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19,195

Continental Air Defense Command
Air Defense Command

HISTORICAL STUDY NO. 10

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SEAWARD EXTENSION OF RADAR
1946-1956

By Lydus H. Buss

Directorate of Historical Services
OFFICE OF INFORMATION SERVICES

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foreword

It is a truism that while offensive action begins at the moment enemy aircraft or missiles become airborne, defensive action can not begin until knowledge is gained of the enemy attack. Thus, the problem is to find a means of learning of the attack as soon as possible.

In the immediate post-World War II days, air defense planners saw a need for lines of radar placed far beyond the nation's borders. But the warning system had to be started from scratch and built as the money and resources became available. The Air Force started by placing a few radars around a small number of vital targets inside the country. Gradually, the warning lines were expanded outwards from the vital targets to the nation's borders. Only by 1956, the tenth year of post-war air defense, were warning lines north of our borders and off-shore going into place. This study tells of one segment of this growth -- the effort to put radar off shore.

This study is organized into five sections. The first is introductory and covers the early planning for airborne early warning aircraft and picket ships. The second tells the story of the airborne early warning and control force. The third covers the picket ship history. The story of Texas Towers is told in the fourth section. The last section contained in chapter seven, gives a picture of the off-shore forces at the end of 1955 and of the shape of things to come.

The study was drawn from a wide variety of sources -- official

correspondence and publications from the Joint Chiefs of Staff down to and including ADC squadrons, interviews with CONAD staff officers, official histories of ADC units (and in one case of a Navy unit), personal observation at an AEW&C unit and aboard a Navy ship, and secondary sources such as published articles and books. As in any historical study, however, only a relatively small part of the vast amount of information on the subject could be told. Readers desiring more information are invited to use any of the documents cited in the reference notes. These documents are available at the CONAD/ADC Directorate of Historical Services and in the USAF Historical Division.

Notification of any errors found by readers will be greatly appreciated.

L. H. B.

Colorado Springs, Colorado
31 December 1955

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Chapter One

EARLY PLANNING

Plans In The Immediate Post-War Period

In designing the post-war air defense system, military planners knew that the earlier the warning of the approach of hostile bombers the better. They saw a need for placing radar beyond the northern borders. And because some fifty percent of the nation's vitally important targets were concentrated within 150 miles of the coasts, they saw a need for extending radar seaward.[1]

But advance warning was not the only consideration; the ability to engage approaching raiders before they reached our shores was also needed. The combat radius of the interceptor aircraft was about twice that of the range of the shore-based radar. To make it possible to control interceptors at the limits of their range, radar had to be placed off shore.

As early as the spring of 1947, air defense planners began thinking of possible locations for radars outside the country. In April of that year, a newly formed joint Canadian-United States planning agency, which was directly under the respective chiefs of staff, issued a plan on early warning.[2] This group proposed the building of an early warning line across Alaska, Canada, Greenland, Newfoundland, and off both coasts. Their plan was to have both radar-equipped ships and planes patrolling off shore. The

plan was never acted on, however.

The following year, the Air Defense Command proposed establishment of early warning lines.* ADC's suggestion was made following USAF's approval of an aircraft control and warning plan for the continental United States, called Plan SUPREMACY. But this plan, a rather ambitious scheme for the time, did not get through Congress. A smaller program which became the so-called "Permanent System," was passed later. However, after USAF approved SUPREMACY, ADC planners stated their view that "coverage along the coasts must be extended by radar picket boats or airborne early warning stations in order to provide adequate early warning for interception before bomb release line is reached by high speed hostile flights."[3] As ADC saw it in 1948, an early warning belt was needed from Hawaii to Alaska and across the northern border of Canada, down through Greenland and Newfoundland, and off the eastern shore to Puerto Rico. The following map, which was reproduced from the original made at the time, illustrates the area where ADC wanted early warning lines.

USAF was thinking along similar lines. An Air Defense Policy Board in Washington concluded in early 1948 that "seaward surveillance and control is necessary to effective air defense."[4] To provide this, the board recom-

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* This was the first of two post-war Air Defense Commands. The first command was activated in March 1946 and abolished in July 1950. Before its abolition, from 1 December 1948, this ADC served as an operational command under the Continental Air Command. The second postwar ADC was activated in January 1951. Lieutenant General George E. Stratemeyer commanded the first ADC until it went under ConAC, at which time Major General Gordon P. Saville took over. General Stratemeyer headed ConAC until April 1949 when he was succeeded by Lieutenant General Ennis C. Whitehead. General Whitehead went on to command the second ADC. For an account of air defense organization from 1946 on, see CONAD/ADC Historical Study #9, Organization and Responsibility for Air Defense, March 1946 - September 1955.


THE AIR DEFENSE SYSTEM
U.S.S.R. & SATELLITES
EARLY WARNING BELT
PROPOSED
ARCTIC
THEATER
EARLY WARNING BELT

mended that the Air Force investigate the use of airborne early warning planes and Navy picket ships.

The Air Force had to turn to the Navy for picket ships and for advice on AEW aircraft. By 1948, they Navy had had several years experience in using both. Radar-equipped picket ships had been used with the fleets during World War II and AEW aircraft had been developed in the closing days of the war.

The AEW aircraft was developed as a result of the low-level suicide attacks made on the Pacific fleets by Japanese planes. These attacks were meeting with some success in late 1943 and the Navy sought a means to extend the range at which the Japanese planes could be detected. They came in too low for ship-board radar to detect until they were within 20 to 25 miles.[5]

One answer was to station picket ships at some distance from a task force to give early warning. A disadvantage in this was that the pickets themselves became casualties at a rapid rate.

Another answer was to place a powerful long-range search radar in a carrier-based type aircraft. Various agencies went to work on the problem, and by 1944 an operating model of the radar, later designated the AN/APS-20, was built.[6] The only carrier-type plane that could accommodate the equipment and the crew needed was the Grumman torpedo-bomber, the TBM. By war's end, 27 of them, designated TBM-3W after modification, had been assigned to carriers. None reached the combat zones, however, before the end of the war with Japan.

Following this initial work, the Navy went on to modify a number of B-17's for airborne early warning operations.[7] To the basic parts of the system in the TBM's, they added an indicator system, the AN/APA-53, which

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consisted of four 12 inch position indicators. This made possible the evaluation of radar data and thus constituted the first airborne combat information center. Fighter direction, in addition to early warning, could be achieved. Fighter control capability was limited, however, for there was no height finder. The modified B-27's were termed PB-1W's.

The Navy's next step was to get a larger aircraft and to install additional and improved equipment. They chose the Lockheed standard Constellation (not to be confused with the Super Constellation, a later development). In this plane, the Navy placed a height finder, the AN/APS-45. A greatly improved search radar, the AN/APS-20B, which had greater range, and an improved indicator, the AN/APS-56, were installed. This indicator had five 12 inch PPI scopes. The modified Constellation was termed the PO-1W. This was later changed to the WV-1.

Meanwhile, in 1945, the Air Force had begun studying the possibilities of an airborne control center, primarily for strategic use.[8] But because of duplication of effort and the fact that the Navy had two years head start, the Air Force stopped its general research the following year. It agreed to use the basic Navy radar and to concentrate on the problem of airborne moving target indicators and height finding. Even this was stopped, however. In the fall of 1948, the Air Force suspended all work because of lack of funds, with the understanding that the Navy would continue research.

Navy Responsibility In Air Defense

Thus, it was well-nigh impossible for the Air Force to get a radar screen off shore without Navy help. The basis of inter-service cooperation

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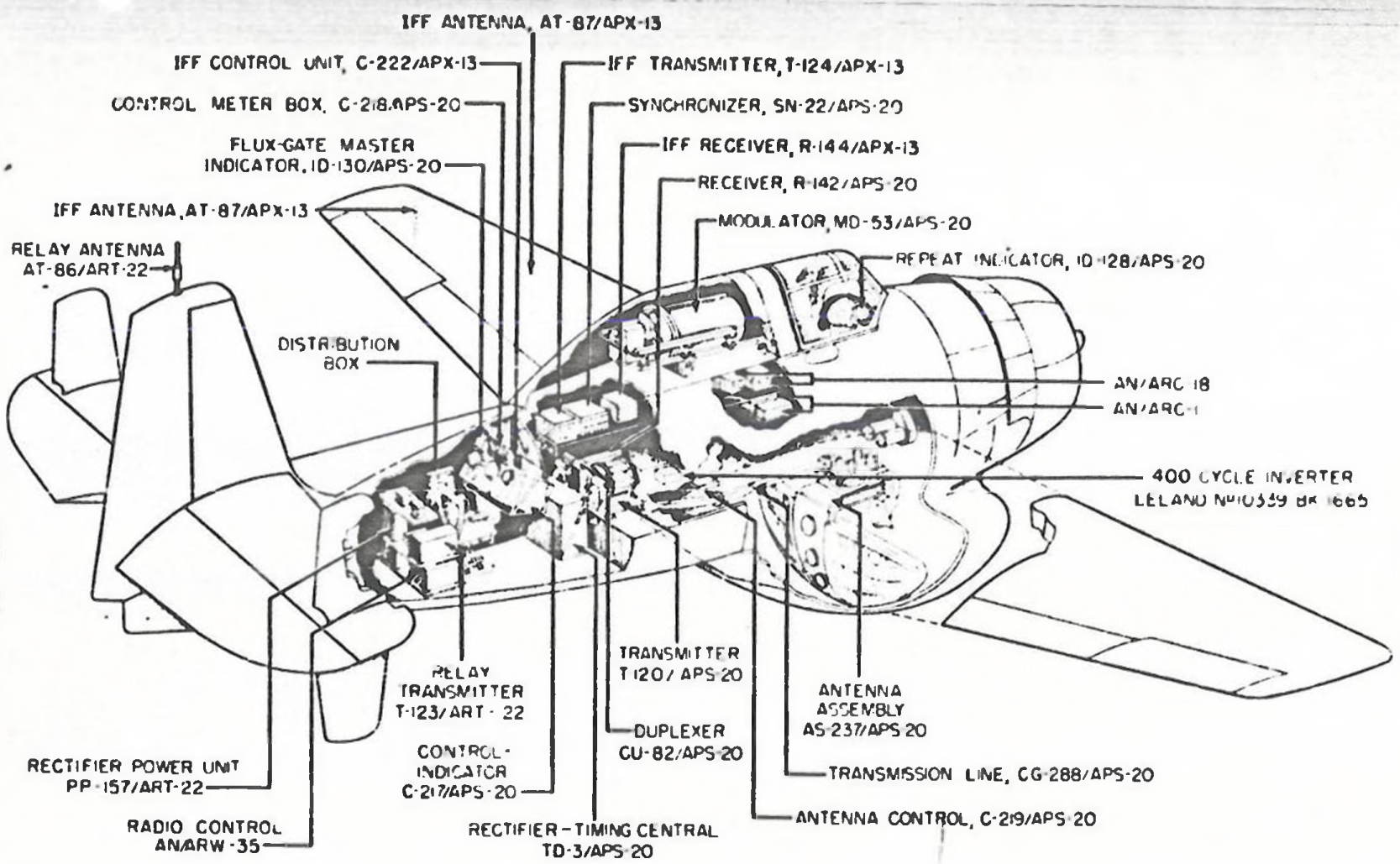

The First AEW Aircraft - The Navy TBM-3W

SOURCE: VC-11, U.S. Pacific Fleet Air Force, Basic Concepts of Air-Borne Early Warning System, 7 December 1949.

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in the post-war period was laid at Key West, Florida, in the spring of 1948. At this small resort city in the Florida Keys, the Joint Chiefs of Staff agreed on the functions of the armed forces. In regard to air defense, the Chief of Naval Operations agreed for the Navy:[9]

> To provide sea-based air defense and the sea-based means for coordinating control for defense against air attack, coordinating with the other Services in matters of joint concern.
>
> To provide naval (including naval air) forces as required for the defense of the United States against air attack, in accordance with joint doctrines and procedures approved by the Joint Chiefs of Staff.

Not until the creation of the Continental Air Defense Command in late 1954, however, were any jointly approved doctrines or procedures issued by the JCS. In the meantime, the Navy took part in air defense on the basis of interim policies set down by the Chiefs of Naval Operations.

In the first such policy statement issued following the Key West conference, the Chief of Naval Operations drew up a number of basic principles which, for lack of a combined JCS policy, were to serve for many years. He decreed that the guiding principle for naval participation in air defense was that "naval forces having important air defense capabilities will be trained and prepared for emergency employment to reinforce and augment forces regularly assigned to this function."[10] But, he stressed, except for naval forces specifically allocated by the JCS, "a routine and continuing peacetime commitment of naval forces to continental air defense is not intended."[11]

As for picket ships, the CNO stated that availability of ships regularly assigned to the operating forces of the fleets for air defense was to be decided by the fleet commanders. When picket ships were employed in an emer-

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gency or for joint training, operational control was to be in the hands of the air defense commanders concerned.

The CNO's statement, it should be noted, was made prior to any formal requirement given to him by the Air Force for picket ships. Thinking had not yet crystallized on picket ship needs at this time. Thus, it is not surprising that the only specific statement about picket ships was on availability in an emergency.

He did point out, however, that the Commanders of the Atlantic and Pacific Fleets had been made responsible for defense of the nation against attack through the Atlantic and Pacific oceans. He interpreted this to include responsibility for air defense in these areas beyond the area responsibility of the Air Force. He considered the Air Force area of responsibility to extend to the seaward limits of the fighter aircraft control system. He did not, however, give any indication of how this air defense part of the fleet commanders job was to be met.

In order to set up interim procedures for training and emergency employment, the CNO directed that agreements be made between appropriate Navy and Air Force commands. Agreements for the Navy were to be made by the sea frontiers.

The first agreement between a sea frontier and an air defense force, which was the nearest Air Force equivalent to the sea frontiers, was reached in December 1949 between the Eastern Sea Frontier (ESF) and the Eastern Air Defense Force (EADF).

The ESF commander agreed to allocate Navy forces under his jurisdiction, which were not more urgently needed by the Navy, to the operational control

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of the EADF commander in an emergency.[12] Included in these forces were airborne early warning aircraft and picket ships. Local Navy commanders were directed by the agreement to see that their crews were familiar with air defense operating procedures.

The two eastern commands followed this agreement with another in late 1950 on specific procedures for joint training. But only two types of training were provided -- fighter and airborne early warning.[13] Picket ship training procedures were not specifically enumerated until the next year when a new agreement was made.[14] However, picket ships took part in joint training exercises much earlier.

At the same time (1951) that this training agreement was negotiated, EADF made a new agreement with ESF on responsibilities and procedures for emergency employment. No significant changes in concept or procedures were made; the purpose being to bring the agreement up to date by including the latest command and boundary changes.[15] The new Central Air Defense Force, which had been activated in March 1951, joined EADF in negotiating this new agreement and the territory and responsibilities of both were covered.

On the west coast, the Western Air Defense Force made similar arrangements with the Western Sea Frontier. In an agreement signed in May 1950, the WSF commander pledged the training of his forces and their allocation in an emergency if possible.[16] As did EADF, WADF rewrote its agreement in 1951 to incorporate the latest boundary and organizational changes.[17]

Airborne Early Warning For Air Defense

The first concrete action for extending the lines of warning seaward was taken at the end of 1949. The Chief of Naval Operations, apparently on his

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own initiative, suggested the possibility of using airborne early warning planes for both anti-submarine warfare and air defense.[18] He recommended that tests be held to determine the feasibility of such operations. If they proved successful, a joint policy was to be issued. The Air Force endorsed his proposal enthusiastically, directing the Continental Air Command to set up a testing program for the air defense part.[19*]

ConAC handed WADF the assignment because the Navy had been using AEW aircraft primarily on the west coast. During 1950, Navy AEW planes -- converted B-17's -- took part in exercises and other joint training.[20**] Later, tests were extended to the EADF and its stations worked with Navy aircraft in the fall of 1950.

Early in 1951, the Air Defense Command asked WADF and EADF for their thinking on AEW in air defense to include their requirements, if any.[21] Both felt that operation of AEW aircraft was too costly for continuous over-water radar extension, but EADF liked the idea better than WADF.

EADF recommended that two squadrons of 24 aircraft each be provided for the defense of the eastern United States.[22] EADF's plan was to base one squadron at Limestone, Maine, and the other in the Duluth, Minnesota, area; the idea being to protect the seaward and polar approaches.

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* In order to keep the record of changing commands straight, a note of explanation is appropriate. On 1 December 1948, the Continental Air Command was established and the Air Defense Command and the Tactical Air Command were assigned to it. ConAC was given the missions and resources of both organizations. On 1 July 1950, the Air Defense Command was abolished but was re-established as a major command on 1 January 1951.

** Navy AEW planes had participated in west coast exercises earlier. In Exercise BLACKJACK, held in June 1949 in the northwest, Navy AEW aircraft operated on a limited basis.

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WADF said that about 19 aircraft could be used on the west coast, deployed in no fixed locations, but used as mobile auxilliaries to the AC&W system. But WADF had doubts about the wisdom of using AEW aircraft at all. Picket ships might be better:[23]

> In the development of a program to extend early warning over the sea approaches to target areas within the United States, the capability of picket ships should be seriously compared to the capability of the early warning aircraft in view of the cheaper cost of operation of the picket ships.

