Commanders and National Air Defense systems.

78. The political partitioning of the NATO area of Europe into areas of national air defense responsibility further limits the efficiency of the Allied forces, especially as certain of the areas to be protected are limited in size. A more liberal attitude is necessary towards the coordination of Tactical Air Forces and National Air Defense systems under centralized Allied control, to ensure the effective and economical use of resources, which cannot be achieved by the existing piece-meal organization.

Anti-Aircraft Defense

79. The integration of the anti-aircraft command structure with the general air defense command structure is incomplete, except in the lower echelons of combat forces. Moreover, the anti-aircraft command structures of the various countries are established on a national basis and effectiveness varies from country to country.

80. Anti-aircraft defense in the land combat zone is an Allied responsibility, except for key-points of national interest, which are a national responsibility.

Anti-aircraft defense in national territories is a national responsibility. In consequence, those countries, especially France and to a lesser degree Italy, in which Allied operational and logistic installations are located, carry a very large anti-aircraft defense burden because they have to protect not only their own key-points, but also Allied key-points on their own territory.

81. This burden is beyond the means of the countries concerned. In consequence, SHAPE has suggested (AG 1254 PPO, 31 March 1953) that the defense of Allied key-points located on national territories outside the land combat zone should be entrusted to user countries. This policy would

alleviate the burden resting on "host" nations. STAND 482 of 27 September 1954 places the responsibility for the provision of forces for the A.A. defence of military installations situated on national territory outside the land combat zone upon an agreement between the host and user nations. Until such agreement is reached and plans for A.A. defense are implemented the lines of communication and logistic installations of SACEUR's combat forces in Central Europe remain virtually undefended.

82. Key Points. The NATO committee for Civil Organization in time of war has issued NATO criteria for the classification of key points (AC/23-D/63). However, national authorities do not in every case adopt these criteria, with the result that lists of category 1A key points, in the case of several nations, are unrealistically long. Nor do all nations arrange their key points in an order of absolute priority for defense. Committees exist in the Northern and Central European Commands to coordinate the national and Allied key points in each area, but no such system exists in the South.

83. Mobilization and Deployment. A large proportion of the units responsible for the anti-aircraft defense of the NATO area of Europe are reserve units. It is essential that the time of mobilization and deployment of these units should be reduced to a minimum to provide the maximum degree of protection against surprise attack. In many countries the time necessary to complete mobilization and deployment is unacceptably long.

84. Recognition. A major limiting factor in the efficiency of the air defense system in the NATO area of Europe is the lack of effective means of recognition. Emphasis must be laid upon having, in SACEUR's area, the maximum possible degree of coordination of aircraft movements control organizations because, to a very large extent, even in 1957, our recognition and, consequently, our means of detecting a surprise attack will depend upon our filtering agencies knowing the whereabouts of our own aircraft, or those referred to in more detail in paragraphs 124-126.

85. Training. The degree of training both in interception and anti-aircraft defense units is unsatisfactory almost everywhere, especially in the case of technical personnel. The training is higher in the combat zone of the Central Sector than elsewhere, but even there it is inadequate.

86. Equipment.

a. AWX Aircraft. The all-weather interceptor force for the NATO area of Europe is weak. The present strength of AWX aircraft is about 10% of estimated requirements, and the rate of production of these costly and complex aircraft is slow. Further, the operational capabilities of the Allied AWX aircraft are still limited owing to shortage of training aircraft and the low state of navigational infrastructure.

b. Day Interceptors. The types in current service have, for the most part, inadequate performances for dealing with the air threat. The performance of enemy aircraft, the extent of the area to be defended and its inadequate depth, give the criteria for the Allied interceptors, and dictate that they should have the highest possible performance.

c. Surface-to-Air Guided Missiles. At present none of these weapons are included in known programs of the European Continental nations, and the Standing Group has stated that no such units should be expected for deployment in Europe before mid-1957.

d. Anti-aircraft Artillery. With the equipment available now and foreseen up to 1957, only limited defense can be given to a small proportion of key points.

87. Not all the units due to mobilize under present plans will have modern equipment, nor do there exist adequate reserves of aircraft, equipment and ammunition. Apart from this, technical support is completely inadequate.

88. Airfields. The technical complexity of the present types of interceptors and all-weather aircraft demands bases which are complex, extensive, costly in construction and maintenance, and vulnerable. This limits the flexibility of operation of these units, which is already hampered by lack of a proper system of command and control.

89. Logistic Support. Interceptor aircraft reserves are practically non-existent, and stocks of maintenance equipment, armaments and ammunition do not permit a sustained effort. There is no bulk reserve of radar.

90. Passive Air Defense. New forms of warfare and the enemy capability of making a surprise attack, give an added importance to passive defense measures. At the present time the Allied position as a whole is extremely vulnerable, especially to an initial attack.

91. Defense of Shipping and Ports. The shortage and inflexibility of present air defense forces and equipment make the protection of shipping extremely difficult. Most of the ports on which SACEUR's forces depend for logistic support are practically undefended. The United Kingdom has asked what anti-aircraft defenses are needed for the Channel ports assigned to the British lines of communication in Central Europe Command. Until this information is forthcoming, no plans can be made.

92. Civil Defense. Committees on which all NATO countries are represented have been set up to deal with the protection of the civil population. Progress by the various nations has not been uniform and is generally inadequate. Coordination of civil defense measures with the plans of Subordinate Commanders has not been effected and no satisfactory means has been established of bringing Western Germany positively into the planning.

93. Summary. In general, this analysis reveals the following weaknesses:

a. The command organization and general air defense structure are inadequate.

b. The efficiency of the air defense system is greatly limited by the national partitioning of the NATO area of Europe, and the consequent division of responsibilities between commanders and national authorities.

c. The control and reporting system is incomplete and inadequate.

d. Operations are hindered by inability to exploit the full depth of the NATO area of Europe, especially in the Central Theatre.

e. The qualitative and quantitative inadequacy of the equipment and aircraft in use.

f. Lack of training of air defense forces.

g. The time lag for mobilization and deployment of air defense forces.

VII. - CAPABILITIES

94. The Standing Group has laid down (TOSWAP 569) that the main aim of this air defence study should be to provide a capabilities plan of the most effective pattern of air defence within the resources generally envisaged in the 1955 Annual Review. It is further stated that the study should evaluate the efficiency of the air defence of the NATO area of Europe and make recommendations for increasing the efficiency thereof. It is to cover the period from now until 1 July 1957.

95. In Section VI, the present air defence system of the NATO area of Europe has been analysed by comparison with the fully developed air defence system described in Section V. This analysis has revealed a great many weaknesses which, in turn, lead to the conclusion that the present air defence capability is very meager and also show that a clear and objective capabilities plan will be hard to formulate until some of the major problems, such as the establishment of a proper staff and command structure and the coordination of national and Allied responsibilities, have been solved.

96. The air defence system described in Section V of this study is a purely theoretical system. It must be recognized that the actual cost of such a system, covering fully all areas of political or military importance, would go far beyond the means of the NATO countries and could only be provided at the cost of completely unacceptable reductions in national forces.

97. Nevertheless, the theoretical fully developed air defence system represents the only reasonable yardstick against which the NATO air defence capabilities can be measured, and the capabilities plan which follows is based on the general pattern of this theoretical system as described in Section V.

98. The capabilities are shown under the following general headings:

a. Control and Reporting system.

b. Electronic counter-measures.

c. Interception lines.

d. Command structure.

e. Key points.

f. Anti-aircraft defence.

g. Mobilization, deployment, and training.

h. Aircraft.

i. Equipment.

For the reasons given in paragraph 95, this study cannot be presented as a complete capabilities plan. Where capabilities can be objectively assessed, they are shown as such below; but, as revealed in Section V, there are certain major areas of weakness in which capabilities are so limited that it has been found necessary to present the information in the negative sense of detailed weaknesses rather than in the positive sense of actual capabilities.

99. Control and Reporting System. Chart (H) shows the extent of the radar cover under existing arrangements. It also shows the extent to which this cover is manned; but the picture it presents is the best one for the defence, for it assumes that hostile aircraft will penetrate at the optimum height for detection during the period that the system is manned.

It will be noted that the only complete radar cover is in the southern half of the Central Theatre, where the equipment is manned for 24 hours per day.

In the Northern half of the Central Theatre, a 16-hour watch can be kept. Further north, in Northern Command, the system can be manned for 8 hours daily and in Southern Command an average watch of only 4 hours is maintained.

100. Chart (H) reveals very serious gaps in the Allied European radar coverage. Broadly these are:

a. The whole of Norway from FINMARK to OSTLANDET.

b. The eastern approaches to the BALTIC exits.

c. The corridor running southwest through SWITZERLAND and LYON.

d. The "back door" into the whole of the southern half of FRANCE.

e. The entire eastern ADRIATIC coast, BALKAN PENINSULA and GRECIAN THRACE.

f. EASTERN ANATOLIA.

g. The "back door" into SOUTHERN ANATOLIA.

101. In the areas in which some radar capability exists at present, the following qualifications must be made:

a. Northern Europe Command. There is very little radar and very little continuous plotting above 20.000 feet.

The proximity of the enemy's forward airfields makes deep penetration possible for his forces before he can be identified.

b. Central Europe Command. In Holland and Belgium the radar is obsolete and short of spares.

In France, there is no radar south and west of the line St. Valery-Orleans-Lyon-Gien. There will be serious gaps over the ports and lines of communication in southwest France.

c. Southern Europe Command. In Italy the cover is extremely limited and the equipment obsolete.

In Greece there is only early warning radar.

In Turkey there is no continuous cover and there is little possibility of continuous plots over 20.000 feet.

There is a serious gap in cover above 20.000 feet throughout the Command.

Proximity of enemy airfields to the Allies in Northern Greece, and in the combat zones of Turkey, make deep penetration easy for hostile aircraft.

102. Chart (I) shows the radar cover now planned to exist in 1957. The gaps have been virtually eliminated except for:

a. The "back door" to France by a circuitous route north of the BRITISH ISLES.

b. The "back door" to SOUTHERN ANATOLIA by a circuitous route through IRAN and IRAQ.

The excessive number of planned reporting sources in Norway,

Italy and Turkey reduces the capability for efficient identification.

Chart (I) also shows the improved radar coverage that could be obtained by a more efficient deployment of Allied radar resources. This goes some way towards closing the northern gap.

The coverage in this chart presupposes, however, that a forward strategy has been adopted and that all nations concerned have obtained the necessary equipment, fulfilled their plans, trained the necessary personnel, and instituted a continuous watch.

103. Electronic Counter-Measures. There is virtually no capability in the NATO area of Europe for electronic counter-measures. Most of the countries concerned have no installations and equipment, nor have they the personnel or the experience.

In consequence, SACEUR's forces do not have the means of jamming enemy navigational aids, radars, remote control systems and communications. No allowance has been made either in current or in future plans for electronic counter-measures or taking advantage of ECM as an aid to tactical intelligence in and immediately before the battle is joined.

104. Interception Lines. Chart (J) shows the present interception lines on which hostile aircraft could be attacked by Allied interceptors as at present deployed; that is, based on the current rearward strategy. It shows that the whole of southwest France is open to hostile attack with little fear of interception, and reveals the great weakness in the Balkan area.

105. Chart (K) shows the interception lines based on the radar cover now planned to exist in 1957. This chart shows that southwestern France is still open to a "back door" attack coming round the British Isles and round the Bay of Biscay.

Chart (K) also shows the improvement obtained by the re-deployment of radar resources to give the improved cover shown in Chart (I) which would mean that:

a. The interception line for SOUTHWEST FRANCE can be moved outwards into the BAY OF BISCAY, provided fighters and anti-aircraft could be provided and deployed and the seaborne radar pickets protected.

b. The interception lines in CENTRAL EUROPE can be moved from 100 to 200 miles further to the eastward, to enable interception to be made nearer to the eastern edge of the combat zone.

c. Interception of attacks directed on NORTHERN ANATOLIA can be made over the BLACK SEA, if airfields can be built further north.

106. It must be realized that in both Charts (J) and (K), the interception lines shown are those that are possible once hostilities have begun. As explained in paragraph 13, the surprise attack can only be identified as it crosses the Iron Curtain. This means that the theoretical limit of radar cover in peace is the Iron Curtain, and that the full range of the Allied radar system is only effective in identification once operations have started.

Command Structure

107. There is no overall air defence command organization covering the NATO area of Europe. The deficiency begins at SHAPE, where there is no special staff handling this responsibility and extends to the level of field commands.

108. The existing naval, military, and air force command organization, which is designed to handle the naval operations and land/air battles in the various NATO commands, is far too restricted in its responsibilities

and within the geographical limits of its authority to handle air defence.

The land and air force commanders can only exercise their authority in their respective combat zones. In the communications zones, the responsibilities for air defence rest with national authorities, except for certain specific responsibilities mentioned in paragraphs 80 and 81.

109. It follows that there is no coordinated system by which all the air defence resources; control and reporting systems, interceptor aircraft, guided missiles (when they become available), anti-aircraft artillery and radio counter-measures, can be handled centrally and to their best effect.

110. Complete centralization would probably be too unwieldy and too slow in operation, but coordination of all these measures within regional organizations is both practical and prudent.

111. Chart (L) illustrates the existing allocation of air defence responsibility. To this extent it represents the current Air Defence Command capability. The principal features of this capability are:

a. Northern Command. In war, the Allied Commander is responsible for the air defence of Norway and Denmark. He does not exercise this authority in peace and has power to redeploy only his assigned resources in war. He has no special Air Defence Staff, nor has he the communications and command posts required.

b. Central Command. The Allied Commanders are responsible for air defence in their respective combat zones. Behind them, the defence of territorial France is a national responsibility. Discussions are now taking place with a view to ensuring that the air defence capabilities of this area, both national and NATO, shall come under a centralized Allied operational control. An Air Defence Operations Center under CINCENT is under study to ensure effective control of the whole of the combat zone and rear areas of CINCENT's command. Belgium and the Netherlands have agreed to this conception.

Discussions are also taking place with the U.K. authorities, whose air defence forces remain under national control, to achieve greater coordination of effort.

c. Southern Command. The whole of ITALY, SICILY, CORSICA, and SARDINIA come under national control except in the extreme north, where a very small sector, north of a line east and west through the head of the ADRIATIC SEA, is the responsibility of the Allied Commander. Air Defence in TIRRHENIAN, ADRIATIC and AEGEAN SEAS, as well as for the whole of GREECE, become the responsibility of the appropriate Allied Commanders in war. For TURKEY and CYPRUS, air defence is a national responsibility.

112. Merchant Shipping and Port Defence.

a. Northern Sector. SACLANT is responsible for the seaborne logistic support of operations in the Northern area. When out of range of land-based fighters and of the radar in the northern area and in Great Britain, SACLANT will use his carrier-borne fighters and units of the Naval Air Force. Andoya is the planned war base of maritime aircraft of SACLANT; these units cannot be at Andoya until the General Alert is declared, as the existing agreements prevent the installation of Allied units in Norway in peacetime. It is recalled that CINCNORTH is responsible for the air defence of coastal shipping of the Norwegian and Danish coasts.

b. Central Sector. Channel Command is responsible for the protection of convoys between the United Kingdom and the Central Europe Theatre. The Channel Air Coordination Committee has approved a common demarkation line defining the areas of responsibility for the air defence of convoys between the various Air Defence Commands concerned (CACC (SEC) 9,

dated 23 March 1953). The arrangement is far from complete as regards war time. For example, the French D.A.T. (Territorial Air Defence) has no unit in position west of St. Valery on the Channel coast, and it does not seem possible to provide one before the middle of 1957. Convoys proceeding along the coasts of the Continent would thus be left unprotected, both at sea and at anchor. Only the British Fighter Command will give convoys some degree of protection when they enter the area covered by its fighters and radar control. Mediterranean convoys will have only limited protection when in the area of the air defence systems adjoining AFMED's line of communication.

c. Southern Theatre. CINCAFMED, CINCSOUTH, and the national authorities concerned are jointly responsible for the protection of convoys in the Mediterranean Sea. For this purpose, when convoys are out of range of national Air Defence Commands and land-based aircraft, CINCAFMED will have 40 carrier-borne jet fighters by the middle of 1957. He will also have 40 piston-driven fighters based on the French aircraft carrier assigned to his Command. The other forces available in the Mediterranean area are thos of:

(1) STRIKFORSOUTH.

(2) The French North African D.A.T.

(3) Italian D.A.T.

(4) Greek D.A.T.

(5) Turkish D.A.T., when formed.

(6) British Middle East Air Force in Cyprus.

It is unlikely that these Territorial Air Defences will have reached a real degree of efficiency even by the middle of 1957, with the possible exception of the air defence units on the North African coast, especially that of the 17th Air Force. This force will be primarily devoted to its own basic mission, and if it is to make a substantial contribution, very strict coordination will be necessary between it and AFMED. STRIKFORSOUTH will be able to give the convoys excellent protection when this task can be combined with the Command's major missions.

113. The Air Defence Command capability in 1957 cannot be assessed with accuracy. It must depend largely upon political decisions towards the establishment of a regional organization with centralized control in each region. The provision of command posts and communications networks must follow the political decisions on the major principles of command and control.

114. Key Points. At Chart (M) is a tabulation of the number of key points to be covered by the air defence systems of the NATO area of Europe*. The tabulation has been broken down into Category 1A key points and others. The reason for this is that the anti-aircraft defence resources available now and foreseen in 1957 are inadequate to deal with the Category 1A points alone. This is partly because there is insufficient equipment and partly because all nations do not follow the internationally standardized method of determining the category of key points. The capability of defending these key points is also assessed in Chart (M). This is the best possible appraisal that SHAPE can make of the quality and availability of equipment and the readiness of the anti-aircraft defence forces. In this connection, it must be remembered that the defence of key points is a national responsibility and that, in making this appraisal, SHAPE is expressing an opinion on forces which are not under its control.

In general, it can be said that within the NATO area of Europe

* See paragraph 14 above.

there exists now the capability of defending adequately only 19 of the 222 Category 1A key points, as shown on Chart (M), and that no real defence can be given to other key points.

The capability for defence of key points in 1957 is difficult to assess. Political decisions on the means of categorizing the points may lead to a readjustment and current and future infrastructure programs will add to the airfields and logistic and command installations. In general, it can be said that, based on current knowledge of key points and the planned availability of forces, the capability in 1957 will be to afford "minimum scale" protection to about 25% of the Category 1A key points in the NATO area of Europe.

This "minimum scale" is defined as the minimum anti-aircraft deployment required to ensure that an enemy raider attacking a vulnerable area from any direction, will be engaged by at least one heavy anti-aircraft battery for at least 30 seconds before bomb release (or by two heavy anti-aircraft batteries for at least 15 seconds before bomb release).

Anti-Aircraft Defence.

115. At Chart (N) is shown the anti-aircraft equipment now available for air defence purposes in the NATO area of Europe in 1954 and that planned to be available in 1957. This chart forms the background to the assessment in paragraph 114 of the capabilities for the defence of key points. Two major points will be noted from Chart (N):

a. There are no guided weapons units available as mentioned in paragraph 86 c.

b. By 1957, acceptable modern anti-aircraft equipment can only be provided for:

About 500 of the 750 H.A.A. batteries (approximately) which it is planned to activate on or shortly after mobilization.

About 6800 of the 8000 or so L.A.A. guns for which it is planned to activate the necessary personnel on mobilization. Under present programmes a large proportion of these guns will be obsolete (Bofors 40 mm L60).

c. The stocks of ammunition are dangerously low, especially in Belgium, Italy, Greece and Turkey.

116. At Chart (C) is shown the total anti-aircraft defence requirements for the defence of the Category 1A key points in the NATO area of Europe*. This should be compared with Charts (M) and (N). It shows that, apart from guided missiles (referred to in paragraph 115 a. above), the relationship in 1957 between planned units, available equipment, and minimum requirements, is as follows:

Heavy A.A. Batteries			Light A.A. Guns		
Requirement	Planned	Equipped	Requirement	Planned	Equipped
2,058	750	532	19,660	8,135	6,778

These figures represent a calculated approximation.

This represents total equipment. From the figures of planned equipment must be subtracted:

* These key points are obtained from the current National and Allied Key points lists submitted to SHAPE. These lists may be modified, in view of para 136 a.

a. equipment for schools and experimental establishments

b. equipment to make good the attrition in peacetime

c. reserves of equipment to make good attrition during the first weeks of war.

Therefore the planned capability is considerably less than is shown above.

The current capability is considerably less because of the reduced quantities of equipment and ammunition now available, as shown in Chart (N).

The shortage of LAA guns is particularly serious because, owing to the performance limitations of present and planned radars, virtually the only answer at present to the low flying threat is the LAA gun backed by some form of observer corps warning around main V.Ps.

117. Insofar as the anti-aircraft defence of Western Germany is concerned, there is as yet no plan for the anti-aircraft defence of national key points of the German Federal Republic and it has not been possible to take any measures to entrust this defence to anti-aircraft units to be integrated into the defence framework of the Allied forces stationed on this territory.

Mobilization, Deployment, and Training

118. It is stated in paragraph 83 that a large proportion of the units responsible for the anti-aircraft defence of the NATO area of Europe are reserve units. At Chart (P) are shown the dates on which these units mobilize in each country, in relation to the alerts, together with SHAPE's estimates of the completion of deployment of the various units expressed in terms of days after mobilization.

It will be seen that certain of the French Air Defence units which, under present arrangements, have some responsibility for the defence of the ports and lines of communication supplying the Central Theatre, are not deployed until between 7 and 14 days after the Simple Alert. In the case of Italy, a similar period has to elapse after the Reinforced Alert.

119. Chart (Q) sets out the degree of training given to the reserve personnel in anti-aircraft defence units of certain NATO countries. It reveals serious weaknesses in the training of men who have to become more and more skilled as the complexity of their technical equipment increases, and who will be required to operate at their maximum efficiency during the critical days at the opening stages of the war.

These limited training facilities must be regarded as exercising a considerable lowering of the air defence capabilities in the countries concerned.

Aircraft.

120. It is virtually impossible to assess a capability in respect of aircraft because the actual size, direction, and tactical nature of the enemy threat are not known, and the availability of Allied aircraft for air defence must vary with the calls on their services for other missions in the land/air battle and in naval operations.

At Chart (R) is a statement of the actual availability of IDF and ADX aircraft in 1954, and the planned availability in 1957. The figures for 1954 are taken from the current SHAPE Order of Battle on 30 June 1954 and those for 1957 are based on replies to AR (53).

These actual and planned availabilities are compared with the requirements for IDF and ADX aircraft as established in MC 26/3.

121. The broad summary of these figures is as follows:

IDF		North	Center*	South
1954	Available	61	727	109
	Requirement	200	1550	700
1957	Planned	25	1137	375
	Requirement	200	1550	700

AEW		North	Center*	South
1954	Available	15	72	-
	Requirement	118	624	240
1957	Planned	82	308	60
	Requirement	128	624	240

* In addition, there will be in the French national air defence system:

IDF	156 by end of 1954	369 by end of 1957
AWX	24 by end of 1954	24 by end of 1957

122. Assistance to air defence in interceptor operations can be provided by some of the fighter bombers of which there are 2156 available now and 2475 are planned to be available in 1957.