Both defense forces agreed that the PB-1W (the modified B-17) and its equipment was not satisfactory for air defense. They felt that possibly the Constellation, which the Navy was equipping for AEW work, might do the job.

This was also the thinking of the plans people at ADC Headquarters. They wanted the dependability of a four-engine aircraft, one with exceptional range, provisions for minimizing crew fatigue, and ready availability from an active production line. The latter factor was particularly important in order to get some extension of coverage off shore as soon as possible. The Lockheed Constellation seemed to fit the bill. In March 1951, the Plans and Requirements Director, Colonel Kenneth P. Bergquist, told the staff that:[24]

> Since the Navy has adopted the Constellation as the vehicle for the airborne equipment, it is considered that it would be uneconomical in both time and money, particularly time, to attempt to use any other type aircraft. Basic Constellations are now being produced for the airlines. With the Navy having already contracted for four additional PO-1Ws to be available by 1 January 1952 it would appear reasonable that if the contract were increased and if no major changes were made in the specifications, an additional 15 or 20 could be available by about 1 April 1952.

The following month, Lieutenant General Ennis C. Whitehead, ADC's Commander, submitted a formal requirement for AEW equipment.[25] He requested that initially ADC be given five squadrons. One was to be placed along the northern

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border and two each on the northwest and northeast coast.

USAF agreed with the requirement, having already given consideration to the need for AEW planes in other commands as well as ADC. It decided, however, to get a larger model of the Lockheed Constellation (some 18 feet longer), called the Super-Constellation by the manufacturer. The Navy had already contracted for some of these for its AEW force. It termed them PO-2W's at first, but later called them WV-II's.

A tentative requirement for 48 of these aircraft in the Navy configuration was established by July 1951 for the entire Air Force, of which ADC was to receive the largest share.[26] This figure was soon increased as ADC's needs became apparent. By the end of the year, the command's quota was raised to 56.[27]

Production schedules at the end of 1951 called for delivery to ADC of the first plane in May 1953 and ten, or enough for one squadron, by the following November.[28] All 56 were to be delivered by late 1955.

By September 1951, ADC had chosen tentative locations for three of the squadrons: McChord AFB, Washington; Otis AFB, Massachusetts; and Presque Isle AFB, Maine.[29] ADC substituted Larson AFB for McChord AFB a little later. Early in 1952, it selected McClellan AFB, California, and Newcastle AFB, Delaware, for the other two squadrons.[30]

Thus, ADC's aircraft, which the Air Force termed the EC-121,* were to be procured by the Navy and produced primarily according to Navy specifications.

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* This aircraft was originally designated the RC-121, the "R" meaning reconnaisance. An Air Materiel Command Technical Order, 1-1-81, dated 15 August 1955, established an early warning designation, "E," and the aircraft was re-designated the EC-121. It will be referred to by the latter designation in this study.

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Its basic equipment was to be the Navy-developed "S" band search radar AN/APS-20B (later modified to AN/APS-20E by increasing transmitter reliability) and the "X" band AN/APS-45 height finder.

ADC was to accept the aircraft and equipment before it was tested by the Air Force. Tests were to be made concurrently with operations and with squadron-assigned aircraft. The reasons were to save money; the fact that this plane was already in production; and, probably most important, the necessity to extend the shore coverage as soon as possible.*

In outward appearance the EC-121 looked awkward, having the large (17 foot) search radar antenna slung under the fuselage in a radome and the height finder antenna mounted in a radome on top of the body. The aircraft interior was divided into four main work compartments: the flight deck, forward crew compartment, air operations center, and aft crew compartment. The air operations center (AOC) contained eight operating positions.

Establishing A Requirement For Picket Ships

While attempts were being made to secure airborne early warning aircraft for air defense, efforts were also being made to obtain the use of Navy picket ships. The reasons for wanting both were many. In early 1950, air defense officials felt an urgent need to extend warning time to northern and coastal targets (Russia had set off an atomic explosion the preceding August). They thought that picket ships could be obtained and put into operation much before the Air Force could get and operate a sufficient number of AEW planes. As told above, the schedule at the end of 1951 provided for only ten aircraft by the end of 1953.

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* See Chapter III.

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SECRET

But picket ships were wanted even after AEW planes arrived in large numbers. AEW aircraft, it was believed, could not completely fulfill the early warning requirement; both ships and planes were required to do the job and to give an all-altitude coverage. AEW aircraft, because of their design and limitations, would be used to provide low altitude coverage. Picket ships would provide high altitude coverage. ConAC said that picket ships could be used to solve two major problems: identification of inbound over-water flights, and radar defense in depth around coastal targets.[31]

In January 1950, ConAC proposed establishing eight picket ship stations.[32] Air Force Headquarters agreed to the requirement and suggested raising the number to ten stations, six for the east and four for the west coast.[33] Two ships would be placed off New York, Philadelphia, Norfolk, San Francisco, and Seattle. ConAC agreed and higher headquarters presented the requirement to the Joint Chiefs of Staff in March. No immediate results were obtained, however.

While waiting for high level action, ConAC went ahead on its own to see what could be done. In October, ConAC directed its defense forces to find out what ships the Navy had and whether any could be furnished for air defense.[34]

The defense forces soon found that permanent allocation of picket ships could not be made. The Navy, through its sea frontiers, said that it simply did not have enough picket ships to meet both its and air defense needs.[35]

The Navy was in the position of being asked to do an extra job without being given additional resources. The best that the Navy could offer at this time was temporary allocation in an emergency. On 22 December 1950, the Chief

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of Naval Operations, Admiral Forrest P. Sherman, directed his Atlantic Fleet Commander to arrange his schedules so that two destroyer-type pickets would always be available on 24-hours notice for duty off the east coast.[36] The Navy was going to convert some smaller ships, destroyer-escorts, to radar pickets in 1951 and Admiral Sherman said that he intended to make these available to EADF for emergency use. Two destroyer-escorts radar (DER), USS Harveson and USS Joyce, were scheduled for completion and assignment to the Atlantic Fleet in mid-1951, and four others later in the year.

EADF was not satisfied with this arrangement, however:[37] It said that

> the requirement of this headquarters for a continuous offshore warning, identification and reporting screen is not met by the commitment of two vessels available only in the event of imminent attack.

WADF, which did not have ships allocated even for emergencies, joined EADF in recommending that vigorous action be taken to push the requirement on the Air Force-Navy Department level.[38]

At the end of 1950, ConAC again asked USAF to see what could be done about getting picket ships allocated on full-time duty. The requirement for a minimum of ten stations still existed, ConAC told Washington, "for an acceptable air defense of coastal target areas."[39] The defense forces had found that neither the Eastern nor Western Sea Frontiers had the resources for meeting the requirement. Therefore, action had to be taken at a higher level.

This was done, but to little avail. In January 1951, the Air Force Chief of Staff, General Hoyt S. Vandenberg, told Admiral Sherman that ships for ten stations were needed at the earliest date possible.[40] Admiral Sherman said that ships were not available and that they probably could not be provided before 1954. In return, General Vandenberg replied that they were needed by

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mid-1952 and asked him to re-examine his capability to provide the ships.

While the question was being discussed in Washington, EADF and ESF representatives got together to find the best means of employing the two ships allocated for emergency use. The conferees decided that the capability of picket ships had not been adequately tested in exercises. As a result there was not enough information to develop operating procedures.[41] They decided that a comprehensive test should be made at one location. A Civil Aeronautics Administration reporting point for inbound flights called "Tuna," approximately 130 miles off the coast of New Jersey, was selected.

Operation TUNA, as the test was termed, was held from 20 February through 19 March 1951. One ship was on station at all times during this month. Three ships -- USS Benner, USS Dyess, and USS Bordelon -- were used, each for about ten days. The ships reported to one station, the direction center at Santini, New York, operated by the 685th AC&W Squadron.

The radar on USS Benner, an SC-5, proved unsatisfactory for continental air defense work because of limited range. The SPS-6B on the other two ships was more adequate, having an average range of about seventy miles.[42]

The test was very worthwhile, both because it proved the value of picket ships in air defense and because it uncovered many areas that needed correcting. It showed that warning from the ship made it possible to intercept at greater distances.[43] An increase in numbers of aircraft identified through correlation of flight plans was another result. The ships were able to furnish navigational aid to aircraft and to detect airborne electronic emissions.[44] The 26th Air Division, which ran the test, concluded that:

During periods when communications were adequate, the picket ship

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> at Point Tuna provided... an average early warning of approaching aircraft when such aircraft were approximately 200 miles from the New York area. This warning is more than twice the average provided by shore stations when a picket ship is not on station.

Poor ship-to-shore communications was the main problem area uncovered. Neither radio-telegraph nor voice contact could be maintained for more than 28 hours without a complete breakdown. Intervals of over three hours occurred during which no contact could be made. Among the causes for the difficulties were a shortage of usable frequencies, shortage of transmitters and receivers on the ships, and heavy interference. The commander of USS Dyess commented that "communications are likely to provide the weakest link in the early warning system."[45]

Periodic operations with Navy ships continued during 1951. Much effort was placed on finding a workable communications system. ADC asked its defense forces to investigate the possibilities of using radio-teletype circuits currently in existence between picket ships and Navy shore stations for passing aircraft plots.[46] These plots could be re-transmitted to nearby direction centers, ADC suggested, by use of a tape relay.

EADF reported that it found in a test held in July for this purpose that the use of radio-teletype was feasible and had merit.[47] WADF did not hold a test just for radio-teletype, but during the last half of the year held a series of over-all communications tests.[48]

In addition to these special tests, both defense forces had the participation of picket ships in their exercises. In the WADF exercise of February, three ships operated, but with negligible results. The one general comment was, "Communications were very poor."[49] EADF held an exercise in June in which two ships operated in the general vicinity of Point Tuna.

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Communications were improved over the TUNA test; one reason being that the ships communicated with three direction centers rather than one as in TUNA.[50] EADF concluded that proper and sufficient frequencies had to be assigned to picket ship operations.

At the close of 1951 another request was sent to Washington for allocation of picket ships. Writing this time was the Air Defense Command which had taken over the air defense job at the first of the year. ADC said the need to extend coverage was urgent and picket ships were the only means of meeting it in the immediate future, for there would not be enough AEW aircraft until 1954.[51] USAF had advised earlier that General Vandenberg had inquired about the Navy's "plans and progress to meet our requirements for radar picket ships."[52] The new Chief of Naval Operations, Admiral William M. Fechteler (he succeeded the late Admiral Forrest Sherman on 1 August), had replied that he would make a survey of his ability to meet the air defense requirement with a type of vessel that would be available sooner than destroyer-escorts. ADC now suggested that if the Navy could not furnish the ships soon that the possibility of civilian concerns or the Coast Guard supplying them be investigated. USAF said it would.[53]

Whether it did or not and what the CNO's survey disclosed is not known by the author. Apparently, the CNO found his resources inadequate. The upshot was that no ships other than those of the Navy were made available and that no more than one or two stations were manned until 1955. It will be recalled that Admiral Sherman had said that this would be the time period when the Navy would have enough ships to meet air defense needs.

Chapter Two

THE START OF THE AEW&C FORCE

The First ADC Plan For AEW&C Aircraft

ADC had its first comprehensive plan for employment of AEW&C aircraft ready for USAF consideration in February 1952. The plan proposed the establishment of two barriers approximately 800 miles long some 200 miles off both coasts.[1] Each barrier was to be manned by four AEW&C planes orbiting on station with about 200 miles between planes. At this spacing, ADC estimating the probability of detection at between 80 and 90 per cent for low altitudes.

The eastern barrier was to start about 125 miles southeast of Nova Scotia and run to about 250 miles northeast of Norfolk, Virginia. The western line was to run from about 250 miles west of Seattle, Washington, to about 200 miles west of San Francisco.

Originally, ADC intended to operate its AEW force from five bases. ADC now dropped this idea as uneconomical and inefficient, One base on each coast was now proposed, tentatively selected as Hamilton AFB, California, and Mitchel AFB, New York. However, the runways could not be expanded to the length necessary for AEW operations at these bases. ADC next considered Otis AFB, Massachusetts, and McClellan, Mather, and Castle AFB's in California. The first 30 of the 56 aircraft programmed at this time were to go on the east coast because of the priority of the eastern target area.

ADC planned that each mission would average from 11 to 13 hours, with eight hours on station. The additional time was allotted for going to and from station. Five aircraft were to be ready for each eight hour shift on each coast, or 15 per day. On each shift four would actually fly; the other would remain on back-up. At this rate of flying, each plane would be flown approximately 2,065 hours per year or 172 hours per month.

The plan proposed that the planes fly at around 2,500 feet altitude. Greater ranges could be obtained at higher altitudes; but ADC had learned from the Navy that the higher the altitude the greater the sea clutter on the radar scope. The Navy's experience was that range had to be sacrificed to good tracking and control capability. ADC said it would change its method if the problem of sea clutter was solved or experience proved the low altitude unnecessary.

Knowing that crew fatigue would be one of the most important deterents to efficient operation, ADC planned to follow Navy findings for duty rotation. It was known that the efficiency of a radar scope operator lagged markedly after about 40 minutes in the air. After this time, it was necessary to rotate personnel to plotting, tracking, or telling and then to provide a rest. With this rotation scheme, an operator would not be on a scope more than two hours during the eight hours on station. ADC felt that aircrews should fly only two days in succession.

Because of the complexity of the aircraft and its equipment, this first plan called for all maintenance to be handled by the Lockheed Aircraft Corporation. But a little later ADC decided that it could be done by Air Force maintenance personnel.[2]

In developing a T/O&E for the AEW&C force, ADC followed the organization

of a typical B-36 wing. At each of the two bases there were to be a group headquarters, three tactical squadrons of ten planes each, one electronic maintenance squadron, and one periodic maintenance squadron.[3]

The tactical squadrons were to have no maintenance personnel, all organizational maintenance being performed by the periodic maintenance squadron. Field maintenance of the aircraft was to be done by the base maintenance squadron. The electronic maintenance squadron was to do both organizational and field maintenance of the radar and radio equipment. An around-the-clock maintenance schedule was to be set up in order to meet the 172 hours needed per aircraft monthly. In all, some 2,500 people would be needed at each of the two bases.

Proposed Use Of B-29's As Interim Aircraft

While ADC's plan was being considered by higher headquarters, a proposal was made by USAF to modify 30 B-29's for AEW operations until the EC-121 was received.[4] The first EC-121 would not be available until mid-1953 and only ten by the end of that year. USAF said it could make five modified B-29's available by late 1952 and all 30 by mid-1953. The B-29's could be used until sufficient EC-121's arrived and then turned over to another command.

ADC opposed the idea because it thought that the B-29's would be coming at about the same time as the EC-121's.[5] Operation of both would be extremely difficult, ADC felt, and might harm the development of the EC-121 program. Also, the B-29's would have only limited value since they would not be equipped with height finders.

After discussing it for some months, USAF finally agreed to ADC's point of view and in August cancelled the B-29 project.[6] ADC was willing to wait for the

FC-121.

Approval of ADC's Two-Base Plan

USAF differed with ADC's plan on two points: the use of two bases rather than five and the operation of the aircraft at the high rate of 172 hours per month. On the first point, USAF asked for a comparative cost study of five versus two bases.[7] On the second point, USAF sent an alternate plan that reduced the flying hour and personnel requirements.[8] Its plan was for a flying hour rate of 100 hours and total troop allocation of 2,750 spaces instead of the 4,582 spaces in the ADC plan.

Before ADC sent a cost study on bases and justification for operation at 172 hours monthly, it surveyed bases on both coasts. As a result of this survey, ADC selected Otis AFB and McClellan AFB. Its choice was made on the basis of location, climatic conditions, runway strength and length, air traffic congestion, and planned future use.

In its cost study, ADC figured the facility requirement cost for five coastal bases suited to AEW operation at well over $31,000,000.[9] For Otis AFB and McClellan AFB, this cost was set at about $25,000,000, or over six million less. The annual operating cost for the five selected bases was reckoned by ADC at $45,439,500; for the two bases at about $39,000,000. This was a saving of an additional six million. Finally, five bases would have required over 5,500 people, while two bases needed only 4,500 -- a saving of 1,000.

ADC's plan for two bases was the one finally accepted. On 16 September 1952, the Air Force Council gave its approval and on 6 October formal approval was granted by USAF Headquarters.[10] Two AEW&C groups were to be organized, one at Otis AFB and one at McClellan AFB. Each was to have 30 aircraft. USAF in-

creased the aircraft authorization sufficiently for this. Manpower spaces were to be allocated during FY 1954 and 1955 to match aircraft deliveries.

USAF also went along with ADC's contention that it could maintain the 172-hour flying rate and that it was cheaper to fly more hours than to buy more planes. However, during the build-up of facilities and personnel, operations were to be on a reduced scale. The aircraft were to be flown no more than 100 hours per month. Also, the crew was to be limited to 12 members and a ratio of 1.2 crews per aircraft.[11] ADC's ultimate manning requirement was 18 crew members and a ratio of 2.5 crews per plane. The 18-man crew was to consist of seven officers and eleven airmen.[12]

ADC wanted to place the first AEW&C squadron at Otis AFB because of the high priority of the important northeast target complex, but it could not.[13] ADC thought at this time that the first ten planes would be delivered by the fall of 1953 and therefore support facilities would have to be ready by that time. This required immediate funding, but funds for Otis AFB building were not provided.[14] Thus, ADC decided that, however desirable, the first squadron could not be put at Otis. Both lack of facilities and severe weather stood in the way. McClellan, on the other hand, had at least some facilities and enjoyed mild weather as well.