123. Equipment. The capability in respect to reserves of equipment is very low. Interceptor aircraft reserves are practically non-existent, stocks of spare parts are low and the availability and future stocks of ammunition are the subject of comment in paragraph 115. Reserves of maintenance equipment are low and there is at present no capability of a sustained air defence effort.

There is no bulk reserve of radar equipment. The time lag in building up such stocks is from $2\frac{1}{2}$ to 3 years, so that the situation may be little better in 1957. Storage capacity for petroleum products restricts stock-piling. The present reserve capacity is, however, only 40 days, and the prospects of establishing re-supply before this is exhausted or destroyed are remote.

Air Traffic Control

124. SACEUR has proposed to the Allied nations that Air Traffic Control Centers should be placed under control on Simple Alert. Agreement to this has not yet been obtained. But this measure is of the greatest importance for making the Air Defence system proof against all surprise attacks.

125. The Mediterranean area is now divided into 7 Flight Information Regions, with their Air Traffic Control Centers. Signals plans have been worked out and organization is proceeding. In the Central Europe Theatre, planning for the definite military organization of air traffic control is under way. These plans cover the control of non-military flying in wartime and of flying in the fixed civilian traffic lanes. So long as these plans have not been completed throughout NATO area of Europe, the effectiveness of the air defence organization will suffer, especially in the most critical initial phase of the transition from peacetime to wartime organization.

126. An organization for coordinating the forces of each major Subordinate Command is being set up. It includes an Air Information Center and signals installations for maintaining contact with the air forces of the other Commands.

127. Summary of Capabilities. The foregoing paragraphs show that the air defence capabilities of the NATO area of Europe in no way measure up to their task, either in 1954 or 1957. There are weaknesses in all aspects of air defence, namely:

a. Inadequate radar cover, due to shortage of suitable equipment and manpower, inability to maintain continuous watch and the limitations of a rearward strategy.

b. There are no means of taking electronic counter-measures.

c. Interception lines are too far to the west because of the rearward strategy.

d. There is no proper command organization or staff.

e. Responsibilities are divided between national and NATO authorities.

f. There is no coordinated system of assessing priorities of key points.

g. There is a serious shortage of effective modern anti-aircraft equipment and a corresponding lack of ammunition. This is particularly serious as regards LAA which for some years will be virtually the only answer to the low-flying threat.

h. Insufficient attention is paid to the training and mobilization of the reserve Air Defence units.

i. There are serious shortages of IDF and AWX aircraft.

Of these, the cardinal weakness lies in the command structure, in the lack of proper staffs and in the divided responsibilities. The present system fails completely to make effective use of the Allied resources. Vigorous action, appreciation of the problems and acceptance by nations and Commanders alike of the responsibilities involved, and drastic reorganization can produce a better system without much extra expenditure.

This is the first requirement; the other improvements will follow once the command structure has been established.

VIII. - RECOMMENDATIONS

128. The recommendations which follow fall into two categories: those which can be implemented now without great cost, and those which take a great deal of time and money to implement. The immediate objectives are principaly the establishment of proper staffs at the level of SHAPE and Subordinate Commands, a proper command structure, and the coordination of air defence throughout the NATO area of Europe* by unifying air defence responsibilities on a regional basis. Future objectives comprise the increase and redistribution of resources, the improvement of equipment and aircraft, and the use of guided missiles.

129. It is clear that neither governments nor the political and higher military echelons of NATO will be prepared to go to the great expenditure necessary on the improvement of the air defence system until they can be satisfied:

a. That the requirements bear the stamp of expert advice and scrutiny.

b. That the resources when applied will be used to their best effect.

130. SHAPE THEREFORE RECOMMENDS:

a. THE ESTABLISHMENT OF SPECIAL AIR DEFENCE STAFFS AT SHAPE UNDER THE AIR DEPUTY AND AT SUBORDINATE COMMANDS.

b. THE DEVELOPMENT OF A PROPER COMMAND STRUCTURE WHICH WILL COORDINATE ALL AIR DEFENCE RESOURCES. THIS SHOULD INCLUDE THE ORGANIZATION OF APPROPRIATE ALLIED AIR DEFENCE ZONES COVERING THE COMBAT AND COMMUNICATIONS AREAS OF SACEUR'S MAJOR SUBORDINATE COMMANDS.

The succeeding paragraphs deal with the above recommendations in greater detail as well as with further steps which can be taken now, and with proposals for the problems which the Air Defence Organization recommended above should study.

131. It is recognized that political decisions will be required before the command and regional organizations proposed in 130 above can come into being. These organizations are necessary before any major improvements can be made, but the establishment of the Air Defence Staffs is even more essential as a first step and there seems no valid reason why this step should not be taken immediately.

132. Air Defence Staffs. Responsibility for Air Defence within the NATO area of Europe (see para. 14) should rest with SACEUR and, by his delegation with NATO Commanders at lower echelons. SACEUR's present terms of reference should be broadened accordingly. The tasks of these Commanders will be to handle all Air Defence measures in close cooperation with adjacent and higher Commanders, and to work, within the limits of their authority, with national governments. Initially, SACEUR should be authorized an increase in his SHAPE Staff of not more than twelve officers for this purpose. Corresponding increases would be required in the Staffs of the appropriate Subordinate Commands.

133. Scientific advice is essential to these staffs, especially at SHAPE and the Center. There is a need for a scientific group, under SHAPE direction to aid in planning the technical aspects of the Air Defence System, especially in respect to aircraft control and reporting. The scientific staffs should work with the military staffs from the very outset.

* See paragraph 14 above.

134. Command Structure. Firm recommendations as to the detailed command structure should await further study and analysis by the Air Defence Staffs proposed in paras 132 and 133 above. In broad terms, however, it is visualized that the command structure required to control the Air Defence System of the NATO area of Europe would consist basically of an Air Defence Commander in each of the regions described in para 135 below. Each Air Defence Commander would be responsible to the appropriate Senior Commander and would have, in addition to his air and control and warning units, directly under him a Land Anti-aircraft Command Organization, responsible for all land based air defence operations within his area, excepting these at field army and lower mobile force levels. To enable the command structure to function executively there will have to be Air Defence and Operating Rooms, with appropriate communications, in the North, in the Centre, and probably two in the South (one for Italy and one for Greece and Turkey). The Air Operations room at SHAPE will have to be extended to present major events and trends in air defence.

135. Regional Organization

a. The whole of the area of SACEUR's command responsibility should be treated as a single Air Defence Zone to include the NATO area of Europe* in close liaison with SACLANT and CINCHAN.

b. This Air Defence Zone should be subdivided into regions or Air Defence Commands generally as follows:

(1)	North	Norway and Denmark coordinating with UK and CINCENT.
(2)	Center	The Central European area including France, Western Germany, the Netherlands, Belgium, and Luxembourg, coordinating with UK, CINCNORTH and CINCSOUTH.
(3)	South	Italy, coordinating with CINCENT.
(4)		Greece and Turkey, coordinating with the British Middle East Command.

c. Later developments in this structure might be an Iberian Air Defence Command and a Balkan Air Defence Command to include Yugoslavia.

d. The responsibility for the Air Defence of convoys and of the LOCs through the Mediterranean should be a matter for joint coordination and cooperation between CINCAFMED, CINCSOUTH, and adjacent National Authorities.

e. The proposed Air Defence Commands should be divided into Sectors, as extensive as possible.

f. The United Kingdom, remaining under national control, should assist in coordination with CINCNORTH and CINCENT.

g. French North Africa, remaining under national control, should act in closest coordination with CINCSOUTH and CINCAFMED.

Further Measures

136. In addition to the above three recommendations, there are certain other steps on which action can be taken without heavy expenditure and which should be given top priority attention by Air Defence Staffs as soon as they are established. In the majority of cases this action is an essential preliminary to future development. The principal steps are as follows:

* See paragraph 14 above.

a. Key Points

(1) That all nations and commands should adopt, and adhere strictly to, the criteria for the classification of key points as laid down by the NATO Committee for civil organization in time of war (AC/23-D/63).

(2) A clear policy must be established which distinguishes national from Allied key points and determines the responsibility for the defence of each.

b. Control and Reporting System. Steps should be taken urgently to achieve longer periods of manning of the existing control and reporting systems, to improve existing equipment and make good deficiencies and to ensure the maximum degree of effectiveness against surprise attack. The planning of the control and reporting system with the resources envisaged for 1957 should be proceeded with and all possible preparation made for it to be effective.

c. Interception and Base Lines. These should be carefully studied with a view to their improvement now and to enable the resources and developments anticipated in 1957 to be applied with minimum delay and maximum effectiveness.

d. Alert Measures and Passive Defence. Improvement in Alert Measures and above all uniformity in their application is essential. Considerable progress has been made, but it is hoped that the weakness of the Air Defence situation as revealed in this study and the intimate relationship between Air Defence and Alerts, will stimulate a more realistic attitude towards Alerts, and to the Passive Defence Measures which they call into operation.

e. Mobilization and Training. Mobilization of Air Defence units should be accelerated to the maximum degree possible since, without the active participation of these units, the mobilization of national forces may be brought to a standstill by enemy air action. The units must be ready to operate as soon as they are mobilized. This postulates a very high degree of training which in turn demands annual training.

f. Equipment. Equipments should be available to ensure that all units which it is planned to activate on or shortly after mobilization shall be fully equipped with effective modern equipment, backed by sufficient reserves of equipment and ammunition to make good attrition and expenditure in the first 90 days of war.

137. Long term measures which it is recommended that the Air Defence Staffs should study include:

a. Use of guided missiles, and unguided rockets.

b. Improvements in radar coverage and depth.

c. Electronic counter measures.

d. Radar watch and warning.

e. Minimum anti-aircraft defence requirements.

f. Convoy protection.

g. Logistic support.

h. Passive defence.

i. Civil defence.

j. "Y" Intelligence Services.

138. Scientific developments are a national responsibility and SHAPE can do no more than present requirements as a "user". The particular

fields in which SHAPE recommends scientific development are:

a. IDF and AWX aircraft, capable of operating off short runways or grass airfields.

b. Guided missiles and rockets.

c. Medium and light anti-aircraft artillery, and ships' anti-aircraft armament.

d. Low altitude radar.

e. Automatic signal systems to transmit information.