ADC set 1 July 1953 as the date for activation of the first squadron.[15] As soon as facilities were ready at Otis this unit was to move there. This was expected by about April 1954. The second and third squadrons were to be activated at Otis in July and October.

EADF objected to this decision, emphasizing that it had "an urgent requirement for AEW&C capability along the Eastern Seaboard due to extreme vulnerability of the vital target complex to sea penetration routes."[16] EADF did not agree with

ADC's reasoning in placing the first unit at McClellan and then moving it some ten months later. It said that Otis facilities would not be ready for the first or second squadrons and possibly not for the third. Support limitations, with the possible exception of fuel storage and warehousing, would still exist when these units came.

ADC realized that all facilities would not be available by April 1954. However, ADC felt that by this time the weather would be better and the lack of facilities would not be such a severe handicap. Maintenance could be performed on the parking ramp, for example.[17] This could not be done during the preceding winter. In California's mild weather, however, temporary facilities would suffice. ADC hoped that by the following winter, Otis would have adequate facilities.

Communications Plans

In other operations plans issued in 1953 and 1954, ADC covered communications and control. ADC planned that high frequencies in the two to twelve megacycle band would be used to provide communications between the AEW&C aircraft and ground stations.[18] All data gathered by the AEW&C plane was to be "told" to a ground communications point. Cross-telling of this data was then to become the responsibility of the station in whose area the aircraft was operating. Initially at least, identification was to be performed by the ADDC in whose subsector the AEW&C station was located. Weapon control was to be passed from the central communications point to the aircraft. Voice communications were planned for speed, but it was expected that under some conditions radio-telegraph would have to be used.

On the west coast, central communications points were to be set up at McChord AFB, Washington, and Norton and Hamilton AFB's, California. On the east coast, the ground stations named were: P-13, Brunswick NAS, Maine; P-10, North Truro, Massachusetts; P-45, Montauk Point, New York; P-54, Palermo, New Jersey; and P-56, Cape Charles, Virginia. Each ground station was to be equipped with AN/FRT-15 transmitters and adequate receiving equipment.

Activation of the First AEW&C Squadron

By the beginning of 1953, the original EC-121 delivery schedule proved to be very optimistic. The original schedule had called for the delivery of the first aircraft by mid-1953 and a total of ten by the fall. At the start of 1953, however, delivery of the first plane was re-scheduled for November 1953 and a total of ten by April 1954.[19] By the fall of 1953, delivery of the first complete aircraft had been moved up to January 1954 and a total of ten by June. Actually, the first complete aircraft did not arrive until May 1954 and the first ten not until October 1954.

USAF had by this time programmed for 64 aircraft, the first ten planes of which were to be EC-121C's, the remainder EC-121D's.[20*] The adequacy of only four planes for attrition was questioned by ADC. USAF said that the 64 aircraft were actually only the number programmed for the original force of

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* The basic aircraft used in the "C" and "D" models were almost identical. The "D" model had two 600 gallon wing tip tanks, two more windows and changes in the number and location of some antennas. Internally, the "D" had a change in the video distribution system with the installation of the AN/APA-56 which added video mapping and other refinements to the scope presentation; the APN-70 Loran was substituted for the APN-9, and among other small changes, the APN-22 Radar Altimeter was substituted for the APN-1 and the SCR-718C.

five squadrons and that more planes would be provided in the FY 1955 production program for the sixth squadron.[21] USAF later approved a seventh squadron and programmed a total of 82 EC-121's.

The lag in delivery of the aircraft resulted in delay in the activation dates of the squadrons. ADC's policy was to phase the program in accordance with aircraft delivery.

A reason for the aircraft delay was a lag in delivery of radar equipment to the Lockheed Plant. About mid-1953, Lockheed officials asked the Air Force to accept two planes that were ready except for the radar. ADC and USAF decided to take them in order to begin flying and maintenance training.[22] Lockheed said it could make the first one available for factory training at its plant on 15 October, the second on 15 November.[23] They could be delivered to McClellan AFB by December. ADC planned to use them until complete aircraft were on hand and then send them back to Lockheed for the radar.

ADC now decided to activate its first squadron on 1 October 1953.[24] This was the 4701st, activated as a T/D unit to serve as a training and test organization. The 4701st was to be overmanned to provide personnel for schools and to provide a trained cadre for the second squadron. Later, when other squadrons were activated and the two groups formed, it was to be reorganized as a T/O unit under another number. ADC planned to activate its second squadron at Otis AFB about mid-1954, also as a T/D unit. As the first squadron, it was to be reorganized later.

The two EC-121C's without radar arrived as scheduled.[25] One was lost the following February in a crash near Hamilton AFB leaving the squadron only one aircraft until May 1954 when the first complete plane was delivered.[26] Three

more fully equipped aircraft came in June. The 470lst got its remaining six planes by October. In July, the radar-less plane was sent back to Lockheed for its equipment.

Providing Trained Personnel

The EC-121 and its radar equipment, in fact the whole AEW operation, was new to the Air Force. There were no experienced personnel to man the first squadron. The Air Force could provide men with basic training and experience, such as four-engine pilots and radar technicians. But it had no EC-121 pilots or AN/APS-20 and AN/APS-45 radar technicians. Nor were there any Air Force schools or equipment to set up schools. To give an EC-121 to the Air Training Command at this time would have meant taking it from the tactical squadron. ADC had to turn to outside sources for help.

To form a nucleus for the first squadron, ADC Headquarters sent its own men to McClellan AFB.[27] The chief of this group, and thus the first commander of an Air Force AEW&C unit, was Lieutenant Colonel Russell E. Cheever.

Responsibility for manning the first squadron was taken by ADC Headquarters for the first month. After that, WADF took over. Initially, the 470lst was authorized 74 officers and 382 airmen.[28] USAF authorized overmanning to provide for schools and for the second squadron of 33 officers and 208 airmen.

For the specialized training, arrangements were made with Lockheed and the Navy. The initial training program was for a small number of people only. How many would have to be trained at these outside sources was not known at this time. Eventually, ATRC and ADC would have courses set up to provide the specialized training. But ADC wanted to get a core of highly skilled people

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as soon as possible to begin unit training. Classes at Lockheed and the Navy's school were started in 1953. Most of this initial training was completed the following year.

At the aircraft plant in Burbank, California, training was given to pilots, flight engineers, and key aircraft maintenance personnel.[29] Forty pilots went through this course by February 1954. Lockheed and the Navy sent instructors to the AEW&C squadron for a short period.

Training for AEW radar specialists was provided by the Navy at its Fleet Airborne Electronics Training Unit, Pacific Fleet, at San Diego. From November 1953 to August 1954, 43 airmen were trained there.[30] Graduates of this school went to a short course on radar installation at the Burbank factory.

The squadron started its flying training and ground training upon receipt of the first aircraft and men. In January 1954, for example, the aircraft were scheduled for six hours a day, six days each week.[31] Controllers were sent to the Yuma, Arizona, proficiency course.

Familiarization flights were made by all crews starting in May 1954.[32] By June, routine radar training missions were being flown on a station about 150 miles off the coast. The squadron practiced and evaluated its operating procedures. Since permanent facilities for communications were not ready when the 4701st began training, interim facilities were set up at Mill Valley AFS (P-38) in the 28th Air Division.

Plans For Otis AFB Changed

As we have seen, ADC chose to put its first squadron at McClellan because of inadequate facilities at Otis, with the idea of moving this squadron to the

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east coast about April 1954. ADC planned to put a second squadron at Otis in July and a third in October.

As it turned out, none of these dates could be met. The whole program had to be changed. In 1954 there were no maintenance, housing, or any of the other required facilities at Otis. Not until 1955 could ADC move its first squadron there, and even then facilities were not entirely adequate.[33]

The permanent facilities for Otis were placed in the FY 1954 and 1955 (and later FY 1956) Military Construction Programs, but building could not be started as planned. USAF could not approve the master plan until ownership of the land was settled.[34] The Army and the state of Massachusetts both controlled much of the land. This also held up construction of interim facilities as had been done at McClellan.

At any rate, these questions dragged on for months. It was not until late in 1954 that work on interim facilities and rehabilitation of existing facilities got started, and then it was slowed by bad weather. The interim facilities for three squadrons was completed in late 1955 and permanent facilities were scheduled for completion by August 1956.[35]

Because of the year's delay in building at Otis, ADC decided to keep all AEW&C activities on the west coast until about March 1955.[36] The 4701st was to move at that time.

In the meantime, ADC had gone ahead and activated its second squadron, the 4712th, at Otis AFB on 1 March 1954.[37] On 25 May, the 4712th, less its personnel, was moved to McClellan, which made it simply a record transfer.[38] It was then manned with a cadre from the 4701st.[39]

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Activation Of The 9th Air Division

Headquarters ADC decided by March 1954 that neither it nor the defense force headquarters could give as close or as continuous supervision to the AEW&C program as needed. "Preliminary operations of the AEW&C program and further study of forthcoming requirements in this area have indicated a need for quality 'top level' supervision, if the program is to be successful," explained ADC to USAF.[40]

To supervise the program, an organization on the division level with a general officer in command was needed, ADC said. It had to be at least a division because of "the multitudinous operational problems to be faced in a new and unknown type operation, the development and testing of training methods and of tactics and techniques, the complexity of the aircraft, and the fact that each aircraft is a mobile direction center...."[41]

ADC wanted two divisions. The first should be activated at McClellan as soon as arrangements could be made. This division would run the program from there until March 1955 when it would be moved to the east along with the 470lst Squadron. At that time, a second division would be activated at McClellan.

USAF agreed with the need for a change in organization, but had a different solution. It authorized one division temporarily to get the program underway and two wings to take over when the division was inactivated.[42]

USAF said that the responsibility and functions which ADC planned to give to the AEW&C group were too much for a unit of that size. A similar force of tactical and maintenance squadrons in the Strategic Air Command was organized into a wing. ADC's groups would be raised to wing level and con-

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sidered as operational units. These wings were not to be activated until July 1955, however. To provide an organization to plan, supervise, and coordinate the program in the formative stage before the wings came into being, USAF authorized a division. It was to be activated on 1 May 1954 and inactivated "not later than July 1955."[43] USAF explained that, "At this point in time, the requirement for developing tactics, techniques and procedures should have been fulfilled, and with both Wing Hqs in-being, the required operational headquarters will have been provided so that the Air Division can be inactivated."[44]

USAF approved setting the division up as a T/D unit and ADC's manning proposal.[45] ADC had proposed 27 officers and 52 airmen. The 8th Air Division (AEW&Con) was activated as planned on 1 May and Colonel Kenneth H. Gibson (he was raised to Brigadier General rank in July 1954) assumed command on 19 May.[46]

Although at first ADC Headquarters planned to take direct charge of the division, the ADC Command Council decided on 28 April to assign it to WADF.[47] As will be seen later, the original plan was reverted to the following year.

The mission of the division, to which all AEW&C units were assigned, was simply stated: "to provide airborne early warning and control in the air defense combat zone."[48] The 8th Air Division was also given authority to command, organize, train, and equip all personnel assigned; to develop AEW&C techniques and intercept control procedures; to conduct AEW&C unit training; coordinate operations with appropriate divisions; and to take part in air defense exercises.

Activation Plans

By April 1954, a new AEW&C program had been worked out based on delays

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at Otis and the expected aircraft delivery schedule.[49] ADC planned to have all six tactical squadrons of the original program activated by August 1955. By this time also, a wing and two support squadrons were to be in operation on each base.

The first tactical squadron to be activated at Otis was to be the 961st, scheduled for December 1954. Also in December, Otis was to get the 551st Wing and the 551st maintenance squadrons. A month earlier, the 4701st was to be reorganized under a T/O, and renamed the 960th, and to move to Otis with ten planes. The third eastern squadron, the 962d, was to be activated in July 1955.

At McClellan AFB, the 4712th was to be reorganized to a T/O unit, the 963d, in March 1955. In this month, the second squadron slated for McClellan, the 964th, was to be activated. The third McClellan squadron was the last of the original six. In August 1955, this one, the 965th, was to be activated. McClellan's wing, the 552d, was to be activated in July 1955. Its two maintenance squadrons were to be activated at the same time as those at Otis - December 1954.

ADC expected the maintenance facilities at Otis to be inadequate when the first squadron arrived there. Until maintenance capability was built up, ADC planned to get much of the work done by the Lockheed Aircraft Service at Idlewild Airport, New York.[50] Lockheed would provide periodic inspections and 400-hour cycle reconditioning. Pre-flight and post-flight inspections as well as unscheduled maintenance were to be done at Otis.

In an operations plan issued in March 1954, ADC set the operationally ready dates for the two wings. The Otis AFB Wing, the 551st, was to be capa-

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ble of operating on four stations, 24 hours per day by 1 March 1956, the McClellan AFB wing, the 552d, by 1 January 1957.[51] This would allow nearly three years from the date of activation of the first squadron (October 1953).

By the end of 1953, ADC had added a seventh AEW&C squadron to its program. USAF originally programmed it for McClellan AFB.[52] But ADC wanted it located more strategically and asked that it be placed on the east coast.

ADC wanted this squadron in the east as a part of an overall plan it was shaping at this time for the ultimate AEW&C force and for defense for the next few years. ADC was putting together a requirements plan (which will be discussed more fully later) for the period to 1960. In it, ADC planned to ask that coverage be provided seaward to about 475 miles from Nova Scotia to Savannah, Georgia.[53] ADC planned that two lines of AEW&C stations (nine stations in all) would be used to provide this coverage. The outside line was to be operated continuously, while the aircraft for the inside line were to be on stand-by alert. For this east coast coverage, two wings of 30 aircraft each would be needed.

One wing was already planned for Otis AFB. ADC wanted the second wing in the Norfolk, Virginia, area. Langley AFB was suitably located, but it could not be expanded enough to handle the wing. Seymour-Johnson AFB, Goldsboro, North Carolina, was the second choice.

Thus, ADC wanted to put the seventh squadron at Seymour-Johnson as the beginning of the build-up there. USAF approved this request on 8 February 1954[54] and the squadron was programmed in the FY 1955 public works program. This unit, the 966th Squadron, was scheduled for activation in November 1955.

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AEWAC Force Status

By the end of June 1954, the 8th Division Headquarters had over 30 per cent of its officers and 20 per cent of its airmen (T/D authorization 27 officers and 52 airmen). The 4701st Squadron was completely manned (T/D authorization 74 officers and 382 airmen). The 4712th Squadron had 26 per cent of its officers and over 40 per cent of its airmen (T/D authorization 109 officers and 572 airmen).[55]

Five aircraft were assigned, one of which had no radar. Twelve crews were on hand.[56] Colonel Gibson reported that about 85 per cent of the authorized equipment was on hand for the 4701st Squadron. Aircraft spares were generally in good supply, but electronic spares were very scarce.

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Chapter Three

BUILDING THE AEW&C SYSTEM

Radar Extension Plans

By 1954, ADC had crystallized its plans for the over-all extension of radar northward and seaward. At mid-year, ADC sent Air Force Headquarters its requirements plan for the years 1954 to 1960. ADC had conceived a two-zone system of defense for the North American continent: a combat zone and an early warning zone.

ADC defined the combat zone as an area "encompassed by a line representing the maximum limit of contiguous radar cover around the United States and certain parts of Canada and Mexico."[1] The early warning zone was to be north of this area and consist of two lines -- a mid-Canada early warning line and a northern Canada distant early warning line.

In the combat zone ADC wanted to extend coverage out to sea about 475 miles on the east coast and 250 miles on the west coast. The degree of extension was determined by such factors as vulnerability to attack from seaward, importance of likely targets, expected number of enemy planes attacking particular areas and number of defense weapons. The AEW&C force together with picket ships of the Navy and platforms anchored in shoals off the east coast called "Texas Towers" (see Chapter Six) would provide this extension.

For the AEW&C force, ADC asked for five more tactical squadrons, or a total of twelve by the end of FY 1959.[2] In September 1954, command

planners drew up a tentative deployment for the five additional squadrons.[3] They planned to put two on the west coast - one at Norton AFB in southern California and the other at McChord AFB in Washington, making a total of five there. Norton was later dropped, however, and both squadrons scheduled for McChord. They scheduled two for Seymour-Johnson AFB in order to complete the three-squadron deployment wanted in that area. The fifth squadron was to be placed at Brookley AFB, Alabama, to provide cover for the southeast coast. This location was changed later to Hunter AFB, Savannah, Georgia.

USAF advised in December 1954 that it would not approve the requirements plan as a whole because it was not "appropriate in view of the fact that certain parts of the document have been overtaken by events since publication."[4] It approved certain requirements in it, however. One of these was the expension to 12 AEW&C squadrons, given early in 1955.[5] Later in the year, USAF approved a thirteenth squadron to be placed at Dover AFB, Delaware.

In June 1955, a deployment and operational plan for all elements of the combat zone seaward extension force was issued by a newly-created organization for air defense, the Continental Air Defense Command (CONAD).* CONAD was a joint command created the previous September by the Joint Chiefs of Staff,[6] with headquarters at Colorado Springs. This did not put ADC out of business. But its jobs of general air defense planning, coordinating, and control of the Air Force, Army, and Navy forces taking part in air defense in an emergency were taken over by this super, JCS-directed agency. ADC was to con-

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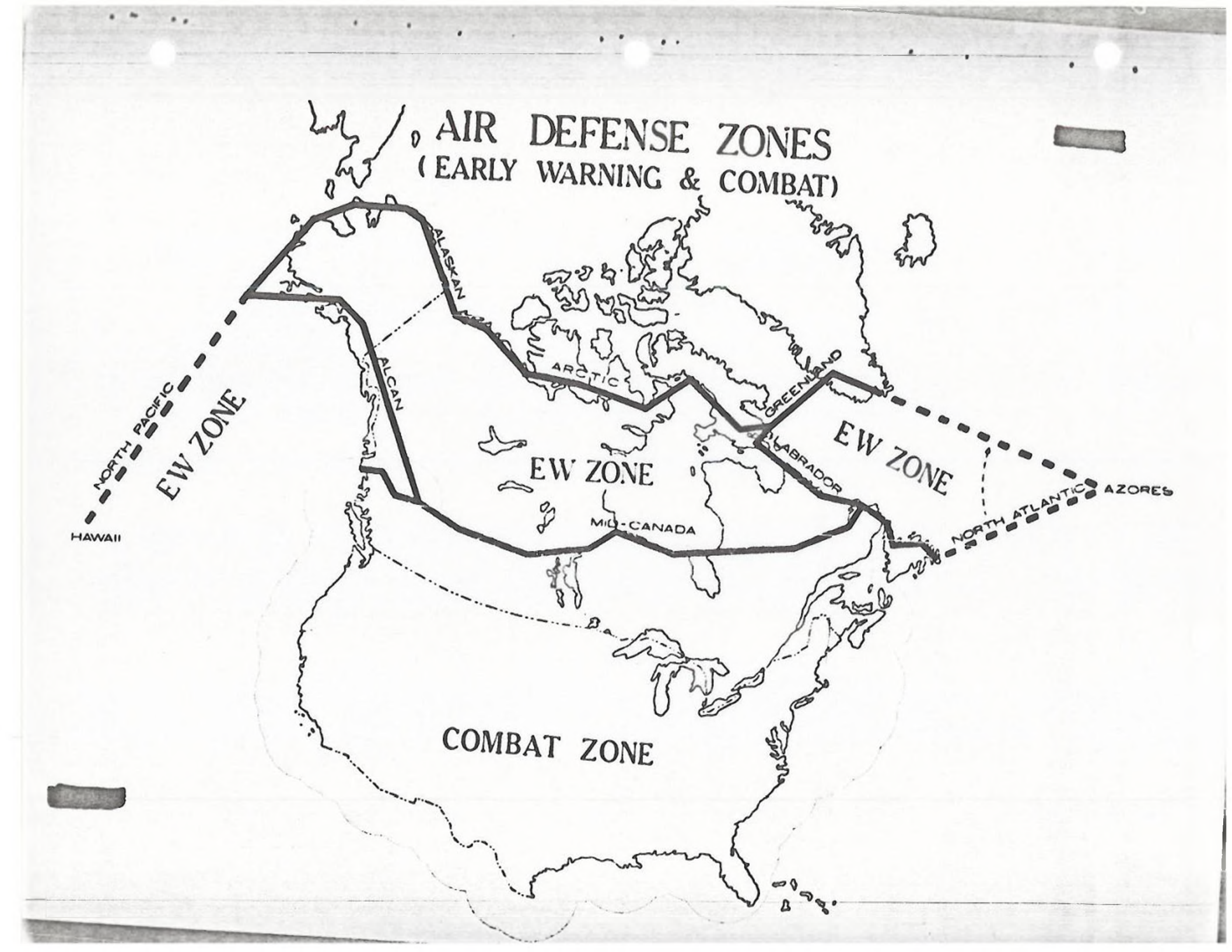
* For additional details on the creation of CONAD, see CONAD/ADC Historical Study #9, Organization and Responsibility for Air Defense.


AIR DEFENSE ZONES
(EARLY WARNING & COMBAT)
ALASKAN
ALCAN
ARCTIC
GREENLAND
LABRADOR
NORTH PACIFIC
EW ZONE
EW ZONE
EW ZONE
MID-CANADA
NORTH ATLANTIC
AZORES
HAWAII
COMBAT ZONE

[redacted]

centrate on running the Air Force air defense forces. ADC was allocated to CONAD along with the Army's Antiaircraft Command, and a Navy component established at this time (see Chapter Five). The JCS made the Air Force the executive agency for CONAD and named ADC's commander, General Benjamin W. Chidlaw, * as CONAD's commander also.

The CONAD plan for extension of the combat zone radar cover projected deployment and operation in two stages.[7] The first was based on the quantity of forces expected to be available by around 1958; the second when enough additional forces had been built up - possibly around 1960.

In the first stage, CONAD wanted to have five AEW&C stations off the west coast and six off the east coast. In addition, the west coast was to have five picket ship stations; the east coast five picket ship stations and five Texas Towers (see map following).

In the second stage, CONAD wanted 12 AEW&C stations off the east coast, but no increase in the other forces. In the Pacific, it wanted eight AEW&C stations and seven picket ship stations.

Thus, CONAD planned to build up to 11 AEW&C stations in the first phase, six off the east coast and five off the west coast; and to 20 stations in the second phase, 12 off the east coast and eight off the west coast. The eastern area, with its preponderance of targets and where a greater percentage of the enemy's attack was expected, was to have the most forces.[8]

This deployment took into account the fact that the AEW&C aircraft would

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* General Chidlaw became commander of ADC in August 1951, succeeding Lieutenant General Ennis C. Whitehead who retired.

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provide low-altitude coverage; picket ships high-altitude coverage. The overall deployment was to give an all-altitude coverage so far as possible. CONAD planned to place AEW&C planes and picket ships in a single row in its first phase,* with the AEW&C aircraft between the shore and the picket ship line. Generally speaking, the east coast deployment placed Texas Towers about 100 miles out, AEW&C stations about 200 miles out, and picket ships about 300 miles out. Off the west coast, the AEW&C and picket ship stations were a little closer in. CONAD's plan for deployment was to provide high altitude (65,000 feet) coverage of about 550 nautical miles and low altitude (surface) coverage of about 320 nautical miles off the east coast; and high altitude coverage of about 460 nautical miles and low altitude coverage of about 280 nautical miles off the west coast.[9]

When the build-up was sufficient to reach the second stage, CONAD planned to add a second row of AEW&C stations on the outside beyond the picket ship stations in the Atlantic. This was to increase low altitude coverage to about 500 nautical miles. The single row deployment plan was to remain the same in the Pacific in this phase. Coverage would be extended to cover the complete length of both coast, however, in this stage (see map, Chapter Seven).

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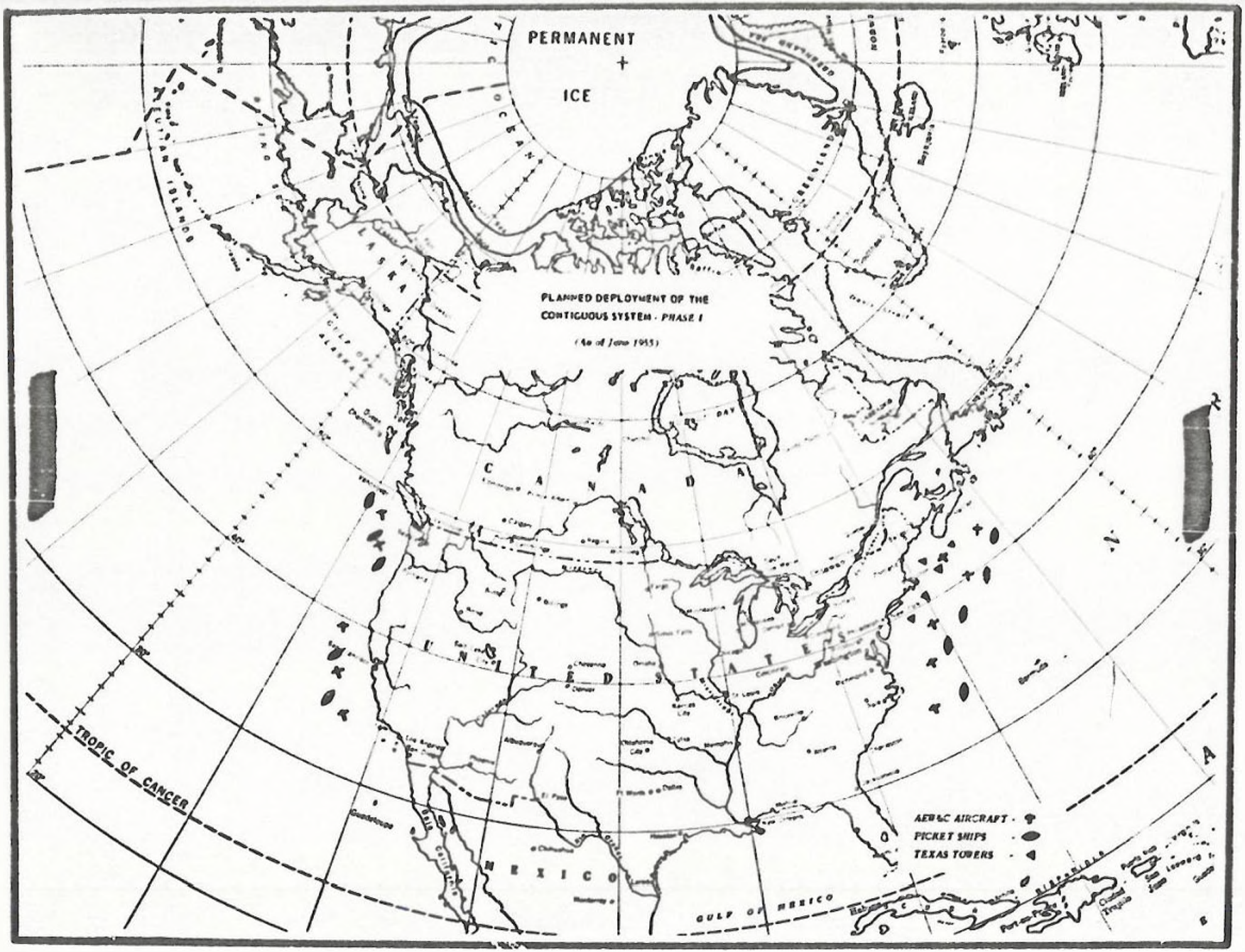
* The geographical coordinates for the AEW&C stations in Phase I were as follows (see Chapter Five for Picket Ship and Chapter Six for Texas Tower locations):

EAST COAST		WEST COAST	
33°20'N	74°45'W	48°00'N	128°25'W
36°25'N	72°45'W	45°50'N	127°00'W
38°43'N	70°50'W	38°20'N	126°30'W
40°00'N	66°45'W	36°40'N	125°05'W
42°18'N	67°10'W	34°10'N	123°20'W
42°10'N	63°32'W		


PERMANENT
+
ICE
PLANNED DEPLOYMENT OF THE
CONTIGUOUS SYSTEM - PHASE I
(As of June 1955)
TROPIC OF CANCER
AEW&C AIRCRAFT
PICKET SHIPS
TEXAS TOWERS
GULF OF MEXICO
CANADA
MEXICO

CONAD did not think it would have enough aircraft to man these twenty stations continuously. Therefore, it planned to man only part of the stations around the clock and cover the rest with aircraft on alert.[10] Advance warning from the Distant Early Warning line would make this possible. On the east coast, CONAD planners proposed manning only the outer row and the northern stations of the inner row continuously. On the west coast, they planned to man only the two northern stations continuously. They noted in this plan that in actual practice this scheme might not work and that enough aircraft to man all stations continuously would be requested in the 1955 to 1965 plan.

Activations and Organization

As planned by ADC in 1954, the six tactical squadrons, the two wing headquarters, and the maintenance squadrons of the original program were activated by August 1955 (see chart following). Two tactical squadrons had been activated at McClellan - one in October 1953 and the other in March 1954 - and the 8th Air Division had been activated there in May 1954. The first squadron, the 4701st, was moved to Otis AFB in March 1955. In this same month, the second squadron, the 4712th, was reorganized under a T/O and redesignated the 963d, and another squadron, the 964th, was activated under a T/O.[11] The third McClellan tactical squadron, the 965th, was activated in August.[12] The McClellan wing, the 552d, had been activated a month earlier.[13] A provisional wing had been operating there since the first of January, however, to relieve the division of day-to-day operational chores, leaving it free to concentrate on overall planning and supervision of the two-coast buildup.[14]

The first unit to be placed at Otis AFB was a provisional wing, activated

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on 1 October 1954, as an advance party.[15] This was discontinued and a regular T/O wing, the 551st, was activated in December 1954.[16] At the same time, the first tactical squadron was activated at Otis, the 961st.[17] In March 1955, the 4701st, now reorganized as the 960th Squadron, arrived from McClellan.[18] The Otis organization was completed with the activation of the third tactical squadron, the 962d, in July 1955.[19]

All of the Otis units were organized on a T/O except the 551st Periodic and Electronic Maintenance Squadrons. Because part of the maintenance was to be done by the Lockheed Aircraft Service, these units were organized on a T/D and their personnel reduced some 40 per cent. By the time that the Lockheed contract expired in September 1956, they would be reorganized under a T/O and fully manned.

This was the extent of the force activated by the end of 1955. As shown above, seven more tactical squadrons had been approved by USAF. Their activation dates, geared to anticipated base building and to availability of aircraft, were spread over the next three and one-half years.

A seventh squadron, the 966th, had been scheduled for activation in November 1955 at Seymour-Johnson AFB. However, by mid-1955, it became obvious to ADC that facilities, primarily family housing, would not be ready in time. USAF suggested that the activation be delayed until June 1956 when it was thought that housing would be available.[20] General Gibson protested this proposal. He did not want to interrupt the scheduled flow of personnel or the training planned at ATRC and other agencies' schools.[21] He feared that the delay would result in loss of the personnel authorizations. Instead he suggested that the 966th be activated as scheduled, but placed at McClellan AFB.

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STATUS OF AEW&C UNITS - 31 DECEMBER 1955

Unit	Base	Assignment	Date of Activation
Hq 8th ADiv	McClellan AFB	ADC	1 May 1954
Hq 552d Wg	"	8th ADiv	8 Jul 1955
552d E/M Sq	"	552d Wg	18 Dec 1954
552d P/M Sq	"	552d Wg	18 Dec 1954
963d AEW&C Sq	"	552d Wg	8 Mar 1955
964th AEW&C Sq	"	552d Wg	8 Mar 1955
965th AEW&C Sq	"	552d Wg	8 Aug 1955
Hq 551st Wg	Otis AFB	8th ADiv	18 Dec 1954
551st E/M Sq	"	551st Wg	18 Dec 1954
551st P/M Sq	"	551st Wg	18 Dec 1954
960th AEW&C Sq	"	551st Wg	8 Mar 1955
961st AEW&C Sq	"	551st Wg	18 Dec 1954
962d AEW&C Sq	"	551st Wg	8 Jul 1955

AEW&C PROGRAM

Unit	Base	Approximate Activation Date (by Qtr FY)
Hq 553d Wg	Seymour-Johnson AFB	2/58
955th AEW&C Sq	"	2/58
956th AEW&C Sq	"	3/58
966th AEW&C Sq	"	1/58
957th AEW&C Sq	McChord AFB	4/58
958th AEW&C Sq	"	1/59
959th AEW&C Sq	Hunter AFB	2/59
967th AEW&C Sq	Dover AFB	1/60

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Both ADC and USAF agreed to this. However, new problems cropped up. ADC saw that it would not have enough aircraft for the 966th if it were activated in 1955.[23] There were three reasons for this. By this time, numerous deficiencies had been found in the EC-121. One modification program had been started and others were soon to start. These would take aircraft out of the command. Secondly, ADC had found that more than the originally-planned 30 aircraft per wing were needed for operations. And, third, aircraft delivery slipped in late 1955. In view of these problems, ADC decided to postpone activation of the 966th for about two years.

Another important change in plans was in regard to the 8th Air Division. Back in early 1954, ADC had asked for two divisions to manage the AEW&C program. USAF agreed to the need for a stronger organization, but authorized wings instead of divisions. But until the wings were set up and could take over operations, USAF authorized a division to oversee the buildup. It gave authority for the 8th Air Division to be activated in May 1954 and to be inactivated in July 1955.