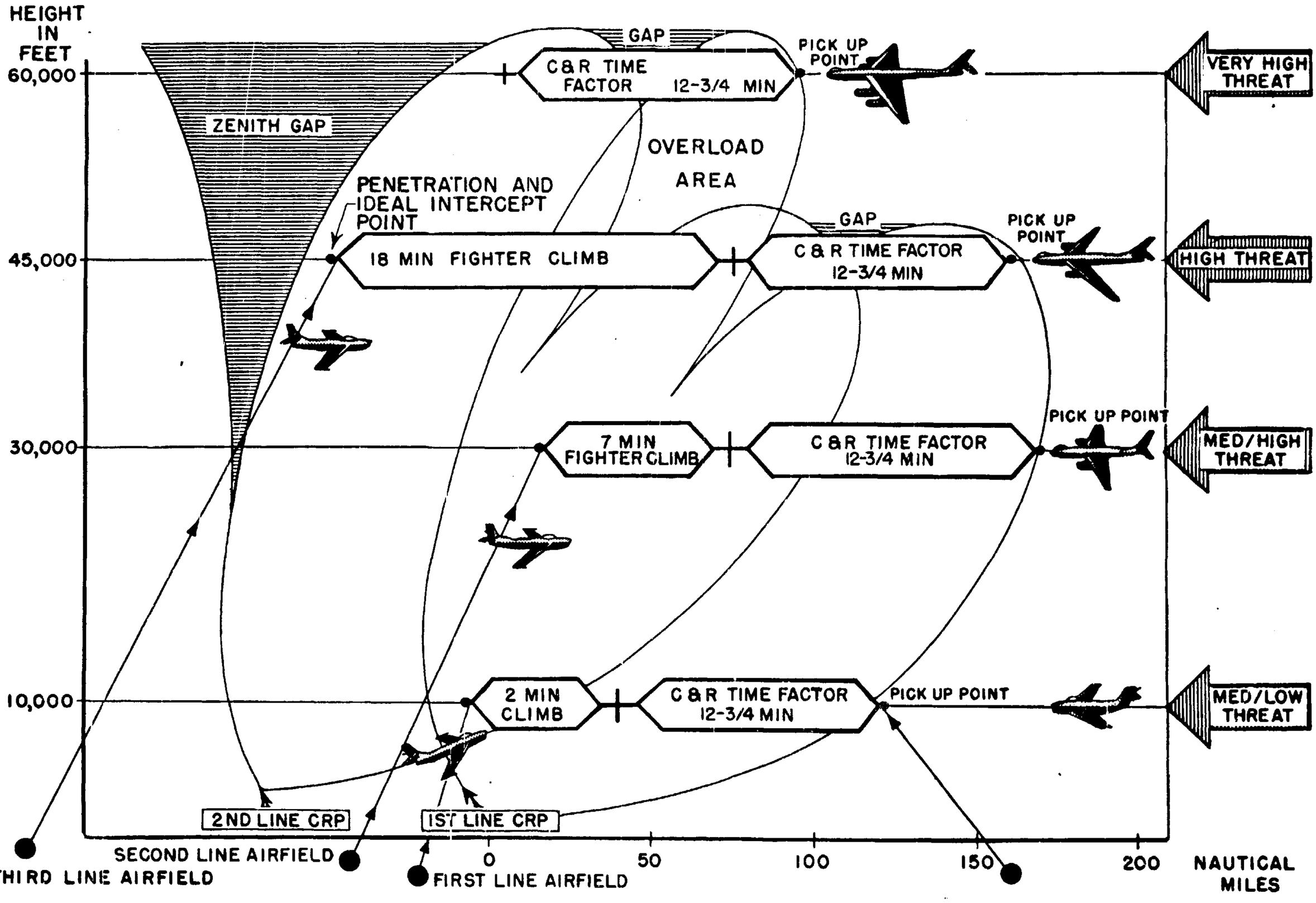
f. Systems for automatic control of interceptor aircraft.

CHARTS

A - The Soviet D-day Air Threat
B - Intercept Problem Radar Penetration-Ideal Intercept and Fighter Base Lines
C - The Interception Problem
D - The Air Defense System - Command and Liaison
E - The Air Defense System - Operational Control
F - The Air Defense System - Reporting and Identification
G - Air Defense Sectors in Europe
H - Present Radar Cover
I - Radar Cover in 1957
J - Interception Lines with Existing Radar Cover (1954)
K - Intercept Lines (1957)
L - Areas of Air Defense Responsibility in Europe
M - Key-Points 1954
N - Anti-Aircraft Forces in NATO Area of Europe - Units Planned to be Mobilised on or shortly after M-day and Equipment Available 1954
O - Summary of Anti-Aircraft Requirements
P - Anti-Aircraft Deployment Dates
Q - Table of AA Reservist Training - National Defense AA Units
R - Allied Fighters - Table 1954 to 1957 - SHAPE Estimate of Availability and Requirements M.C. 26/3