As the inactivation date drew near, ADC asked to keep the division for at least another year.[24] The wings could not take over yet, ADC told USAF. There were still problems of tactics and procedures, aircraft deficiencies, and training that were beyond the resources and authority of a wing organization. A central division was still needed to supervise and control the program. To further this central control, the division was to be placed directly under ADC Headquarters. ADC had not come to any conclusions about the final organization, but still thought that a division was needed for both coasts. USAF agreed, authorizing retention of the 8th for another year - to June 1956.[25]

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ADC wanted to take direct control of the 8th because the buildup of the program had not moved along as rapidly as had been expected. According to General Gibson there were great lags in the assignment of personnel and supply of materiel, particularly of electronic parts.[26] These deficiencies were causing the program to lag. He did not blame the defense force. Rather, he said that the "existing personnel and materiel situations represent a 'best effort' in light of other air defense and Air Force-wide requirements...."[27] But direct supervision by ADC Headquarters was needed.

Another reason for assigning the division to ADC Headquarters was that an awkward command arrangement had arisen with the beginning of activity on the east coast. The 8th Air Division under WADF was in charge of units stationed in EADF territory.

Just a year after its activation, on 1 May 1955, the 8th Air Division was reassigned to ADC Headquarters.[28]

Manning and Individual Training

Because the EC-121 was new to the Air Force, ADC had to turn to Lockheed and to the Navy for help in training its people. Pilots, flight engineers, and aircraft maintenance personnel were sent to a Lockheed school. Search and height finder radar technicians were sent to a Navy school.

Manning of each unit activated during the long build-up period frequently lagged in certain important fields -- a typical problem in setting up any new organization. It was difficult to provide the exact number of people needed in all career fields exactly in accordance with the scheduled build-up. Small school output and competition for the people available with other units ADC-

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wide and Air Force-wide were among the causes of the shortages.*

The two most critical shortages were of radar operators and technicians and of controllers. ADC had been suffering for a long time from a shortage of skilled controllers. Without enough controllers as it was, the defense forces were hard put to meet the quotas asked of them. The result was that ADC had to lower its standard for those controllers assigned to the AEW&C force in order to man it. Initially, ADC required that controllers have one year's experience as AC&W directors.[31] It lowered this to permit assignment of radar observers who had not completed a year as a controller. USAF promised to help out by increasing the number of radar observers sent to controller's school.

General Gibson proposed in the fall of 1954 that a centralized training program be started at McClellan AFB to step up the training of people in all important specialities. A small training program was already in existence at McClellan for a number of fields. But General Gibson wanted a large scale program for the units on both coasts. He proposed that one squadron be set aside solely for AEW&C training to run through March 1956.[32] Considerable other equipment and personnel would also be needed, plus extensive cross-country travel for the people at Otis AFB. General Gibson felt that his plan would so increase the training that full operations could be started at Otis

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* The AEW&C units were no worse off than any other ADC units. AEW&C units had an Air Force precedence rating of II, the same as about half of ADC tactical units. However, the AEW&C squadrons had a unit precedence of 177 and 178 out of a possible 178 in category II. This meant that according to unit rating they should not have had as high a manning status as other ADC tactical units. But Headquarters ADC reported in late 1954 that the AEW had been manned at least equal to, and in most cases better than, other tactical units. For source, see reference notes 29 and 30.

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/ October 1955, six months earlier than scheduled.

ADC Headquarters rejected his proposal, however.[33] Enough training equipment and personnel to establish such a program were not available. ADC programmed equipment had been allocated several months earlier to the Air Training Command to start a formal training program. General Gibson was told that no more for training purposes could be procured and "it is next to impossible to change the flow of this equipment within the time period allocated for the establishment of the training plan submitted."[34] Individual training would continue to be conducted by outside sources and by the ATRC once it got its program underway. Aircrew training would be conducted by the squadrons on each coast.

ADC arranged for a second series of classes in certain specialities at the Navy's San Diego school and at the Lockheed plant. For AEW radar technicians, new classes were started at San Diego on 28 February 1955.[35] At Burbank, radar maintenance courses were started in March 1955. These classes were to continue into 1957 when over 200 men were to be trained. Classes for maintenance personnel in other fields were also started at Lockheed in 1954 and 1955.

ATRC's Technical Training Air Force began basic and specialized courses on AEW radar in April 1955 at Keesler AFB.[36] These courses had been scheduled to start in January, but delay in getting the Navy-procured radar equipment held it up. Eventually, this school would be graduating trained radar technicians in fairly large numbers.

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Unit Training and Operations

Build up to around-the-clock AEW&C operations was to be accomplished by starting limited operations on one station and then adding more stations until finally all were maintained full time. Training missions were started back in January 1954 when the first aircraft and aircrews arrived. By June of that year, routine radar training missions were being flown on station.

The first air defense operations began with participation of AEW&C planes in the nation-wide exercise CHECK POINT held in July 1954. During this two day exercise, the total complement of six EC-121's provided radar cover off Seattle, San Francisco, and Los Angeles.[37] The effort was relatively ineffective, however, because of communications limitations and poor procedures. But much was learned about the aircraft and about techniques.

The first station manned was on the West Coast starting on 1 August 1954. WADF's operations order establishing the station called for operation of one aircraft eight hours per day (0900 to 1700).[38] The station was located off the 28th Air Division's area. On 17 September 1954, a second station was started in the same general area.[39] The plan was to increase the first station to 16 hours daily. By the end of 1955, one station was manned full-time; another partially.[40] These aircraft in the 28th Division's area reported to the radar station at Mill Valley Air Force Station, California.[41]

While the planes were on station, the commander of the division in which they were operating had operational control.[42] The division commander could re-deploy, recall, or assign subsector responsibility as required. The AEW&C plane was to patrol around a control point described in "georef" coordinates and latitude and longitude. From operating experience and tests held by the

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Air Proving Ground Command it was found that flying at a higher altitude than the 2,500 feet once thought necessary was more satisfactory. The APGC, reporting in September 1955 on the results of its second phase of the aircraft operational suitability tests,[43] stated that:

> Comparison of the blip/scan or tracking capability curves shows that during the test the RC-121 achieved the best performance against the B-29 type target with the radar platform at 15,000'. This was true whether the target was at 500' or at 20,000'.

The APGC also noted in this report that the EC-121's tracking performance against high altitude jet bombers was marginal in all cases. At any rate, CONAD stated in its operational plan issued in June 1955 that AEW&C aircraft would fly at altitudes between 5,000 and 15,000 feet.

The first operating station was started on the East Coast on 21 September 1955.[44] This one was manned around-the-clock.

One very great problem remaining in operations in late 1955 was that of obtaining frequencies for the extensive communications system. CONAD handed Air Force Headquarters a communications plan covering the needs for all parts of the seaward extension system - AEW&C aircraft, picket ships, and Texas Towers - in June 1955.[45] For the whole system, CONAD asked for a minimum of 32 UHF channels and 50 other channels in families of frequencies.

The Joint Communications-Electronics Committee of the JCS asked for a reduction.[46] It was difficult to get such a great number of frequencies. The committee suggested that a group of common frequencies be used for command and control circuits. The common frequencies would be less than the number of specific circuits in CONAD's plan. A second suggestion was to use multiplex teletype in place of voice telling circuits from the picket ships to shore.

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[redacted] said that the first suggestion was not acceptable, but that the second had merit and would be investigated.[47] If it proved feasible, it would be adopted and the number of frequencies reduced accordingly. In the meantime, operations were being carried out by using frequencies from ADC's emergency net and a few others given temporarily by USAF and the Navy.[48]

Aircraft and Support Deficiencies

ADC had accepted the EC-121 before it had been tested by the Air Force. The reason, ADC explained, was that because of the "considerable cost of each aircraft and the pressing operational requirement for immediate seaward extension, no aircraft have been allotted specifically for test purposes."[49] Instead, the Air Proving Ground Command ran tests concurrently with operations at McClellan AFB. An evaluation of the plane and its equipment was started in August 1954 and completed in May 1955 - a period of nine months.

The AFGC concluded from its investigation that the aircraft was unsuitable for its mission. The reasons were (1) inability to operate in all types of weather, (2) inadequate navigation facilities, (3) inadequate air-ground data transmission system, and (4) limited range and height accuracy of the AN/APS-45 height finder.[50] The height finder did not have as great a range as the search radar. Neither was very great. The search radar, AFGC reported, provided early warning coverage (based on 20% blip/scan tracking capability) against high flying (40,000 feet) jet targets at 173 nautical miles; against low-altitude (20,000 feet) targets of the T-4 type at 193 nautical miles.[51] The height finder, they stated, could, on the average, measure height of a B-29 target to a range of only 80 miles.[52]

But the EC-121, the APGC concluded, did have value as an interim AEW&C aircraft:[53]

> The EC-121 in its present configuration has a significant Air Defense potential. The search radar can present an effective barrier (with about 200 miles spacing between radars) against TU-4 type aircraft flying at medium or even low altitudes. Against jet bombers (B-47's) at higher altitudes, the APS-20 is considerably less effective (but this is true of radars in general). The radar evaluation tests indicate that the equipment can only partially satisfy the surveillance requirements (detection and tracking) against jet bombers.

The deficiencies found by the APGC were confirmed by the Air Force Inspector General who surveyed the EC-121 supporting system in April 1955. The IG added that the system was harmed by a complex method of procurement, poor liaison between the Air Force and the Navy, lack of a central monitoring agency, and inadequate electronic supply.[54]

The EC-121 was produced according to Navy specifications and was procured by this service. The aircraft had, therefore, to meet both Navy and Air Force mission requirements. General Gibson pointed out that this resulted in having equipment that was satisfactory for one but was not necessarily satisfactory for the other.[55]

Also, certain equipment required by one was not needed by the other. ADC's materiel chief, Major General Marshall S. Roth, said that the greatest difficulty with Navy procurement was a delay in exchange of information between the services on modifications and test results.[56] This was mainly on the electronics system. There were few difficulties on the engine or airframe. This delay in exchange of data had held up correction of deficiencies in some cases.

ADC replied to the IG that it had long been aware of these deficiencies and problems. Much time and effort had been spent trying to make improvements.

Many modifications had already been made to the equipment and many others had been proposed.[57] But ADC had not been able to keep up.

> The machinery and personnel know-how in this command and other commands for handling and keeping up with this highly complicated weapon system has not kept pace with the numerous problems that have arisen. Patch work fixes have been applied, but complete control has eluded this command.

As to reasons for this, ADC named (1) a delay in initial provisioning because AMC delayed in designating the prime depots, (2) lack of group experience in the USAF EC-121 weapon system project office because of frequent changes in personnel, (3) Navy cognizance over contract allocation of major components and spares, and (4) Navy control of nine electronic systems in the plane. ADC said also that the program suffered "because many Air Force agencies apparently do not realize that a great deal of extra effort must be expended in order to resolve the numerous problems encountered by this command when it accepted this untried and unproven weapon."[58]

ADC asked that much more additional emphasis be given at USAF level. The thought was that this might result in releasing more manpower for monitoring the program, lowering the time taken in the modification processing system, adding funds for the modifications, hastening shipments of spares, and expediting publication of handbooks for the EC-121.

But ADC's conclusion was that they had accepted the aircraft too soon. It should have gone to ARDC and APGC for complete testing first. "It wasn't until after we had received the aircraft that the principal deficiencies which are now causing the trouble were discovered. The decision to accept Navy aircraft then in production did not give this headquarters and Headquarters USAF time enough to program proper facilities for its effective support."[59]

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In the meantime, General Gibson wrote that he did not believe that the wings could maintain the aircraft at the flying rate required for full operations.[60] Each plane would have to fly 172 hours per month.

The AEW&C project people in Colorado Springs agreed with General Gibson's conclusion that 172 hours was too much. They felt that possibly each squadron should have 13 to 15 aircraft which would make a flying rate of only 133 to 153 hours per month necessary.[61] But they did not know exactly how to solve the problem. It was the ADC Headquarters view that no more EC-121's in their current configuration should be purchased.[62] The 8th Air Division was told that the only solution appeared to be to limit its operational goals with the EC-121 and then to get better aircraft.

To clinch the need to drop the operational goal, word came of a slippage in aircraft delivery. This was caused by a delay in procurement of enough radar to match the production of aircraft at Lockheed.[63] The planes coming off the line for which there was no radar were to be stored until the radar arrived. Some 13 aircraft would be affected.[64] Delivery would be cut by this number between October 1955 and March 1956. They were to be added to the delivery beginning in March, with all returned by October 1956, at which time all the EC-121's currently contracted for were to be delivered.

Change In Operational Goals

As a result of all these problems ADC had to revise its plans greatly. On 9 September 1955, ADC moved the date for operational readiness for the 551st Wing at Otis back eight months to 1 November 1956.[65*] The date for the 552d Wing

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* Because WADF compromised these dates, they were moved back 15 days in mid-December to 15 October 1956 for the 551st and 15 December 1956 for the 552d.

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at McClellan AFB was left at 1 January 1957. For both wings, the requirement for flying 172 hours per month on each plane was dropped to 140 hours. The concept of each wing manning four stations continuously was changed to "will man continuously 24 hours a day as many stations as possible, utilizing a minimum of 3592 hours per month for station keeping and enroute time."[66]

Then in December, ADC asked USAF to increase the aircraft authorizations for each wing to 34 EC-121's and two C-121's.[67] The latter were to be used for training and support, leaving the EC-121's for the primary mission. ADC explained that each plane could fly 140 hours per month which would provide a total of 5,040 hours monthly (36 X 140). This, ADC felt, was sufficient to once again permit each wing to man four stations continuously. ADC pointed out that actually if all the attrition EC-121's already purchased were used, there would be enough to assign 34 to the wings. USAF would have to buy only the two C-121's per wing to meet ADC's request.

Because of the change in operational-ready dates, ADC asked that the 8th Air Division, scheduled for deactivation in mid-1956, be retained until one month after the McClellan wing became operationally ready, or 1 February 1957.[68] USAF had not given its approval at year's end.

As discussed earlier, ADC decided not to activate the 966th Squadron in November as planned. There were no aircraft for it. ADC said that modification of the EC-121's would take about 12 aircraft from the command at all times and would take about two years to complete.[69*] This loss of planes plus the need

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* A small modification was started in July 1955. This program, called BISQUICK (Bureau of Inspection Survey - Quick), provided nine EC-121's with better cabin cooling.

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to give extra aircraft to each wing made it impossible to give any to the 966th. For this squadron and the six others authorized by USAF yet to be activated, ADC wanted a new aircraft that was better suited to the mission.

The last EC-121 was to be delivered in late 1956. ADC wanted a much more advanced aircraft for the future. The proposed requirement for this aircraft called for a 20 to 24 hour endurance in all conditions of weather.[70] Other requirements included the ability to perform its mission at 25,000 feet, space for a double crew, and greater noise and vibration suppression. Equipment requirements included identification capability, automatic navigation, passive detection capability, semi-automatic ground environment system capability and greatly improved radar. Of great promise in the radar field, was an ultra high frequency type that was being tested.[71] By using this radar and turbo-prop engines, the AEW&C aircraft could be flown at higher altitudes.[72]

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Chapter Four

PICKET SHIPS FOR AIR DEFENSE

Picket Ship Policy

The first high level policy on Navy participation in air defense was made at the Key West Conference in 1948 (see Chapter One). The Navy agreed to help repel an air attack with what forces it could provide in accordance with doctrines and procedures established by the Joint Chiefs of Staff. The Chief of Naval Operations then issued a statement of interim policy to serve until the JCS as a group issued instructions.[1]

The first formal request for picket ships was made by air defense officials to USAF early in 1950. Soon after, a need for ten stations - six off the east coast, four off the west coast - was established with USAF. The Navy felt that it did not have the resources to provide the ships needed continuously. The best it could do was to provide for a meager allocation in an emergency. On 22 December 1950, the CNO directed that two ships be always available on 24 hours notice off the east coast.

This remained the arrangement until the fall of 1952. However, additional ships took part in exercises and other joint training.

In September 1952, Admiral William Fechteler, the CNO, issued a new statement of policy on air defense. His statement reaffirmed the policy of aiding the Air Force to defend against air attack by providing for temporary employment of units of the operating forces in port or temporarily ashore and units of the Reserve Fleets and other naval facilities.[2] But

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Admiral Fechteler distinguished between these forces that would be temporarily employed in an emergency and picket ship forces that might be provided for continuous support even in peacetime. The latter he dealt with in a separate statement.

In his first statement on forces other than picket ships, he reiterated the view of his predecessor that the Atlantic and Pacific Fleet Commanders were responsible for air defense against attack coming through their areas "to be undertaken outside the area of responsibility of the air defense agencies but in concert with those agencies."[3] Unlike his predecessor, however, Admiral Fechteler said he considered Air Force responsibility to extend to the seaward limits of its shore-based radar. The previous policy statement had said to the limits of the fighter aircraft control system.

ADC objected to Admiral Fechteler's proposed limitation. Picket ships and AEW&C aircraft would greatly extend the area in which interceptors could be controlled.[4] Therefore, ADC felt, the limit should not be that reached by the shore-based radar, but that reached by the operational limits of the weapons employed. As will be seen later, this controversy was settled by the establishment of a contiguous area off the nation's shores, in which the Continental Air Defense Command had operational control and responsibility, and an early warning zone. For the sea part of the early warning zone, the Commanders of the Atlantic and Pacific Fleets became responsible.

To return to the situation in 1952, the CNO said in his statement on picket ships that the Air Force Chief of Staff had given him a list of stations to be covered.[5] Admiral Fechteler said that to cover these would take more ships than foreseen and would necessitate a raising of Navy force levels, but he wished to support the Air Force as fully as possible.