CHART B

INTERCEPT PROBLEM
RADAR PENETRATION - IDEAL INTERCEPT & FIGHTER BASE LINES
10,000 - 30,000 & 40,000 FOOT LEVELS



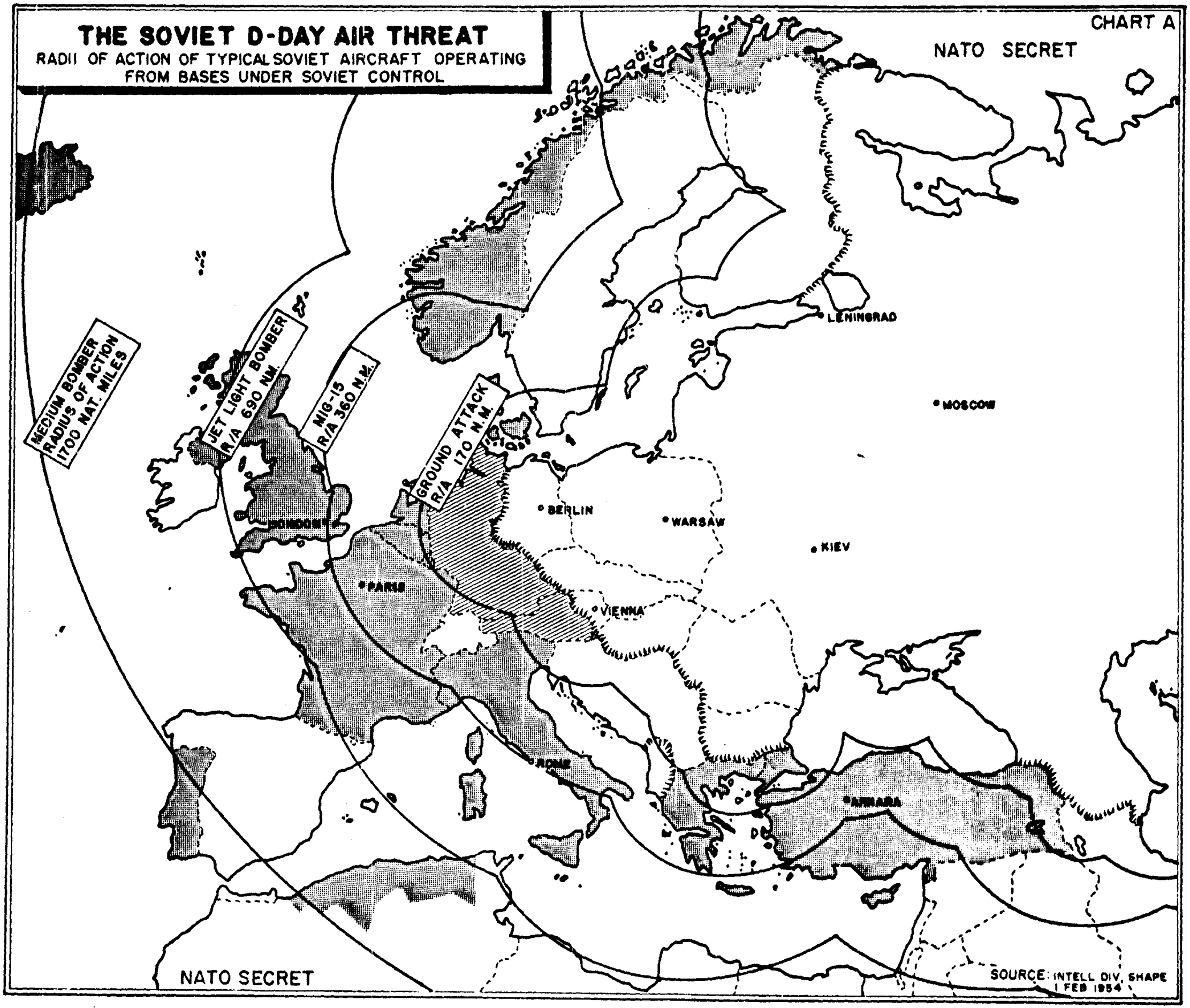
SOURCE : AIR DEF STUDY GP, SHAPE

THE SOVIET D-DAY AIR THREAT

RADII OF ACTION OF TYPICAL SOVIET AIRCRAFT OPERATING FROM BASES UNDER SOVIET CONTROL

CHART A

NATO SECRET

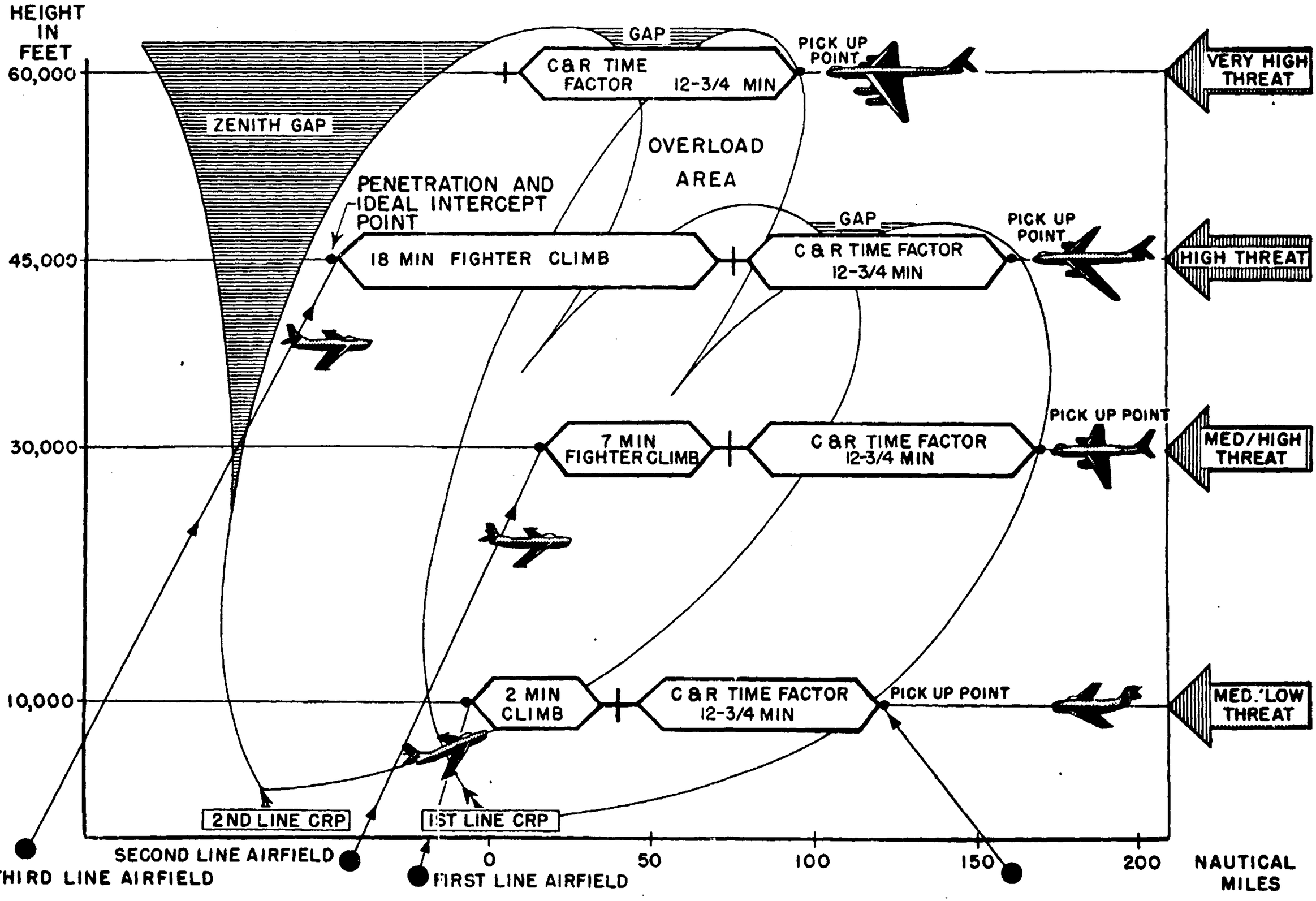


NATO SECRET

SOURCE: INTELL DIV. SHAPE 1 FEB 1954

CHART B

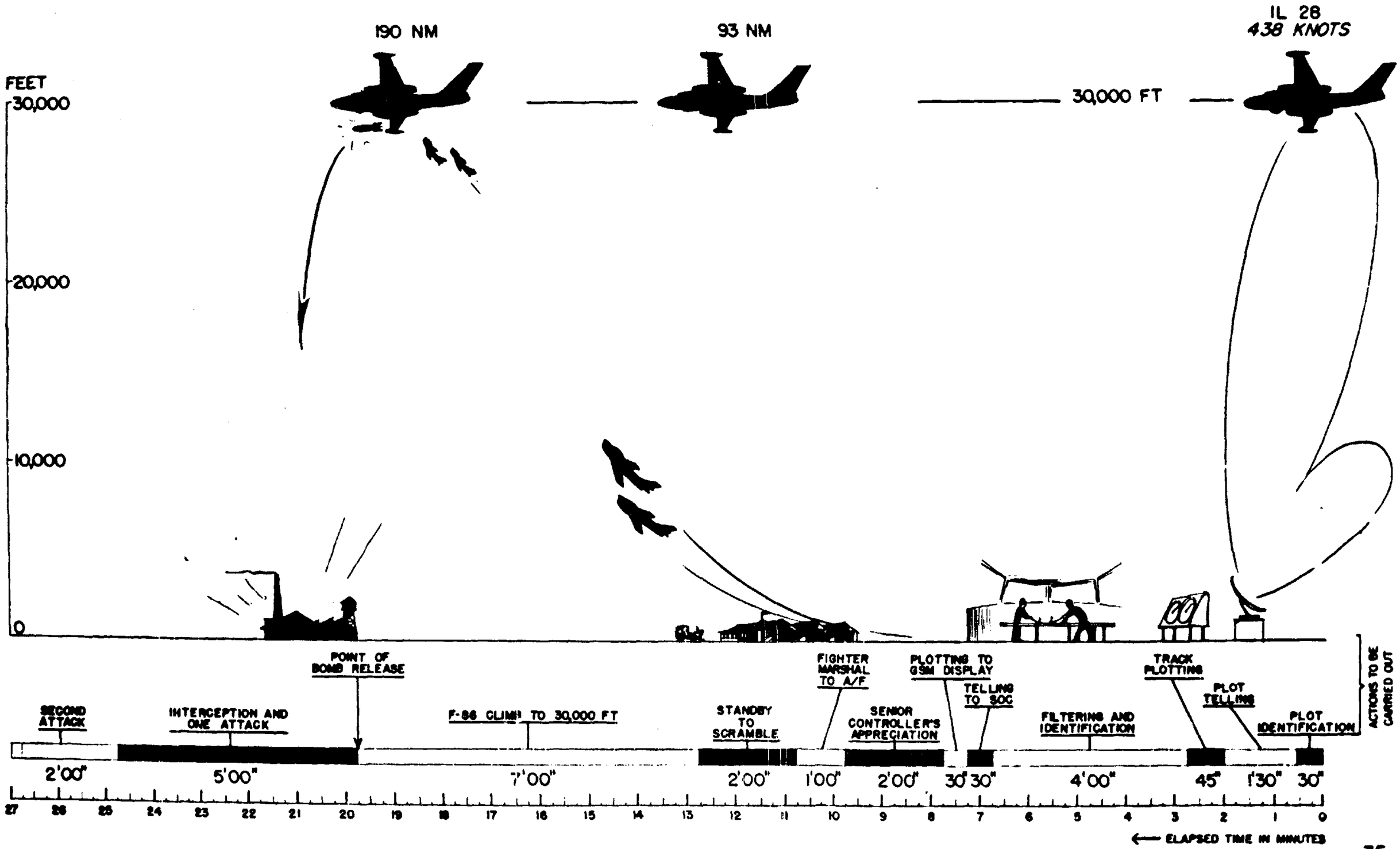
INTERCEPT PROBLEM
RADAR PENETRATION - IDEAL INTERCEPT & FIGHTER BASE LINES
10,000 - 30,000 & 40,000 FOOT LEVELS



SOURCE : AIR DEF STUDY GP, SHAPE

CHART C

The INTERCEPTION PROBLEM



NOTES AND LIST OF ABBREVIATIONS FOR USE WITH CHARTS D, E AND F

1. Charts D, E, F, illustrate the integration and functioning of all main components of a highly developed Air Defense System under the three headings:

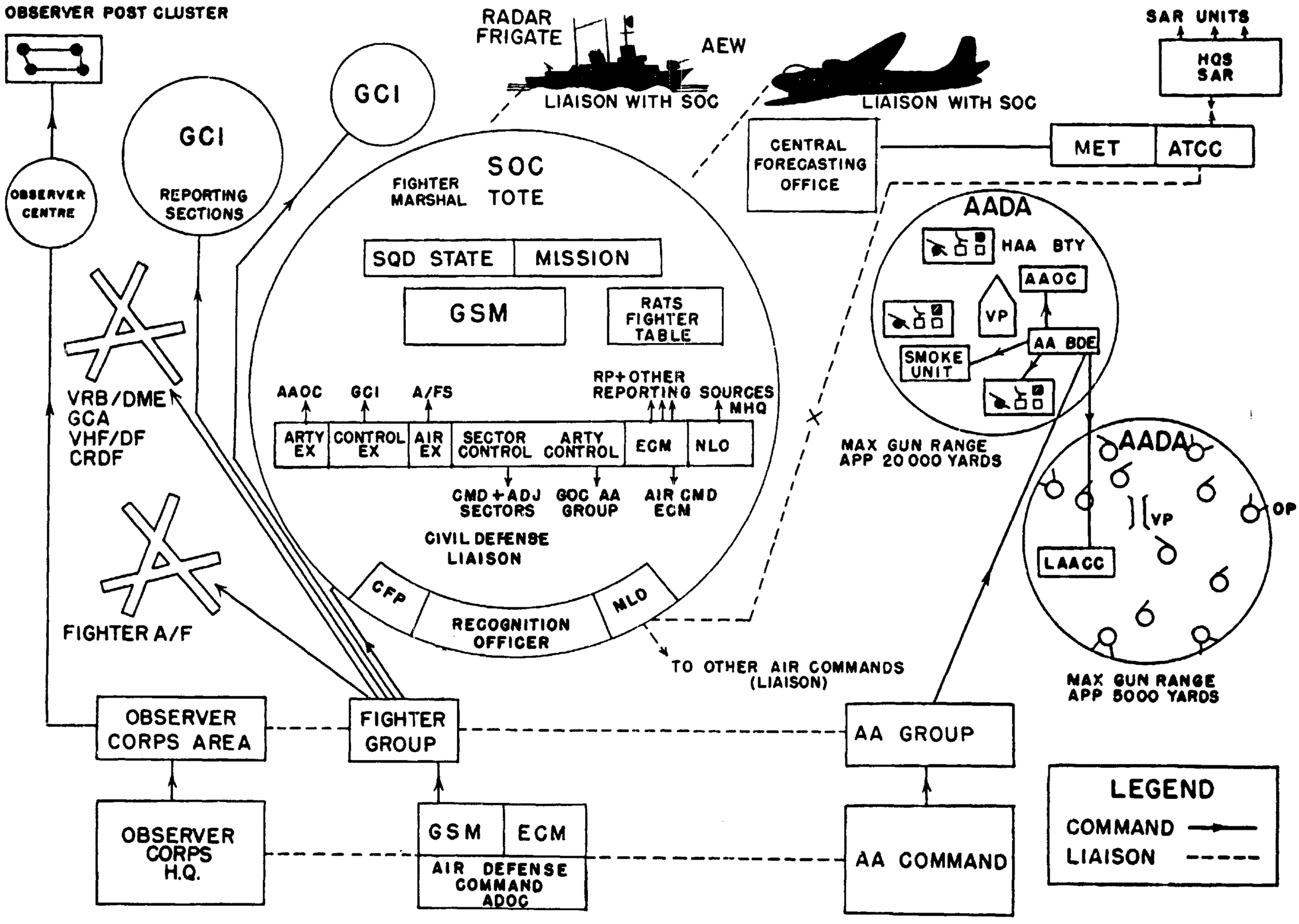
Command and Liaison
Operational Control
Reporting and Identification

2. It is emphasized that the Sector Operations Centre is the focus of the minute-to-minute Air Defence battle.

ABBREVIATIONS

AA	-	Anti-Aircraft
AAOC	-	Anti-Aircraft Operations Centre
ADOC	-	Air Defense Operations Centre
AEW	-	Airborne Early Warning
A/FS	-	Airfields
ARTY	-	Artillery
ATCC	-	Air Traffic Control Centre
BDE	-	Brigade
BTY	-	Battery
CFP	-	Centre of Filtering and Plotting
CMD	-	Commander
CRDF	-	Cathode ray direction finding
DF	-	Direction Finding
DME	-	Distance Measuring Equipment
ECM	-	Electronic Counter Measures
EX	-	Executive
GCA	-	Ground Control Approach
GCI	-	Ground Control Interception
GDA	-	Gun Defended Area
GEE	-	A ground hyperbolic navigation aid
GOC	-	General Officer Commanding
GSM	-	General Situation Map
HAA	-	Heavy Anti-Aircraft
HQS	-	Headquarters
LAA	-	Light Anti-Aircraft
LAAOC	-	Light Anti-Aircraft Operations Centre
MAA	-	Medium Anti-Aircraft
MET	-	Meteorology
MHQ	-	Maritime Headquarters
MLO	-	Movement Liaison Officer
NLO	-	Naval Liaison Officer
RATS	-	Low Flying Hostile Aircraft or Raids
RP	-	Reporting Point
SAR	-	Search and Rescue
SOC	-	Sector Operations Centre
SQD	-	Squadron
VHF	-	Very High Frequency
VP	-	Vulnerable Point
VRB	-	Voice Rotating Beacon

THE AIR DEFENCE SYSTEM - COMMAND & LIAISON



THE AIR DEFENCE SYSTEM – OPERATIONAL CONTROL

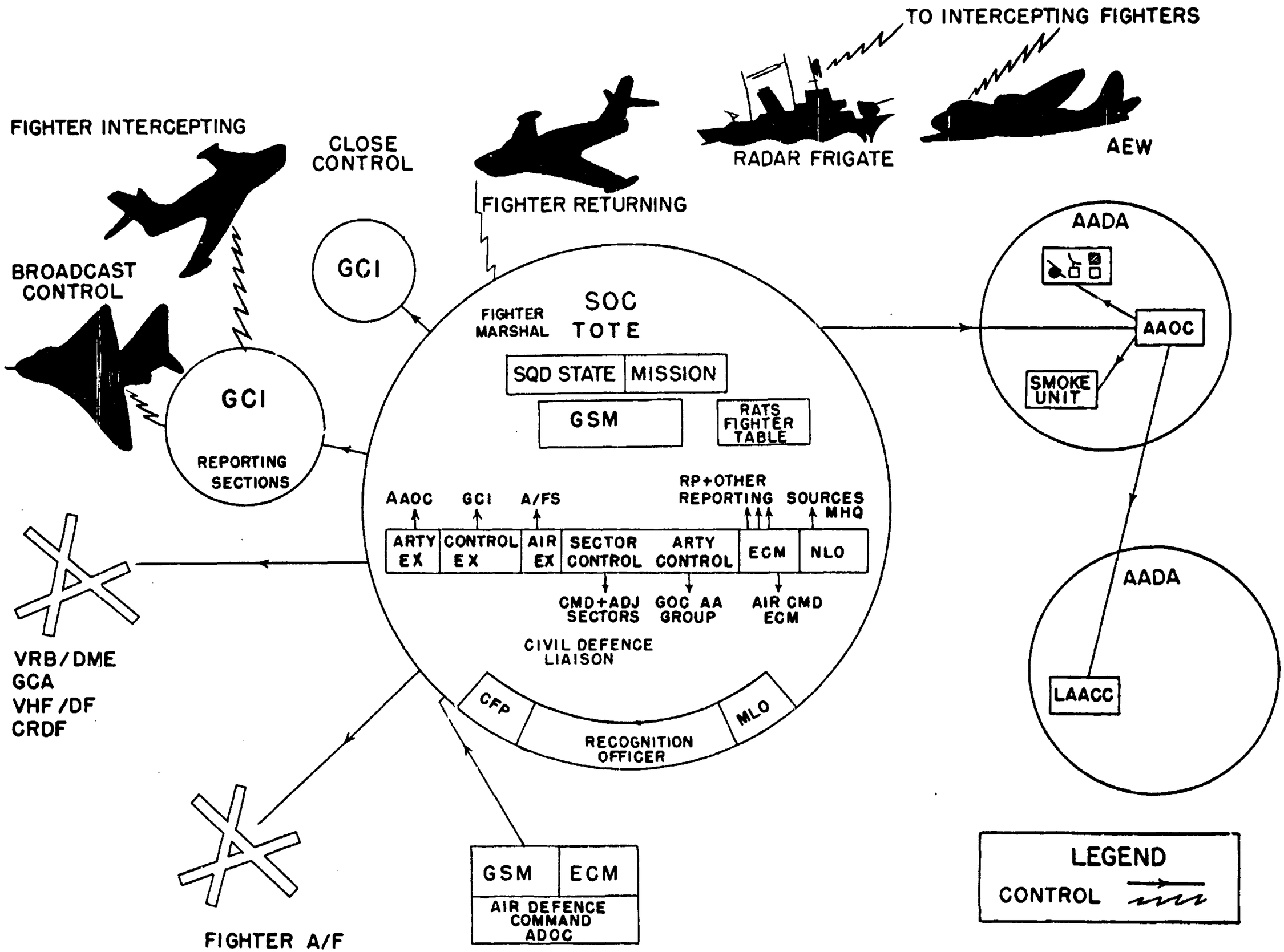


CHART F

THE AIR DEFENCE SYSTEM – REPORTING AND IDENTIFICATION

RADAR FRIGATE

TO PARENT RP AND OBSERVER CENTRE

AEW

TO PARENT RP AND OBSERVER CENTRE MONITORED BY SOC

FIGHTER RETURNING

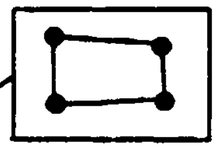
D/F STATIONS

SOC GCI

GCI

RADAR REPORTING POSTS AND IFF (A BAND)

REPORTING POSTS OTHER THAN RADAR



OBSERVER POST CLUSTER

OBSERVER CENTER

TO OTHER OBSERVER CENTRES

NAV OR URN 21 ORGANIZATION

NAV

NAV

SLAVE GEE

SLAVE GEE

PHASING

MASTER GEE

PHASING

SOC

TOTE

SQD STATE	MISSION

CFP

RECOGNITION OFFICER

MLO

GSM

RATS FIGHTER TABLE

RP & OTHER REPORTING SOURCES

AAOG | GCI | A/F S | MHQ

ARTY EX	CONTR. EX	AIR EX	SECTOR CONTROL	ARTY CONTROL	ECM	NLO

CMD & ADJ SECTORS

GOC AA GROUP

AIR CMD ECM

TACTICAL ECM CONTROL AND REPORTING

FROM OTHER CFPs AND SOCs

FROM OTHER CFPs AND SOCs

AADA

AAOC

SMOKE UNIT

AADA

LAACG

GSM	ECM
AIR DEFENCE COMMAND ADOC	

COSMIC TOP SECRET

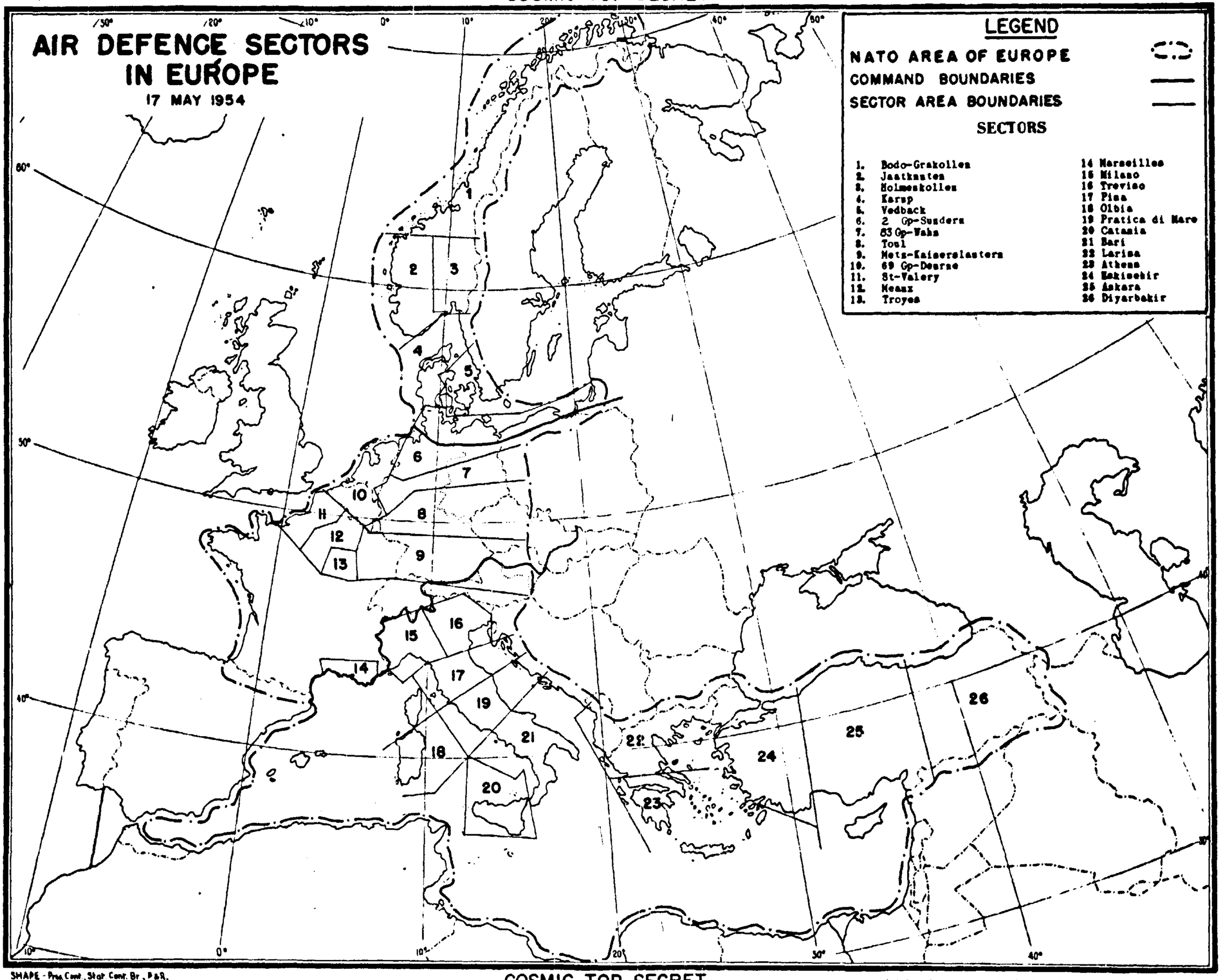
LEGEND

REPORTING ——————

REPORTING & IDENTIFICATION - - - - -

AIR DEFENCE SECTORS IN EUROPE

17 MAY 1954



LEGEND

NATO AREA OF EUROPE

COMMAND BOUNDARIES

SECTOR AREA BOUNDARIES

SECTORS

1. Bodo-Grakollen
2. Jaatkasten
3. Holmenkollen
4. Karup
5. Vedback
6. 2 Gp-Sundern
7. 83 Gp-Wahn
8. Toul
9. Metz-Kaiserslautern
10. 69 Gp-Deurne
11. St-Valery
12. Meaux
13. Troyes
14. Marseilles
15. Milano
16. Treviso
17. Pisa
18. Olbia
19. Pratica di Mare
20. Catania
21. Bari
22. Larisa
23. Athens
24. Eskisehir
25. Ankara
26. Diyarbakir

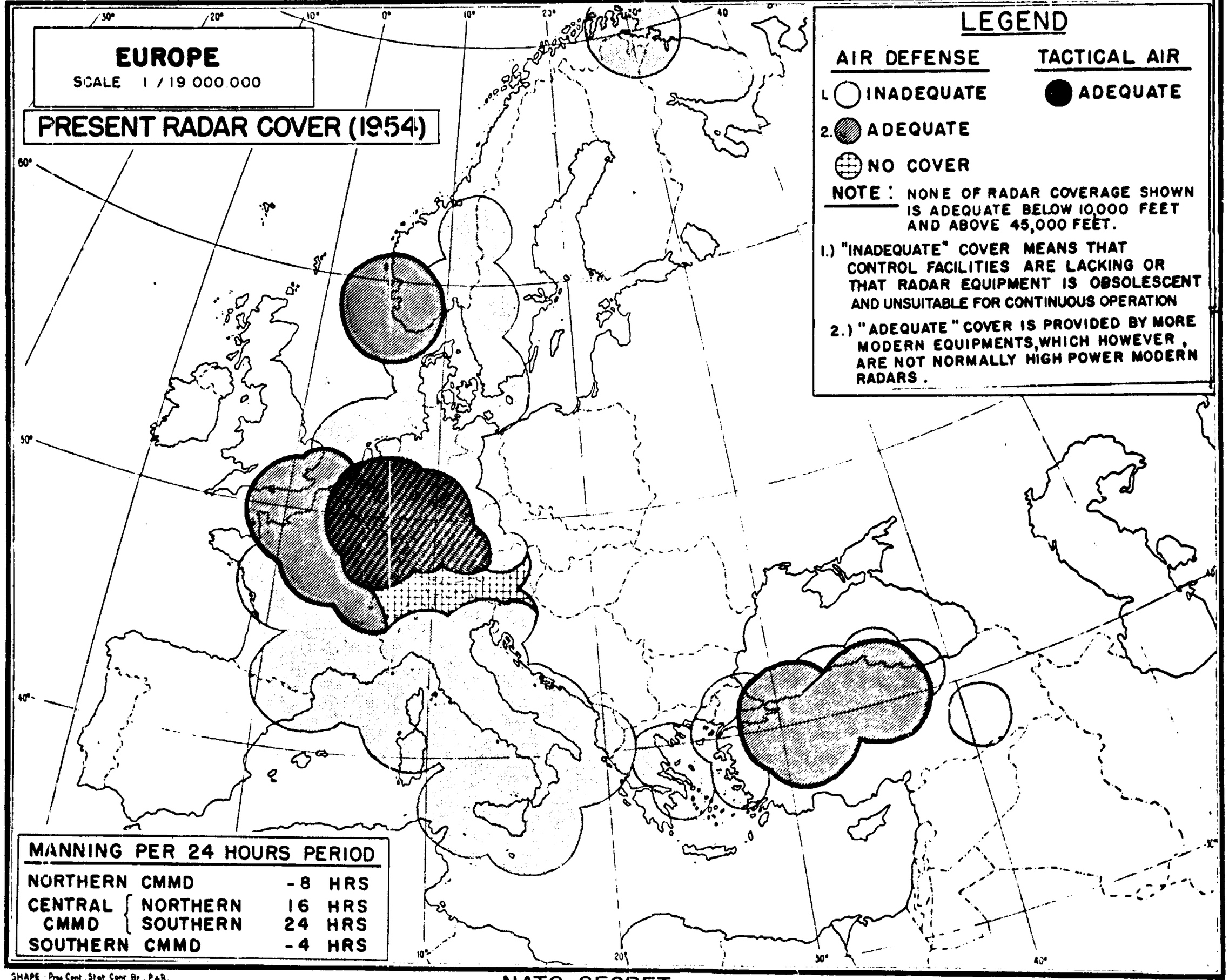
SHAPE - Pres Cont., Stat Cont. Br., P&R.