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Admiral Fechteler saw a way of killing two birds with one stone. The two fleet commanders were responsible for air defense in their areas and needed ships. The Air Defense Command needed ships. Why not combine the requirements in one force? He proposed creating two additional commands, one in the Atlantic and one in the Pacific, to perform "continuous picket functions in support of all military commanders whose primary mission require surveillance...."[6]

As it turned out, separate picket force commands serving all agencies were not established, at least not at this writing. Instead, ships were provided or were to be provided for both the air defense combat zone and the early warning barrier.

In keeping with his policy, Admiral Fechteler provided for a picket ship on full-time duty to develop techniques and procedures. He directed in September 1952 that one picket ship station be manned continuously and one intermittently off the east coast.[7] On the 23rd of this month, one ship went on full time.[8]

Operations and Training

With the placing of one ship on full-time duty, training and work on procedures began on a continuous basis. Actually, however, intermittent operations for this purpose had started earlier. Picket ships, as has been mentioned, had taken part in local joint training and large-scale exercises for some time. Operation of ships specifically assigned for this purpose did not begin, however, until mid-1952. This dates from shortly after activation by the Navy of Escort Squadron 16 in March.[9] Two destroyer escorts, fitted with additional radar and communications equipment, were assigned at this time -- USS Harveson and USS Joyce. Four others were added by November -- USS Strickland, USS Kirkpatrick,

USS Fessenden, and USS Otterstetter. Escort Squadron 16 began operations with EADF in June 1952. One ship was ordered to a station for periods of two to six days to test voice communications with AC&W squadrons.

Beginning in September, manning of one station started on a continuous basis. The ships of the escort squadron took turns at this duty, manning one of the six stations established off the east coast. A second ship was kept on standby duty. Also, at this time, EADF was sending Commander Destroyers Atlantic Fleet its publications so that his other destroyers could take part in air defense if necessary.[10] COMDESLANT had over 100 destroyers possessing an air defense capability, though to a lesser extent that the modified DER's.

The years 1952 and 1953 were spent in testing and in training. From June 1952 to May 1953, in fact, the mission assigned to the picket ships was communications testing, primarily.[11] After this date, it became air defense.

The greatest problem was finding a suitable communications method. Originally, it was decided at JCS level that the Navy would supply the ship-to-shore communications.[12] The Navy thought that its regular ship-to-shore system could handle the communications.[13] The Navy's plan was for the ships to report to a Navy shore radio station. This station was then to send filtered data to an AC&W station by landline. But air defense officials felt that direct ship to AC&W station communications would be better. The Air Force asked the Navy to assign two day and two night frequencies for each of the six picket stations, or a total of 24.[14] The CNO replied that he thought the regular naval communications system would do the job and refused the frequencies.[15] Because of the CNO's views, ADC directed its defense forces to test the Navy system.

It became apparent almost immediately that the Navy's original scheme

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was unsatisfactory. It took too much time. An average of 20 minutes was needed to transmit data from the ships to the AC&W station through the Navy station.[16]

There followed an extensive series of tests with nearly everything being tried including CW, radio-teletype, and voice, with various methods of linking the ship and the AC&W station. To aid in the tests, the Navy set up a radio station at a Sea-Air Rescue station near Newport, Rhode Island, called Beavertail.[17] During the tests it served as a relay and monitoring station. The final method decided upon, as the most rapid means, was high frequency voice reporting from the ship directly to the AC&W station.[18] A monitor was found desirable and so Beavertail was retained.

The radio plan as eventually worked out was as follows.[19] On the East Coast, five ground radio stations were established (the same five that were to handle AEW&C communications): P-13 Brunswick NAS, Maine; P-10, North Truro, Massachusetts; P-45, Montauk Point, New York; P-54, Palermo, New Jersey; and P-56, Cape Charles, Virginia. Each of these stations was to have one picket ship reporting to it. The reason for only five stations was that early in 1954, ADC reduced its requirements by one station off the east coast. Besides having one of these stations assigned as a primary reporting point, each ship was assigned one of the other stations as a secondary reporting point in case of failure of the first station.

A slightly different system was to be set up for west coast pickets. Only three communications stations were established: McChord AFB, Washington; Hamilton AFB, California; and Norton AFB, California.

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Indoctrination and Procedures

In mid-1953, a continuous program for exchange of personnel for indoctrination was started. However, some exchange had taken place earlier. In 1952, for example, 40 officers and men from picket ships visited various AC&W sites, with some of them actually standing duty.[20] During 1952, ten Air Force AC&W personnel visited picket ships.

The first training of any consequence in controlling Air Force interceptors by ships of Escort Squadron 16 began in February 1953.[21] During this year, 29 intercepts were conducted by picket ships. In Januury 1954, in-port interceptor control training was started to supplement on-station training.

As early as 1951, EADF had issued operating procedures for picket ships in air defense. An EADF SOP published in 1952 described the picket ship patrol area as a circle 50 nautical miles in diameter with the center located at the ship's control point.[22] The ship was not to be more than 25 miles from this control point.

Chapter Five

THE CONTIGUOUS SYSTEM AND THE EARLY WARNING ZONE

Navy Responsibility Established

The most important landmark in the history of picket ships in air defense was reached at the end of 1953. At that time, Admiral Fechteler's successor, Admiral Robert B. Carney, signed an agreement with General Nathan F. Twining (who succeeded the late General Vandenberg) that pledged everything that air defense officials had been seeking for so long. By its terms, the Navy would provide ships and lighter-than-air aircraft to extend ADC's shore-based radar coverage seaward contiguously off both coasts.[1] The forces in this contiguous system were to be directed by ADC. The Navy was also to provide forces for extending the early warning system seaward. The forces for these early warning "sea flanks" were to be under the fleet commanders. But they were to coordinate their plans with ADC.

These responsibilities were firmly established in the fall of 1954 with the creation of the joint, tri-service command for air defense -- the Continental Air Defense Command. As noted earlier, the JCS set up this command on 1 September 1954.

The JCS ruled on both the contiguous system and the early warning system.[2] For the former, they set up a Navy force -- "naval forces of the contiguous radar coverage system" -- and allocated it to CONAD along with the Air Defense Command and the Army Antiaircraft Command. The headquarters

of the Navy forces was set up at CONAD Headquarters in Colorado Springs. The first commander of the Naval Forces Continental Air Defense Command was Rear Admiral Albert K. Morehouse. Additionally, naval components were established at defense force and air division level.

The JCS provided that CONAD's chief was to have operational control over all forces assigned or other wise made available. This, of course, included the Navy forces of the contiguous system.

In regard to the seaward extension of the early warning system, the JCS provided that the forces and operations of the sea flanks were to be under the Commanders in Chief Atlantic and Pacific Fleets. However, they directed these commanders to support CONAD in accordance with JCS approved plans and with mutual agreements so as to insure that the sea flanks would meet the needs of CONAD. Also, one of CONAD's responsibilities was to plan for early warning systems and procedures in coordination with appropriate United States and Allied commanders.

Admiral Carney directed that the Navy forces to be assigned initially to the operational control of CONAD were to be the ships of the contiguous radar coverage system while on station.[3] To improve the efficiency and readiness of naval forces in the two systems, he told his Pacific and Atlantic Fleet Commanders to develop and test new tactics and equipment, to hold exercises, and to make forces available for these functions.[4] Among the subjects to be explored, which included improved identification and communications, was the possibility of employing a carrier force in conjunction with the early warning system for identification, tracking, and interception at sea in an emergency. He noted that in general the duties of individual units participating in either the contiguous or early warning systems were the same. Training in

either would be beneficial to the other.

The Combat Zone Picket Ship Program

The plan issued in June 1955 set forth CONAD's requirements for the forces providing the seaward extension of what it called the air defense combat zone, the area "encompassed by a line representing the maximum limit of contiguous radar cover around the United States and certain parts of Canada and Mexico."[5]

This was the two-stage plan discussed before. In the first stage, CONAD wanted to build up to five picket ship stations off each coast. In the second, CONAD wanted to add two stations to the west coast which had a long area exposed to Russian bases and where there would be no Texas Towers. The two additional stations would make it possible to give coverage from off Vancouver Island, British Columbia, clear down to Baja California. This made a total of 12 stations, or two more than initially required (see Chapter One). But the Navy had already planned for 12 stations by this time.[6]

The CONAD plan for deployment of picket ship stations (five east coast, seven west coast) not only differed in total numbers from the original, but also in numbers for the east coast. Initially, six stations had been planned for the east and four for the west. Early in 1954, ADC decided to reduce the eastern stations to five.[7] When EADF planners heard of this, they expressed surprise and confusion.[8] In another letter, they listed some twenty references dating back to October 1950 calling for six stations.[9] ADC replied that five stations met the need when considered along with planned AEW&C stations and Texas Towers.[10]

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Assignment of Ships to the Combat Zone

The Navy had used destroyers early in the postwar period for air defense picket duty and later had used destroyer escorts. While both were excellent as pickets, they were designed for fleet duty and were expensive to operate in continental air defense. Their optimum speed was greater than that needed for offshore patrol. They carried weapons and some personnel that were not needed. A ship with less powerful engines that would use less fuel and without the extra equipment and men required for fleet duty was more practical.

The Navy chose the old Liberty-type transport of World War II fame. It began taking some of these transports from mothballs and converting them into pickets (see drawing on next page). In their new role, they were termed YAGR's (meaning miscellaneous auxilliary ocean radar station ship) and renamed to match their role of watching the skies for enemy planes. The first of them, USS Guardian, was commissioned in February 1955.

The Navy planned to man all stations in the contiguous or combat zone with YAGR's. For the early warning sea flanks, however, it planned to use destroyer escorts (DER's). The latter were also to be used in the contiguous system until their places could be taken by YAGR's.

In August 1954, Admiral Carney directed that a second station be manned full-time.[11] This was done on the seventh of the following month.[12] Early in 1955, a third station was added and by July, five East Coast stations were manned.*

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* According to COMNAVFOREASTCONAD Operations Plan No. 1-55, 1 May 1955, the five east coast stations were located as follows: (1) 42°47'N, 68°23'W; (2) 41°00'N, 68°00'W; (3) 40°00'N, 70°00'W; (4) 38°56'N, 72°05'W; (5) 37°41'N, 73°00'W.

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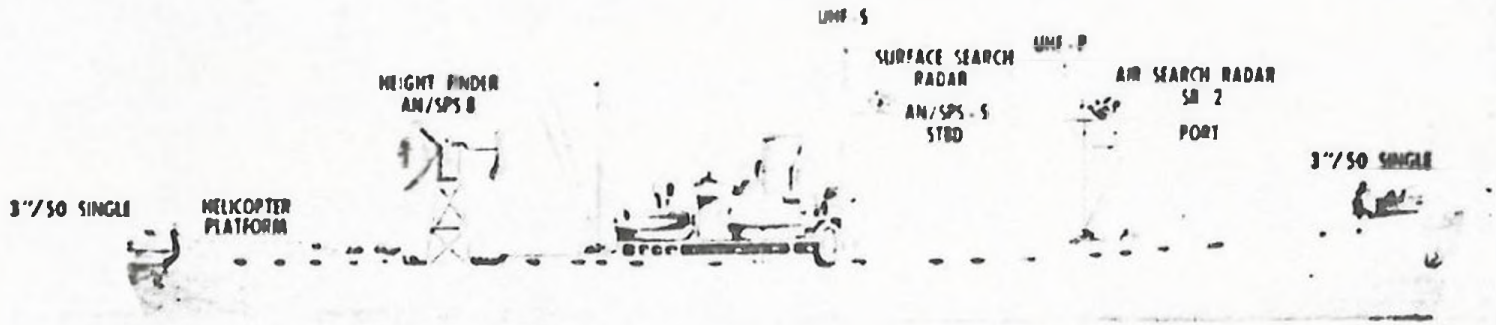
LIBERTY SHIP CONVERSION TO RADAR PICKET YAGR

ADVANTAGES: 1. PROVIDES SATISFACTORY PICKET SHIP AT REASONABLE COST
2. CAPABLE OF OPERATING ON ECONOMICAL BASIS



CHARACTERISTICS REQUIRED:

STABLE RADAR PLATFORM

SEA AND STATION KEEPING QUALITIES SUITABLE FOR ALL WEATHER CONDITIONS

SUFFICIENT SPACE FOR INSTALLATION OF RADAR, CIC & COMMUNICATIONS

ADEQUATE LIVING & MAINTENANCE FACILITIES

HELICOPTER PLATFORM (SPACE RESERVED)

DER's were used exclusively until June. On the 23rd, the first YAGR, USS Guardian (YAGR 1), went on station number Two.[13] Three other YAGR's went into service in July. Two more DER's were added to east coast operations by year's end.

In addition to the four YAGR's, the Navy was using six DER's off the eastern seaboard. The ratio of ships to stations was roughly three DER's per station and four YAGR's for three stations. The reason for the smaller number of YAGR's was that they could stay on station from 30 to 32 days; the DER's for only about two weeks. In July, east coast stations One and Five were manned constantly by DER's; stations Two and Four by YAGR's. Station Three was manned primarily by YAGR's with DER's filling in.

The first west coast station was manned on 30 July by USS Haverfield (DER 393). Three more DER's were put on west coast duty by the end of the year. Training and testing began late in the year on the second station which was scheduled for full-time manning on 1 January 1956.

The Navy schedule called for manning five west coast stations by July 1956.[14] Four YAGR's and six DER's were to be on duty at this time in the Pacific. The five eastern stations were to be manned entirely by YAGR's by July 1957; five western stations a year later. This schedule phased in a sixth western station in July 1957. No schedule for the seventh station had been established at this writing.

Operations

The Commander Naval Forces Eastern CONAD* issued an operations plan in

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* This was the eastern component at defense force level of the Naval Forces Continental Air Defense Command.

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May 1955 covering picket ship operating procedure, stations and manning priority, and communications.[15] He directed that control of picket ship active air defense functions while on station was to be by the joint air division commander in whose sector the ship was operating. When not on station, control of DER's was to be in the hands of Commander Destroyer Force, Atlantic Fleet; of YAGR's, Commander Eastern Sea Frontier.

COMNAVEASTCONAD directed that ships patrol within a circle 25 nautical miles in radius from the control point of the station. Ships were considered off station when more than 25 nautical miles from the control point, or unable to perform their mission.

This procedure was altered in November by CONAD. It ordered picket ships to maintain patrol along the axis of the barrier to a distance of 40 miles on each side of the ship's station.[16] The purpose was to increase the probability of detecting low level attacks. Movements of the ships were to be synchronized so as to keep a constant distance between each ship. This shifting patrol was to be varied in speed and time at the discretion of the defense force commanders in order to eliminate the possibility of an enemy forecasting the future position of any picket ship.

This change in operational procedure accompanied an order by CONAD to move picket ship stations on both coasts about 200 nautical miles out to sea from their current and planned positions.[17] This move was to be made by 1 December 1955. The reason for the move was to gain greater warning time for readying the defenses. The new positions were tested in Exercise CRACKERJACK, held in December, to find the best future locations of the ships.

Two reports of picket ship operations give some indication of their per-

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formance and the extent of normal operations. The first report covering operations from December 1954 through March 1955 showed that the DER's made a total of 131 training intercepts and 15 active intercepts.[18] The average detection range of the ships was 90 miles, with a maximum range of 157 miles. The average error in picket ship plots was 5.4 miles. Voice communications with ADDC's was 77 per cent effective on the average.

The second report was by the commander of USS Skywatcher (YAGR 3) on his operations in July 1955 who reported attempting seven training intercepts and completing five. He said his SRa radar "proved to be a reliable air search radar with some surprising results."[19] Aircraft were picked up below 20,000 feet at an average range of 125 miles and above this altitude at 188 miles. The maximum UHF communications range with interceptors was 90 miles.

As with the AEW&C force, picket ship operation was hampered by not having enough suitable frequencies. Because high frequencies were so difficult to get, ADC decided to try to get along with a smaller number. To a request by WADF in September for more frequencies, ADC replied:[20]

> In view of the extremely congested high frequency spectrum and the remote possibility of obtaining clear channels, it is necessary that we take a realistic approach to obtain ship-to-shore communications based on current equipment and its limitations.

ADC felt that the immediate need was for one reliable circuit from ship to shore and directed its field forces to work toward this end. Efforts were then to be put on the use of other techniques such as radio-teletype so as to lower the number of frequencies needed and yet meet the ultimate communications requirement.[21]

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Seaward Extension of the Early Warning Lines

As early as 1948, air defense planners had seen a need for an early warning line of radars across northern Canada and extending out to sea with ships or planes (see Chapter One). This early plan called for a sea flank running from Alaska to Hawaii on the western side and from Greenland to Newfoundland and down to Puerto Rico on the eastern side.

Other proposals followed and the idea was discussed at various levels, but it was not until late in 1953 that high level agreement was reached. In October of that year, a joint Canada-United States Military Group recommended installing a line of radars generally along the 55th parallel in Canada.[22]

The following year, location studies were made. While the land portion of this line, which was first termed the Southern-Canada and later the Mid-Canada line, was to be generally in the hands of Canada, sea flanks were to be managed by the United States. The American Joint Chiefs of Staff approved establishment of sea lines from Hawaii to Kodiak Island, Alaska, on the Pacific side and from Newfoundland to the Azores on the Atlantic side.[23] The Mid-Canada line was to be operating by about 1957.