SOURCE: Air Def Study Group, SHAPE

EUROPE

SCALE 1 / 19.000.000

PRESENT RADAR COVER (1954)



LEGEND

AIR DEFENSE	TACTICAL AIR
1. INADEQUATE	ADEQUATE
2. ADEQUATE	
NO COVER	

NOTE: NONE OF RADAR COVERAGE SHOWN IS ADEQUATE BELOW 10,000 FEET AND ABOVE 45,000 FEET.

1.) "INADEQUATE" COVER MEANS THAT CONTROL FACILITIES ARE LACKING OR THAT RADAR EQUIPMENT IS OBSOLESCENT AND UNSUITABLE FOR CONTINUOUS OPERATION

2.) "ADEQUATE" COVER IS PROVIDED BY MORE MODERN EQUIPMENTS, WHICH HOWEVER, ARE NOT NORMALLY HIGH POWER MODERN RADARS.

MANNING PER 24 HOURS PERIOD

NORTHERN CMMD		- 8 HRS
CENTRAL CMMD	NORTHERN	16 HRS
	SOUTHERN	24 HRS
SOUTHERN CMMD		- 4 HRS

SHAPE - Pro Cont, Stat Contr Br, P&R.

SOURCE: RADAR SEC, SIG DIV.

COSMIC TOP SECRET

EUROPE

SCALE 1 / 19.000.000

RADAR COVER IN 1957

CHART I

LEGEND

—— PLANNED COVER

---- PROPOSED " "

✦✦✦✦ MOBILE STATIONS

SHAPE · Pres.Cont., Stat. Cont. Br., P&R. 28 SEPT. 54

COSMIC TOP SECRET

CHART K

EUROPE

SCALE 1 / 19.000.000

INTERCEPT LINES 1957

LEGEND

— PLANNED

- - PROPOSED

30° 20° 10° 0° 10° 20° 30° 40° 50° 60° 70°

50°

40°

10° 0° 10° 20° 30° 40°

SHAPE - Pres Cont., Strat. Cont. Br., P&R, 23:9:54

COSMIC TOP SECRET

EUROPE

SCALE 1 / 19.000.000

CHART J

INTERCEPTION LINES WITH EXISTING RADAR COVER (1954)

LEGEND

ENEMY IL28 SPEED 438KNTS | FIGHTER F86 SPEED 500 KNTS

ALTITUDE 20000'

FORWARD DISTANCE F86 50 NAUTICAL MILES

- RADAR COVER
- PENETRATION LINE
- INTERCEPTION " "
- DIRECTION OF THE ATTACKS

MANNING – PER 24 HRS PERIOD

NORTHERN COMMAND		8 HRS
CENTRAL COMMAND	NORTHERN.	16 -
	SOUTHERN	24 -
SOUTHERN COMMAND		4 -

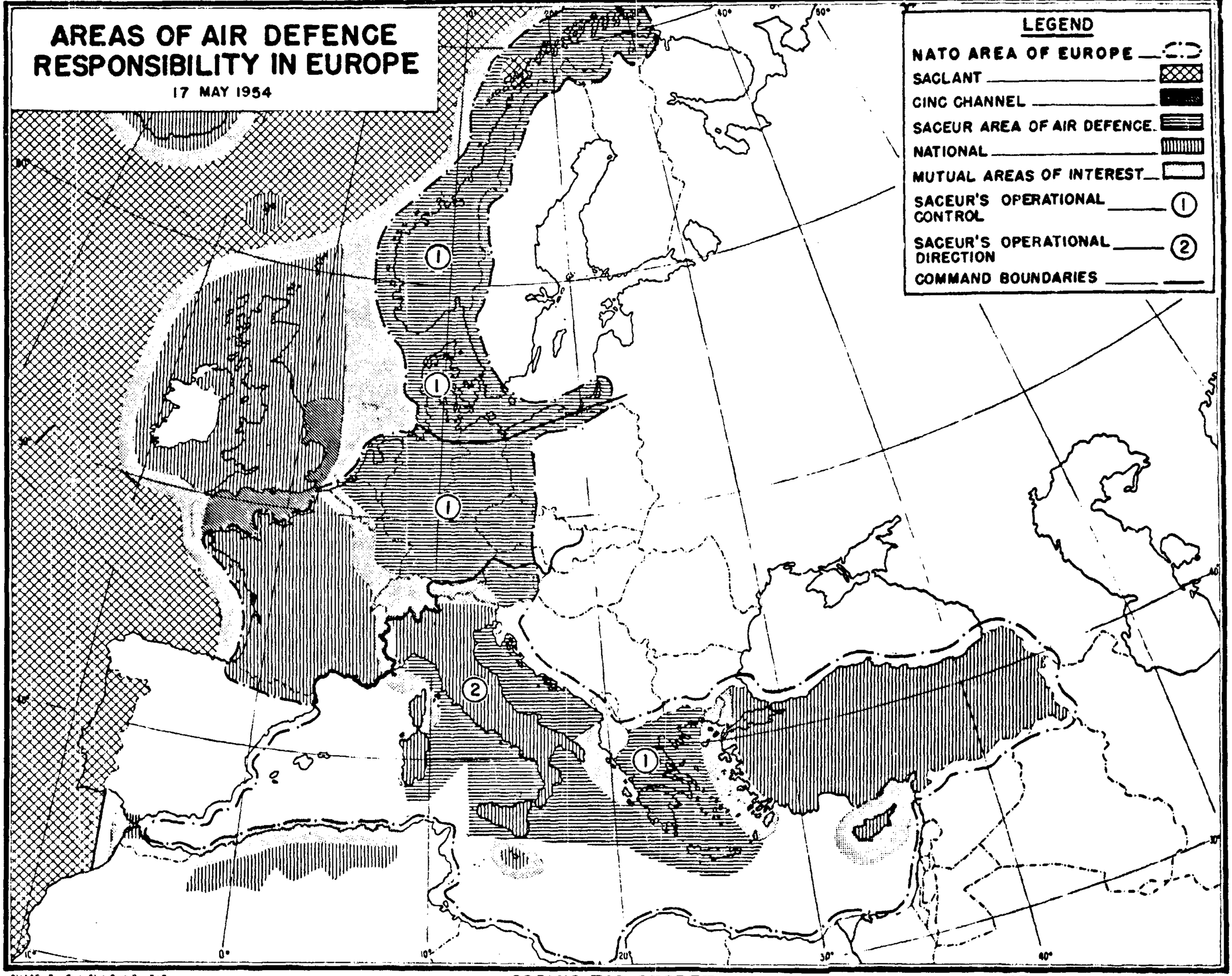
SHAPE - Prog. Cont., Strat. Comt. Br., P&R.

COSMIC TOP SECRET

SOURCE : DIO DIV SHAPE - 20 SEPT 56
PREPARED BY : GRAPHIC PRESENTATION CENTER

AREAS OF AIR DEFENCE RESPONSIBILITY IN EUROPE

17 MAY 1954



SHAPE - Pres. Cont., Stat. Cont. Br., P&R.

SOURCE: AIR DEF STUDY GROUP, SHAPE

CHART "I"

KEY POINTS IN NATO AREA OF EUROPE *, 1954

Table 1. Key Points Requiring H.A.A. Defence

NATION or ALLIED COMMAND	Key Points Category 1.a.	Key Points Category Other	SHAPE Estimate of Key Points for which H.A.A. Defence is available. Adequate Defence with Modern Equipment NUMBER	SHAPE (b) estimate of combat efficiency	Defence with obsolete equipment NUMBER
NORWAY	8(a)	-(c)	NIL	-	6
DENMARK	6	8	1	60%	1
NETHERLANDS (incl Allied LofC)	10(c)	-	-		1
BELGIUM (incl Allied LofC)	6(c)	0	1	25%	-
N.A.G. Combat Zone	18(c)	0(c)	6	75%	-
C.A.G. Combat Zone	12(c)	14(c)	7	85%	-
FRANCE (incl Allied LofC)	77 (plus 30 in Paris Area)	9(c) (all USAREUR)	3	40%	15
ITALY	22	82	NIL	-	26
S.E. Combat Zone	19	23	NIL	-	20
GREECE	15	6	NIL	-	NIL
TURKEY	28	-	NIL	-	1?
MALTA	1	-	1	90%	-
T O T A L	222	142(d)	19		82

* As defined in para 14 of the SHAPE Air Defence Study

(For Table 2 and notes - see next page)

Table 2. Key Points Requiring L.A.A. Defence

NATION or ALLIED COMMAND	Key Points Category		SHAPE Estimate of Key Points for which an Adequate Scale of Defence is available
	l.a.	Other	
NORWAY	9	-	6
DENMARK	20		8
NETHERLANDS	18	0	6
BELGIUM	9	0	9
N.A.G. Combat Zone	40	0	28
C.A.G. Combat Zone	[illegible]	42	17
FRANCE	[illegible]	26	13
ITALY	39	100	3
S. EUR. Combat Zone	19	25	10
GREECE	46	44	4
TURKEY	145	-	19
MALTA	1		1
TOTAL	507	237	124

GENERAL NOTES:- 1. The systems of categorization of key points used by the various nations vary. As far as possible SHAPE has assessed the categories in the key points lists submitted by the nations, calling all key points shown in the highest category as "l.a".

2. L.A.A. defence is based at present on the Bofors L/60 gun which is obsolescent.

3. Expected speed and height of attack for H.A.A. defence has been taken at 500 mph at 15,000 feet.

4. This table should only be accepted as a <u>calculated approximation</u>.

References: a. Key points list still under study at Northern European Key Points Committee.

b. The estimated state immediately on completion of mobilisation, taking into account equipment, training, logistic support and reserves of equipment and ammunition.

c. Accepted by C.I.A.A. Committee.

d. Incomplete.