In the meantime, consideration was given to construction of a second line much further north at about the 69th parallel.[24] The reason for this second line, which became known as the Distant Early Warning (DEW) Line, was that the Mid-Canada line would not give enough warning time. The Military Study Group mentioned above expressed this view on the need for a line in the far northern regions:[25]

> A review of intelligence reveals that by the time a [Distant Early Warning line] could be installed, the USSR could have available numbers of aircraft of such advanced performance that a line as far north as

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practicable is essential to provide the required warning time.

In other words, warning of an attack by faster bombers being built by Russia had to be sent from a line across the top of the North American continent if the defenses were to be readied in time. A minimum of two hours was needed. A Joint Air Force-RCAF group reporting later in 1954 said that Soviet aircraft development made the need urgent: "a requirement for distant early warning exists now and by 1957 an adequate distant early warning system will be a vital necessity."[26]

This did not mean abandonment of the Mid-Canada line. It was to be kept to provide defense in depth. The Military Study Group said that it was "essential for providing the minimum amount of warning necessary for, and adaptable to, active air defense."[27]

By late 1954, both the USAF and the RCAF had decided to cut out the Alaskan link to the Mid-Canada line.[28] Rather, the Pinetree radar chain coming up from Holberg, Vancouver Island, was to be connected to it at Dawson Creek, British Columbia. The Mid-Canada line was then to run from Dawson Creek to Hopedale, Labrador, where it was to connect with the NEAC radar system running down to Cape Race, Newfoundland.

The National Security Council recommended to President Eisenhower in February 1954 that a distant early warning system be built as soon as feasible.[29] He approved the recommendation. The following month the Secretary of Defense directed the services to implement the elements each was responsible for. This was followed by the study quoted above by the Canada-United States Military Study Group. They recommended the establishment of such a line and for other groups to be convened to choose the locations and equipment. A Locations Study Group

was then appointed.

Before the latter group made its first report, the American and Canadian air defense commands finished studies of line locations. In a joint report, which favored keeping the DEW line on this continent rather than extension to Europe, they proposed the line as follows:[30]

(a) From Hawaii by sea to Kodiak (there to be integrated with the Alaskan radar system).
(b) To Herschel Island thence to Padloping Island in the Davis Strait.
(c) Across the Davis Strait to Greenland, then south to Cape Farewell.
(d) From Cape Farewell by seawing to the Azores.

The Locations Study Group issued its first report in November 1954.[31] They also recommended that the Hawaii to Kodiak sea line, originally planned for the Mid-Canada line, serve as the Pacific extension for the DEW line. They proposed using the Alaskan coastal radars from Kodiak and running the line over to Cape Dyer and across the Davis Strait to Holsteinborg, Greenland, but made no suggestion for the area beyond. But among the proposals being studied by this group was one put forth by the Navy for extending the sea line from Greenland to England via Iceland and the Faroes.[32]

CONAD's chief, General Chidlaw, objected at once to consideration of an eastern extension to England. He said that a line to England was not acceptable for continental air defense purposes and could not be justified. Therefore, continued study of it was "an unnecessary waste of time."[33] General Chidlaw reiterated CONAD's previous proposals and the joint CONAD-RCAF proposal for extension of the line to the Azores. This line was flexible and was less susceptible to false crossing for "spoofing" purposes. An inter-hemispheric line was not feasible or practicable, he declared. "This statement is predicated on the

unreliability of existing communications, intelligence complications, and the inability to regulate and control world wide air traffic, thereby, permitting an intolerable number of unidentified aircraft line crossings and spoofing raids by the enemy."[34]

By the end of 1954, approval had been obtained from the Canadian Government to construct the land portion of the DEW line.[35] A contract was signed between the Air Research and Development Command and the Western Electric Company for the design, construction and installation. A target date of 1 July 1957 was set for its completion.

In January 1955, the JCS approved the portions of the line on which there was general agreement: Hawaii to Kodiak Island by sea, then by land to Cape Dyer.[36] Nothing was approved beyond Cape Dyer, including the Atlantic sea flank.

In June 1955, CONAD's Deputy Commander, Major General Frederic H. Smith, Jr., presented CONAD's case to the JCS for the Greenland-Azores line and its reasons for opposing the Navy-proposed Greenland-England line. The line to England, he said, would be approximately 1,230 miles from the nearest Soviet base on the Kola Peninsula and about six hours flying time to the United States east coast.[37] If the Russian Long Range Air Force operated across this line, it would be operating in territory closer to its home than to the United States. CONAD felt that this line would be too easy to spoof. Its commander would be put in the position of not knowing what to do if the line was crossed, for crossing it would not necessarily mean that an attack was coming. "The United States would have difficulty in molding world opinion to the extent that any crossing of this line would be considered a direct threat to the United States."[38]

The Azores line would be closer and would not have these disadvantages

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to the same extent, General Smith continued. It would be about 2,100 miles from the nearest Soviet base and about four and one-half hours flying time. This line would be close enough to justify action by CONAD if crossed in large numbers. He conceded that this line could also be spoofed, but he felt that the United States would be on firmer ground in challenging Russia's right to cross it.

Better identification of transoceanic traffic was another factor listed in favor of the Azores line. A warning line, General Smith explained, should be so situated that flights would penetrate it as close to a right angle as possible to permit identification. The Azores line would allow this. But the England line would run just about parallel to routes followed by normal traffic.

Another point was flexibility. Initially, a line could be run from Newfoundland to the Azores as planned originally for the Mid-Canada line. Then in a later period, it could be swung up to southern Greenland. Or, it could be moved shoreward to add to the contiguous system if needed.

Meanwhile, Admiral Carney proposed that a joint Navy-Air Force group study possible relocation of the already approved Pacific sea extension.[39] His proposal was to use land-based radars along the Aleutians and then to go by water to Midway. USAF agreed to the study to get information for future consideration of any relocation. But it emphasized that nothing should be done that would stop the current Pacific program.[40]

In answer, the new CONAD commander, General Earle E. Partridge* expressed

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* General Partridge moved from command of the Far East Air Forces to that of CONAD in July at General Chidlaw's retirement.

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surprise at the fact that this matter had been given to a group in Washington.[41] The JCS had named his headquarters as an important planning agency for early warning systems. He suggested that it would be more appropriate for the JCS to ask his views on any relocation. USAF replied that it would try to get the study responsibility moved to CONAD.

However, USAF advised in September 1955 that it had stopped trying to transfer the study responsibility because of "current budgetary considerations" and that the study would be made there.[42] CONAD's answer was to reiterate its previous stand:[43]

> CONAD desires that the Pacific extension of the DEW line remain as presently directed by the JCS. Location of the line here provides information most responsive to Continental air defense requirements. Request Headquarters USAF support this position to the utmost in the conference with the USN.

At the end of the year, CONAD learned that the location of the line was to be changed. The JCS reversed their previous decision for the western sea flank to run from Hawaii to Kodiak and approved the location of it between Midway and Adak in the Aleutians.[44]

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Chapter Six

TEXAS TOWERS

Origin Of The Idea And Approval By USAF

Up to this point, this study has treated the use of radar-equipped ships and planes for extending the warning net off shore. It has been shown that the employment of both in continental air defense had been thought of and even planned for as early as 1947. A relative latecomer to the planning for off-shore warning was the idea of using stationary platforms for radar.

In the summer of 1952, scientists at the Lincoln Laboratories of the Massachusetts Institute of Technology studied means of putting radar off-shore.[1] They concluded that a means was offered by the shoals lying off the northeast coast. On these shoals, they believed, platforms similar to those used by oil companies for off shore well drilling could be built to hold heavy radar. These proposed platforms were dubbed "Texas Towers."

There were five strategically located shoals in the North Atlantic on which Texas Towers could be built. Their names and approximate locations were:* Brown's Bank, 75 miles south of Nova Scotia; Cashes Ledge, 100 miles

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* The locations proposed by Lincoln, which with slight variations became the selected sites, were as follows:

Nantucket Shoal	40°45'N	69°19'W
Georges Shoal	41°44'N	67°47'W
Cashes Ledge	42°53'N	68°57'W
Brown's Bank	42°47'N	65°37'W
Unnamed Shoal	39°48'N	72°40'W

east of New Hampshire; Georges Shoal, 100 miles east of Cape Cod; Nantucket Shoal, 100 miles southeast of Rhode Island; and an unnamed shoal 80 miles southeast of New York. At Cashes Ledge, Georges Shoal, and Nantucket Shoal, the water was some 50 to 60 feet deep. But at Brown's Bank and at the unnamed shoal the water was considerably deeper, over 100 feet.

ADC liked the idea and recommended it to USAF in September of that year. Lincoln's suggestion, ADC said, "has considerable merit and proposes to be an economical partial solution towards meeting picket vessel requirements of this Command."[2] ADC did not mean that picket ships could be eliminated from their requirements, but rather that a smaller number of ships might be needed and overall coverage could be increased. ADC recommended "that these off-shore stations be considered along with picket vessels as a means of fulfilling the urgent requirement for seaward extension of radar coverage...."[3]

The following month, Air Force Headquarters said that it would consider the possibility of using towers and ships in combination and in March 1953 asked ADC what it wanted at the towers in order to develop a requirement.[4] ADC told Washington that its concept was to automatize and remote all operations so far as possible to keep personnel requirements to a minimum.[5]

The estimated personnel requirements for two time periods were presented. The first was for the remainder of the period of the manual system, the second for the period when the air defense system became semi-automatic.* For the manual period, ADC said that somewhere around 27 men would be needed on each

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* For information on the semi-automatic system, termed SAGE (Semi-Automatic Ground Environment), see the ADC, Operational Plan, Semi-Automatic Ground Environment System for Air Defense, 7 March 1955 (Doc 449, Hist. CONAD/ADC, Jan-Jun 1955).

tower. With the semi-automatic system only around 17 would be needed, with the requirement for scope operators deleted. ADC did not plan to put controllers on the towers in either time period. The command thought it possible to send all data to a parent radar station or, in the later period, to a computer center, where all interceptions could be controlled. This was considered to be a much more economical method.

As for radar, ADC wanted the AN/FPS-3 search set and a good height finder, such as the AN/FPS-6. For communications to shore, ADC recommended submarine cable; for air operations, UHF, with high frequency equipment for back-up.

ADC submitted a more complete and firm list of equipment in late summer of 1953. The command asked for one AN/FPS-3 and two AN/FPS-6's on arctic towers and with radomes.[6] To remote the data to shore, ADC requested the Slowed Down Video Transmission System. Among other items listed were two AN/GRD-32 UHF transceivers and an AN/APR-9 Passive Detection set.

In November 1953 USAF drew up a planning guide for Texas Towers.[7] It presented a number of interesting facts for consideration of the USAF staff agencies: (1) The National Security Council had stated in September that contiguous radar coverage seaward should be effected as soon as possible; (2) The Air Force air installations officer had said that the Texas Tower type of construction was feasible; (3) The Judge Advocate General had ruled that the construction of Texas Towers on the high seas adjacent to the territorial waters of the United States was not a violation of international law; and (4) Each Texas Tower with all equipment including submarine cable would cost about $4,000,000.

USAF notified ADC in January 1954 that it approved five Texas Towers and that they had been included in the FY 1954-55 budget program.[8] The Navy's Bureau

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of Yards and Docks was to supervise the construction. USAF named the Air Force Installations Representative, New England Division, Corps of Engineers as the Air Force agency to monitor the project. Technical radar plans and engineer assistance were to be furnished by the Rome Air Force Depot.

In March 1954, USAF authorized the Bureau of Yards and Docks to prepare the contract plans and specifications.[9] At this time, USAF assigned project numbers to the towers. They were: TT-1 (for Texas Tower-1), Cashes Ledge; TT-2, Georges Shoal; TT-3, Nantucket Shoal; TT-4, Unnamed Shoal; and TT-5, Brown's Bank.

The Navy contracted with a joint venture of the De Long Corporation and the Raymond Concrete Pile Company in July 1954 to make core drillings. Site surveys were made in the summer by two engineering firms with the assistance of these two companies and other agencies. Their feasibility report dated October 1954 became the site survey report.[10] In December, the Navy gave a contract to the Bethlehem Steel Company to build the first tower.[11] For this tower, ADC chose the Georges Shoal site, which was on one of the more shallow locations and situated off the area where the first semi-automatic system was to go into operation. This tower had been given the project number Texas Tower Two. The Raymond and De Long Companies were given a contract to tow the tower to the site and to erect it.

The location of Texas Tower Two was described by Mr. George F. Tait, Vice President of the De Long Corporation and Texas Tower project manager, as follows:[12]

> The site is in the midst of the great shoal area known as Georges Bank. This shoal covers hundreds of square miles and consists of alternate shoals and deeps harassed by innumerable tide

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rips formed by the very strong conflicting currents. The entire area is avoided by mariners and even commercial fishermen generally pass it by. Georges Bank has only one attraction - at some points the water is shallow enough to permit the permanent emplacement of a radar platform....

Erecting The First Tower

September 1955 was set as the beneficial occupancy date for tower Two and June 1956 as the date for the start of operations.[13] The tower was built by Bethlehem Steel at its Quincy, Massachusetts, yard. While it was officially launched on 20 May 1955, it was not actually floated until two weeks later because of trouble in launching. On 3 June, it was floated to another dock where temporary legs were installed and it was fitted for sea. It sailed for the site on 12 July, arriving two days later.

At the site, workmen of the Raymond and De Long Companies dropped temporary legs to the shoal 55 feet down in order to jack the tower up.[14] They raised it until the bottom of the hull was 63 feet above water, its permanent position. Then the three permanent caissons, which were ten feet in diameter and 185 feet in length, were sunk into the shoal to a depth of 48 feet. Inside each caisson they inserted a steel tube six feet in diameter running from the main deck down about 140 feet. This tube was to provide housing for utilities and connections for supply of fuel oil and fresh water. The space between the inner tube and the outer was filled with concrete. The bottom 40-odd feet was filled entirely with concrete. An outer shell, 15 feet in diameter, was placed around the bottom 60 feet of each caisson and also filled with concrete.

The hull was triangular in shape, about 200 feet on each side (see photo-

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graph on next page). It was 20 feet deep, divided in the center to make three decks: the lower deck which was the bottom of the structure; the second deck inside the main hull; and the main or top deck. On the main deck was placed a deckhouse or radome deck. This ran the length of one of the 200 foot sides and was 12 feet high and 60 feet wide.

The bottom deck was for storage tanks and pumps. The second deck was for living quarters, administrative offices, galley and mess hall, food storage, heating and ventilating equipment, and power generating equipment. The main deck was kept clear of obstructions for use as a landing platform for helicopters. In the center of the radome deck and raised about 28 feet was the AN/FPS-3 search radar's antenna. Flanking this antenna at radome deck level were the two AN/FPS-6 antennae. All radar operating equipment was housed in the space under the radome deck.