COSMIC TOP SECRET

ANTI-AIRCRAFT FORCES IN NATO AREA OF EUROPE *
UNITS PLANNED TO BE MOBILIZED ON OR SHORTLY AFTER M-Day AND EQUIPMENT AVAILABLE

CHART "N"

1954

	NORWAY		DENMARK		NETHLNDS		BELGIUM		BAOR		USAREUR		FRANCE		ITALY		MALTA		GREECE		TURKEY		TOTAL	
TYPE OF UNIT	HAA BTYS	LAA GUNS	HAA BTYS	LAA GUNS	HAA BTYS	LAA GUNS	HAA BTYS	LAA GUNS	HAA BTYS	LAA GUNS	HAA BTYS	LAA GUNS	HAA BTYS	LAA GUNS	HAA BTYS	LAA GUNS	HAA BTYS	LAA GUNS	HAA BTYS	LAA GUNS	HAA BTYS	LAA GUNS	HAA BTYS	LAA GUNS
UNITS PLANNED	45	379	15	288	40	448	64	604	18	564	28	384	184	1888	103	332	20	144	Nil	282	101	652	618	5965
EQUIPMENT AVAILABLE	4	387	13	279	3	492	10	752	18	564	28	384	35	1890	5	533	20	144	Nil	336	Nil	728	142	6489
AMMUNITION IN DAYS RATE "C"	21	30	13	15	30	30	1	2	55	22	90	90	14	34	3	7	20	20	Nil	20		14		

1957

UNITS PLANNED	45	428	25	397	88	1120	104	816	18	564	28	384	184	1888	136	380	20	144	Nil	282	92	1732	740	8881
EQUIPMENT PLANNED	29	442	25	349	25	492	104	916	18	564	28	384	147	1890	136	533	20	144	Nil	336	Nil	728	53..	6778
AMMUNITION IN DAYS RATE "C"	21	40	30	30	30	30	7½	7½	90	90	90	90	40	45	45	90	20	20	Nil	20		14		

Remarks : HAA BTYS are expressed in terms of batteries completely equipped with modern equipment.

* As defined in para 14 of SHAPE Air Defence Study.

COSMIC TOP SECRET

CHART "O"

SUMMARY OF ANTI-AIRCRAFT REQUIREMENTS IN THE NATO AREA OF EUROPE *

COUNTRY	SAGW BNS	HAA BTYS	LAA GUNS
NORWAY (Incomplete)	4	94	896
DENMARK	6	119	1046
NETHERLANDS		102	1538
BELGIUM		134	1464
B.A.O.R.		26	300
U.S.A.R.E.U.R.		33	376
C.E. COMBAT ZONE	8		
FRANCE	12	577	5452
ITALY	7½	483.	3396
MALTA	1	24	144
GREECE	3	163	1732
TURKEY	3	303	3316
T O T A L	44½	2058	19660
ADDITIONS			
HAA FOR NATO AIRFIELDS		1449	
AA DEFENCE FOR NATIONAL AIRFIELDS *		648	2304
GRAND TOTAL	44½	4130	21964

* With runways over 6,000 feet

* As defined in para 14 of the SHAPE Air Defence Study

(Continued)

CHART "O" (Contd.)

ANTI-AIRCRAFT REQUIREMENTS

COUNTRY	COMBAT FORCES	NATO AIRFIELDS	KEY POINTS	TOTAL	REMARKS
NORWAY (Incomplete)					No national key-points list yet received at SHAPE
SAGW BNS	Nil		4	4	
HAA BTYS	20	Nil	74	94	
LAA GUNS	224	288	384	896	
DENMARK					
SAGW BNS			6	6	
HAA BTYS	20	Nil	99	119	
LAA GUNS	224	224	598	1046	
NETHERLANDS					
SAGW BNS		(Covered by	Combat	Forces	Network)
HAA BTYS	26		76	102	
LAA GUNS	300	416	822	1538	
BELGIUM					
SAGW BNS		(Covered by	Combat	Forces	Network)
HAA BTYS	33		101	134	
LAA GUNS	376	448	640	1464	
NORTHERN ARMY GROUP					Out of Belgium, Netherlands, and BAOR Combat Forces
COMBAT ZONE					
HAA BTYS			76	76	
LAA GUNS		416	320	736	
B.A.O.R.					
HAA BTYS	26			26	
LAA GUNS	300			300	
U.S.A.R.E.U.R.					
HAA BTYS	33			33	
LAA GUNS	376			376	
C.A.-G. COMBAT ZONE					To be covered by French and USAREUR Combat Forces
HAA BTYS			150	150	
LAA GUNS		672	1890	2562	
CENTRAL EUROPEAN COMBAT AND COMMUNICATION ZONE		(Overall Area	Defence)	8	
SAGW BNS					
FRANCE (Including UK and US Ls of C)					
SAGW BNS			12	12	Note: US List is incomplete
HAA BTYS	33		544	577	
LAA GUNS	376	1440	3636	5452	
ITALY					
SAGW BNS			7½	7½	
HAA BTYS	80		403	483	
LAA GUNS	896	672	1828	3396	
GREECE					
SAGW BNS			3	3	
HAA BTYS	33		130	163	
LAA GUNS	376	192	1164	1732	

(Continued)

CHART "C" (Contd)

ANTI-AIRCRAFT REQUIREMENTS

COUNTRY	COMBAT FORCES	NATO AIRFIELDS	KEY POINTS	TOTAL	REMARKS
TURKEY					
SAGW BNS			3	3	
HAA BTYS	80		223	303	
LAA GUNS	896	352	2068	3316	

NOTES ON REQUIREMENTS:

1. These requirements are based on the following sources:

a. National anti-aircraft key-points lists, supplied by all countries except Norway. Only priority 1A key-points have been considered.

b. Allied key-points lists drawn up by the Central European Anti-aircraft Defence Committee. Unfortunately, this Committee had been awaiting for over a year the list of key-points to be furnished by EUCOM of the key-points on the US lines of communication across France. Only a list from USAREUR has as yet been received. Thus, the list of US key-points is incomplete.

c. List of NATO airfields in Allied Command Europe.

d. The anti-aircraft forces required in the Land Combat Forces in accordance with SHAPE/582/52.

2. The anti-aircraft defence of national key-points in Western Germany has not been considered as SHAPE has no German key-points list.

3. It is emphasized that the basis on which the defence of these key-points has been calculated is "minimum defence" - i.e. the minimum anti-aircraft defence required to ensure that every enemy aircraft attacking singly from whatever direction within the effective operational ceiling of the defence will be engaged by the defence for a period of 30 seconds before bomb release by at least one battery of 4 Heavy anti-aircraft guns, or can be engaged by two light anti-aircraft guns. As regards heavy anti-aircraft defence, the operational ceiling has been taken as 15,000 feet, and the speed of attack as 500 m.p.h.

4. No Heavy anti-aircraft or surface-to-air guided weapons defence has been allocated to individual airfields. Certain airfields, within already established anti-aircraft defended areas, are given incidental protection.

If heavy anti-aircraft defence were allotted to all NATO airfields, the overall total requirement would increase by 1449 anti-aircraft batteries. (LAA has been included in plans for these fields already). If this defence were allotted in addition to all national airfields, the additional requirement would be increased by 648 heavy anti-aircraft batteries and by 2304 light anti-aircraft guns.

5. Insufficient information is available on S.A.G.W. and, therefore, the guided weapon requirement is only an estimate.

As regards HAA and LAA defence, proper anti-aircraft reconnaissances of key-points have not yet everywhere been carried out. The figures for HAA and LAA defence can only be considered as a <u>calculated approximation</u>.

In spite of every care in calculation the figures of requirements can therefore only be considered as an order of magnitude.

6. It is well realized that the final requirement is so large as to be unattainable.

It will be necessary to decide on the proportion of anti-aircraft defences which it is practically possible to set up, and on the balance between the various types of weapons in this defence system.

Key-points must be listed in order of absolute priority for defence, and only those key-points to which it is possible to allot adequate defence will be defended. All others will be without anti-aircraft defence. The temptation to scatter anti-aircraft defence over a large number of key-points must be resisted.

CHART "P"

ANTI-AIRCRAFT DEPLOYMENT DATES

NATION	Date of Mob.	SHAPE Estimate of completion of deployment (in days)			
		H.A.A. Def. First	H.A.A. Def. Last	L.A.A. Def. First	L.A.A. Def. Last
NORWAY	R.A.	M+2	M+7	M+2	M+5
DENMARK	R.A.	M+3	M+5	M+3	M+4
NETHERLANDS	S.A.	M+½	M+2	M+½	M+2
BELGIUM	S.A.	M+1	M+2	M	M+2
BAOR	Active	M+½	M+2	M	M+2
USAREUR	Active	M+½	M+1	M	M+1
FRANCE	S.A.	M+2	M+14	M	M+7
ITALY	R.A.	M+2	M+10	M+2	M+7
MALTA	Active	M	?	M	?
GREECE	R.A.	-	-	M	M+3
TURKEY	R.A.	M+1	M+10	M	M+7

R.A. = Reinforced Alert

S.A. = Simple Alert

COSMIC TOP SECRET

CHART "Q"

TABLE OF AA RESERVIST TRAINING

NATIONAL DEFENCE AA UNITS

NATION	COLOUR SERVICE	RESERVE TRAINING
SHAPE Standard	2 years	One 2-hour period per week individual training. Fourteen days unit training, including practice firing, every year.
NORWAY	1 1/3 years	Three weeks every four years.
DENMARK	1½ years	NIL
NETHERLANDS	1¾ years	One month every year,
BELGIUM	NIL	First eight months: 32 two-hour periods. Next two years : 10 two-hour periods per year. One six-day exercise per year. Thereafter: One six-day exercise every two years. NOTE: Increase of about 50% under present consideration.
FRANCE	1½ years	Legally three weeks every three years; in practice every five years
ITALY	1 1/3 years	Certain selected officers and specialists are called up once during the period of reserve service. Otherwise NIL.
GREECE	2 Years	NIL
TURKEY	2 years	NIL

 CHART "R"

ALLIED FIGHTERS - TABLE 1954 TO 1957

SHAPE ESTIMATE

OF AVAILABILITY AND REQUIREMENTS

M. C. 26/3

	1954			1955			1956			1957		
	IDF	AWX(F)	AWX(I)	IDF	AWX(F)	AWX(I)	IDF	AWX(F)	AWX(I)	IDF	AWX(F)	AWX(I)
NORTH												
DENMARK	16	16	-	25	16	-	25	16	-	25	32	-
NORWAY	-	-	-	-	-	-	-	25	-	-	50	-
TOTAL	16	16	-	25	-	-	25	41	-	25	82	-
REQUIREMENTS	200	96	32	200	96	32	200	96	32	200	96	32
CENTRE												
BELGIUM	192	8	-	192	8	-	192	48	-	192	64	-
CANADA	300	-	-	300	-	-	300	-	-	300	-	-
FRANCE	150	-	-	144	-	-	144	-	-	225	-	-
NETHERLANDS	112	-	-	128	-	-	128	16	-	144	48	-
PORTUGAL	-	-	-	-	-	-	-	-	-	-	-	-
U.K.	220	64	32	220	64	32	198	64	32	176	64	32
U.S.	100	100	-	100	100	-	100	100	-	100	100	-
TOTAL	1074	172	32	1084	172	32	1062	228	32	1137	276	32
REQUIREMENTS	1550	352	272	1550	352	272	1550	352	272	1550	352	272
SOUTH												
ITALY	150	-	-	150	48	-	150	48	-	150	48	-
U.S.	-	-	-	-	-	-	-	-	-	-	-	-
ITALIAN AREA	150	-	-	150	48	-	150	48	-	150	48	-
REQUIREMENTS	375	96	24	375	96	24	375	96	24	375	96	24
GREECE	25	-	-	75	-	-	75	12	-	75	12	-
REQUIREMENTS	100	24	24	100	24	24	100	24	24	100	24	24
TURKEY	50	-	-	75	-	-	75	-	-	150	-	-
REQUIREMENTS	225	72	-	225	72	-	225	72	-	225	72	-
TOTAL SOUTH	225	-	-	300	48	-	300	60	-	375	60	-
REQUIREMENTS	700	192	48	700	192	48	700	192	48	700	192	48
SACEUR	1315	188	32	1409	236	32	1387	329	32	1537	416	32
REQUIREMENTS	2450	640	352	2450	640	352	2450	640	352	2450	640	352

SOURCE: SHAPE OT/16/54 - 15 March 1954.