The hull and its equipment weighed about 6,500 tons. The reason for only three legs was to keep resistance to wave forces to a minimum.[15]

Beneficial occupancy by the Air Force and ADC was made on 2 December 1955, three months later than originally scheduled mainly because of delays in launching. By this time, however, ADC saw that operation at the tower could begin sooner than expected. The equipment could be installed much earlier than thought at first. The Middletown Air Materiel Area advised that communications and electronic equipment would be installed and operating by the end of January 1956.[16] In July 1955, ADC moved the date up to 1 February, four months earlier than scheduled.[17]

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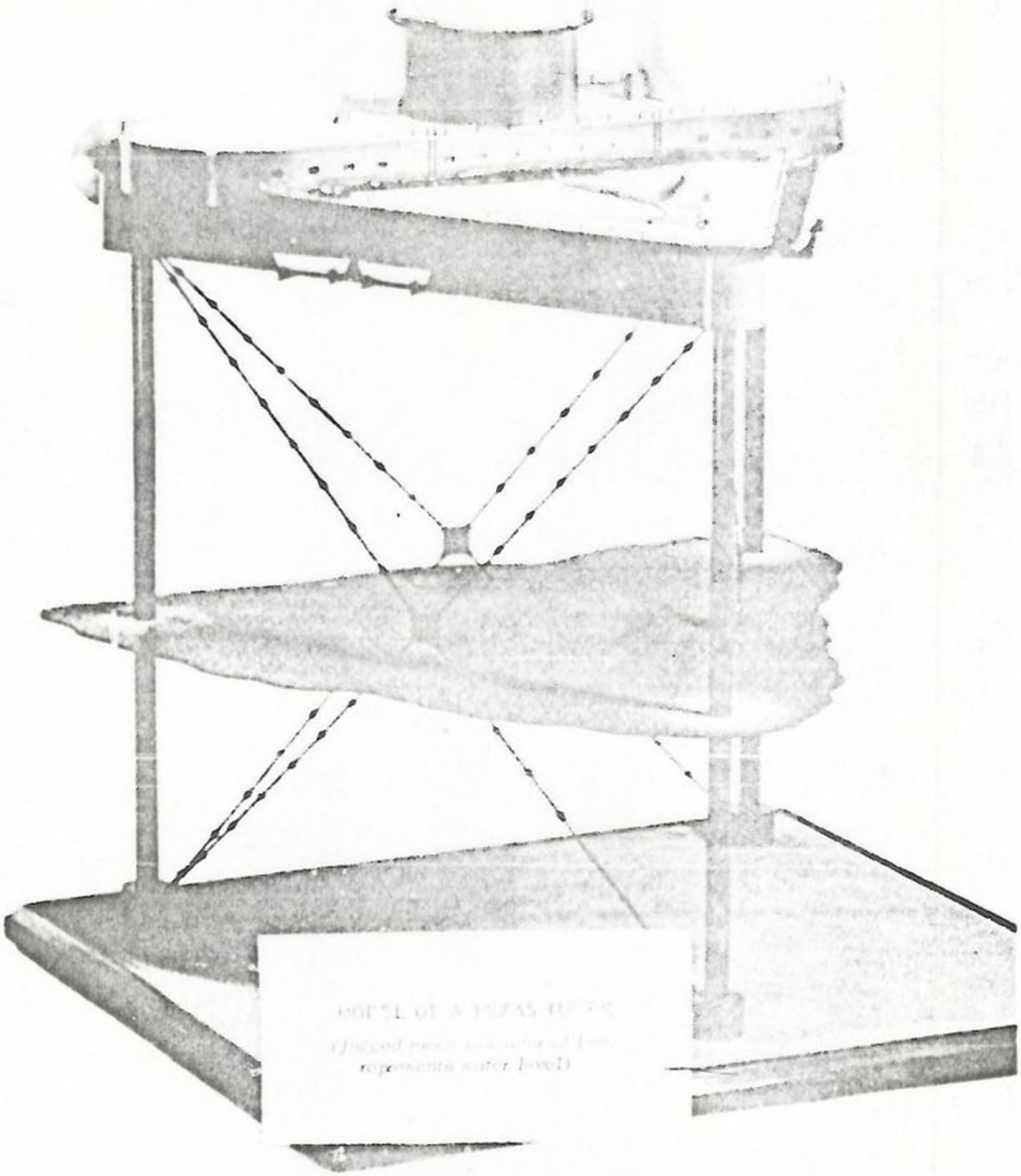

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Operational Procedures, Manning, And Support

In the meantime, ADC was working on the operational procedures, manning, and support for towers in general and for TT-2 in particular. ADC planned to use TT-2 as a test case for the other towers.

The Command issued its first general operational plan for Texas Towers in mid-1954.[18] It reiterated its original concept that the search radar data should be sent to a parent shore station. All interceptors would be controlled by this shore station. Height information, however, was to be determined by the tower operators and reported by voice to the parent station. ADC listed the parent stations for the towers as follows: P-10, North Truro, Massachusetts, for TT-2; P-13, Brunswick NAS, Maine (later changed to P-10), for TT-1; P-45, Camp Hero, New York, for TT-3; P-9, Navesink, New Jersey, for TT-4; and P-13, Brunswick NAS for TT-5.

ADC planned that communications to the shore station were to be by submarine cable and by tropospheric scatter radio. A high frequency radio voice channel was planned also for use in case of failure of the main communications sets. For ground-to-air communications, ADC wanted a minimum of four UHF tactical channels plus the UHF AICC and emergency channels. ADC wanted four multichannel (AN/GRC-27) for the tactical circuits and two single channel (AN/GRT-3, AN/GRR-7) for the AICC and emergency circuits.

ADC found soon after issuing this plan that it could not get an adequate submarine cable in time for operation from the first tower. In August 1954, ADC told USAF that both the Air Materiel Command and the American Telephone and Telegraph Company had advised that a minimum of two years would be required to put in a dependable cable.[19] ADC suggested the use of tropospheric scatter

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as the primary communications, at least for initial operations at the first tower.[20] This suggestion, the command said, was to "insure that the Air Force is not forced into installation of an incorrectly designed submarine cable facility under pressure of meeting an operational date...."[21]

Because there was no other choice, tropospheric scatter radio became the primary means of communications to shore for the first tower. To meet the time deadline, however, the first equipment had to be commercial type installed on a commercial contract.[22] Later, this equipment was to be replaced with military equipment. One high frequency voice circuit was also provided for emergency communications. Installation of submarine cable was held up pending further study.

At the end of 1955, it appeared that ADC would also be unable to realize its concept of remoting the search radar data to shore prior to operation of the semi-automatic or SAGE air defense system. When the SAGE computer (AN/FSQ-7) came into operation, tower search radar data could be sent to shore by means of the Lincoln Fine Grain Data System, AN/FST-2. But ADC wanted to transmit the data prior to that time, right from the beginning of tower operations. ADC thought that Slowed Down Video equipment could be used for this and so stated in its plan of July 1954. However, in tests held before this device was installed, it proved unsatisfactory because it gave multiple returns on single aircraft and had considerable azimuth inaccuracies.[23]

Realizing that it might not be able to transmit the data, ADC made provision for controlling from the first tower. Four control positions were installed on the tower.[24] Later, ADC planned to install the AN/GPA-37 on the tower if no means for sending the data back to shore had been found. ADC

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wanted this equipment at the tower (or possibly towers), as at its other radar stations, to increase their capability. The AN/GPA-37, termed the Radar Course Directing Group, would perform routine calculations and provide a memory and display, thus enabling a director to handle a larger number of interceptions. This equipment was scheduled for delivery beginning in mid-1956.

But ADC still wanted to remote the tower search radar data. ADC explained to the Rome Air Development Center that, "In an effort to reduce the number of operational personnel on the Texas Tower, this headquarters desires to remote all control functions to the shore direction center."[25] And to ARDC, it said, "Satisfactory equipment for remoting the radar video from the Texas Towers... would increase the ground control effectiveness. This would in turn increase, proportionately, the effectiveness of the manned and unmanned interceptors."[26]

In January 1955, the Command sent a requirement to ARDC for remoting equipment to take the place of slowed down video.[27] ARDC replied that it had been given no requirement previously for video transmitting to shore-based manual centers and that no effort had been made to develop such equipment.[28] ARDC said that it understood that the AN/GPA-37 was to be operated manually at the towers until the SAGE AN/FSQ-7 center was in operation. Then, the tower data could be sent by the Fine Grain Data System, AN/FST-2. ARDC advised that it was unlikely that equipment for remoting to the manual system could be developed "even on a crash basis in sufficiently short time to provide a material time advantage over the programmed date of the AN/FST-2 - AN/FSQ-7."[29] This fine grain data system was scheduled for 1957.[30]

ADC pursued the matter further. It learned from the Rome Air Development

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Center that a system known as RAFAX (Transmitter Coordinate Group CA-682/GFA-29) might do the job and was in production.[31] USAF opposed this, however, recommending that controlling be done from the tower until the fine grain data system was installed:[32]

> To provide remoting equipment prior to the installation of FGD for SAGE will necessitate the re-engineering of a video transmission system such as RAFAX and installing it as an interim system. The developmental effort and re-engineering required will be expensive in both money and manpower.
>
> The time period involved...in relation to the SAGE implementation does not justify the engineering and installation of interim point-to-point data transmission equipment.

By April 1955, ADC had changed its plans and decided to control from the tower in the initial stage of operation. An operational plan issued in this month stated that in the first stage the tower was to operate manually as a direction center.[33] Radar data was to be sent to the parent direction center where identification was to be performed and tactical action initiated. Scramble orders were to be issued by the parent center (in the case of the first tower this was the 762d AC&W Squadron at North Truro) and aircraft directed to the tower area where control might be passed to the tower directors.

Beyond this, ADC planned an intermediary stage prior to going into SAGE operation. In this second stage, the search radar video and air-to-ground communications would be remoted to the parent center from tower two - if a means became available. At the end of 1955, nothing for this purpose had been developed. When the SAGE center came into operation, the search radar data was to be automatically fed into the AN/FSQ-7 computer at the shore station.

The manning for one crew on the tower was set at 41 by ADC in its plan for mid-1954. ADC changed this figure to 46 early in 1955.[34] The greatest change resulted from the necessity to control from the tower. Three controllers

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and two radar maintenance personnel were added to the proposed manning. Some other changes were also made such as the addition of a utilities supervisor and a winch operator and the deletion of electronic countermeasures personnel. No passive detection or other ECM gear was programmed for the tower and the latter personnel had been put on the manning table in error.[35] But the result of all the changes was a net gain of five.

ADC asked in June 1955 for the addition of two airmen heating specialists to the tower manning, bringing the total up to 48.[36] USAF approved 47 men per detachment, deleting one cook (which left three).[37]

In order to rotate tower personnel at regular intervals, ADC wanted a crew ratio of two, or a second detachment.[38] USAF opposed this double manning, calling it a luxury, and maintained that the shore crew would have nothing to do.[39] USAF agreed to the need for rotation, but recommended rotating tower duty among all personnel of the parent squadron.

In defense of its double manning plan, ADC claimed that the number of men in each crew was very conservative.[40*] There were far more positions on the tower than crew members, ADC said, and all men would have to handle several jobs in which they would be cross-trained. Because each man would have part time jobs in addition to his main duty, hours of work would be long. These long hours plus the confining nature of tower living would combine to make frequent rotation necessary.

To rotate all of the men of the parent squadron as USAF proposed would have meant that each man would have had to receive additional training. ADC cited as one example the fact that the towers were to have an AN/FPS-3 search radars.

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* The tower could accommodate 76 people.

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The AN/CPS-6B was the primary search radar of all the parent shore stations except P-45, Camp Hero, New York. The squadron personnel would have to learn both equipment if they went to the tower. ADC considered such a training burden impractical.

ADC disagreed that there would be any idleness at the parent site. For one thing, transportation difficulties would make it impossible to move an entire crew at one time. For the most part, replacement would be on an individual basis so that there would be nearly a constant rotation. The parent squadron would have a training program continually for tower people. And the shore site would have a large workload in supporting and working with the tower such as plotting and telling data from the tower. Tower personnel would be used to handle these extra jobs.

Despite ADC's protestations, USAF disapproved a crew ratio of two, authorizing a ratio of only 1.5.[41] A plan for crew rotation had now to be worked out. Another factor that would have to be considered in the rotation plan was the decision made at the end of October to give overseas credit and pay for tower duty.[42]

For training of tower personnel, ADC planned to use training standards currently in effect.[43] No skills would be required that were not already covered by a USAF AFSC. ADC expected to work out a program with ATRC to provide the necessary schooling to insure the availability of qualified personnel in phase with the operational dates of the towers.

To provide the initial personnel for tower number Two, the 762d AC&W Squadron, its parent unit, was to be increased in size. This organization was to be used as a test to find the most suitable type of organization for the towers.

The tower was to be considered as an auxilliary station to North Truro AFS

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and the commander of North Truro as the tower commander.[44] He was to have custody of the tower. The accountability was to be assigned to Otis AFB as if the tower were merely another building at North Truro.

Since operations had not yet started at the tower, there was no experience in normal day-to-day living. Obviously, there would be certain disadvantages. The space was small; there would be problems of isolation and monotony. What had been done to make life as pleasant as possible was summarized by EADF's Vice Commander, Brigadier General Donald B. Smith, at the launching of the first tower:[45]

> A great deal of attention has been paid to their comfort while on this lonely duty. Their quarters are bright and cheerful; the most modern equipment is being installed; recreational equipment of all types have been provided and there will be moving pictures, radio and, if possible, television, for the entertainment of those not standing watch. There is a completely equipped dispensary for their medical care. There will be regular mail service and a well stocked library.

For support of the tower, ADC's first plan was for assistance from the Navy. ADC planned that the Navy would furnish sea transport for the normal transportation of all personnel and supplies.[46] In addition, all rations and fuel were to be supplied by the Navy. Major repair of the installations and periodic inspection of the life boats were also included in the Navy's responsibility.

ADC asked USAF in January 1955 to make cross-servicing agreements with the Navy for this support.[47] USAF replied that it opposed this concept, however, and that it believed that the Air Force should provide as much support as possible.[48] A support plan was finally worked out at an ADC-USAF conference at the Pentagon in March.

The plan agreed upon was for normal transportation of men and dry cargo to be by ADC-assigned helicopter.[49] Liquid cargo was to be supplied by ships of the Military Sea Transport Service, the Navy or Coast Guard, or a private company.

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Fresh water was to be provided by distillation of sea water at the tower. Emergency transportation was to be by sea or air, depending upon availability of transportation and the nature of the emergency.

USAF authorized two H-21B type helicopters immediately for support of the first tower.[50] These aircraft, together with their crews, were assigned by ADC to the 564th Air Defense Group at Otis AFB. The commander of the parent 762d AC&W Squadron was to have operational control of the helicopters. The H-21B was a large, twin-rotor helicopter of tandem configuration. In addition to its two crew members, it could carry 20 passengers or a cargo of around 4,000 pounds.

Four additional H-21B's were to be assigned for support of the remaining squadrons. ADC considered that a total of six helicopters was enough to handle transportation to the five towers. But in an effort to assure constant availability of one helicopter and to provide for unforeseen needs while the first operation was tested, two helicopters were provided for the first tower. ADC thought also that some sea transport might have to be added for normal transport of men and goods.[51]

Texas Tower Two was to be operated as a detachment of the 762d AC&W Squadron according to an EADF plan for logistics issued in July 1955.[52] EADF made the 4707th Air Defense Wing at Otis AFB responsible for support and named the 564th Air Defense Group, also at Otis, as the support base for all supplies except communications and electronics. The 4700th Air Defense Group, Stewart AFB, New York, was named the electronic support base.

A 45-day supply of food was to be kept on the tower (30 day normal, 15 day field rations). There was to be a 30-day stock of fuels, lubricants, and

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water. Electronics and general supplies and equipment were to be kept at a 45-day supply. For power, TT-2 had eight 100 KW diesel generators programmed initially.[53] ADC decided that this was inadequate and added two 250 KW generators. The other towers were to receive seven 250 KW generators, or 200 KW generators, if there was not room enough for the larger units.

Program For The Four Other Towers

Two of the other four Texas Towers were to be built in Fiscal Year 1956 and the remaining two in FY 1957. In October 1955, USAF asked what priority ADC wanted for the remaining towers.[54] ADC's list in order of priority was as follows: TT-3, Nantucket Shoal; TT-4, Unnamed Shoal; TT-1, Cashes Ledge; and TT-5, Brown's Bank.[55] ADC explained that these priorities resulted from the operational date of March 1957 for the first SAGE subsector. Towers Three and Four were to be tied into this subsector. USAF therefore scheduled these two towers for construction first -- in FY 1956; towers One and Five for the following year.[56]

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Chapter Seven

1955 TO 1960

Status Of The Off-Shore Force At The End Of 1955

At the end of 1955, the forces operating off-shore were all in the combat zone and consisted of the following. Off the east coast, five picket ship stations and one AEW&C station were manned around-the-clock. On the Pacific side, one picket ship station was manned full-time and another was on training and testing status. One AEW&C station was manned continuously and another partially.

As planned at this time, the 551st AEW&C Wing at Otis AFB was to be operationally ready by 15 October 1956; the 552d Wing at McClellan AFB by 15 December 1956. These two wings and the three tactical squadrons of each had been activated by the end of 1955. Five west coast picket stations were to be manned full-time by July 1956. The first Texas Tower was to begin operating by about February 1956; two others in FY 1956 and the last two in FY 1957.

Beyond this, planning called for a sixth Pacific Coast picket station in July 1957 and a seventh at a later date. In the next three and one-half years, seven more AEW&C tactical squadrons were programmed. By the first quarter of FY 1960, two additional squadrons were to be added to the west coast and five to the east coast.

The CONAD plan issued in mid-1955 called for a two-stage build-up.

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In the first, CONAD wanted five AEW&C stations and five picket ship stations off the west coast; and six AEW&C stations, five picket ship stations, and five Texas Towers off the East Coast. In the second stage, it planned to build up to 12 AEW&C stations in the Atlantic, but not to increase the other forces. In the Pacific, it planned eight AEW&C stations and seven picket stations. No specific dates had been set for these stages. CONAD's planners hoped that by around 1960 there would be enough forces for this second stage.[1]

In the first phase, CONAD's plan for deployment was to give coverage from Maine to Florida at high altitude (65,000 feet) out to 550 nautical miles and at low altitude (surface) out to 320 nautical miles; off the Pacific Coast at high altitude out to 460 nautical miles and at low altitude out to 280 nautical miles.* CONAD's deployment plan for the second stage was for the purpose of increasing low altitude coverage off the east coast out to 500 nautical miles and to completely cover the length of both coasts.

The map which follows shows the planning in 1955 for coverage when the second stage was reached. Prior to operation in this stage (or time period) many changes could, and undoubtedly would, be made. The purpose here is to give some indication of what CONAD wanted and foresaw as the off-shore combat zone coverage in the 1960 time period.

To achieve this goal, radars had to be greatly improved, particularly on AEW&C aircraft and picket ships. CONAD said in its plan that it needed radars available by December 1956 that were capable of detecting and tracking targets with the equivalent of one square meter reflecting surface at ranges up to

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* These figures were to be changed undoubtedly in the near future -- probably out to greater distances. There was, for example, the current evaluation of employment of picket ships 200 miles further out. A decision on their final location had not been made at the end of the year.

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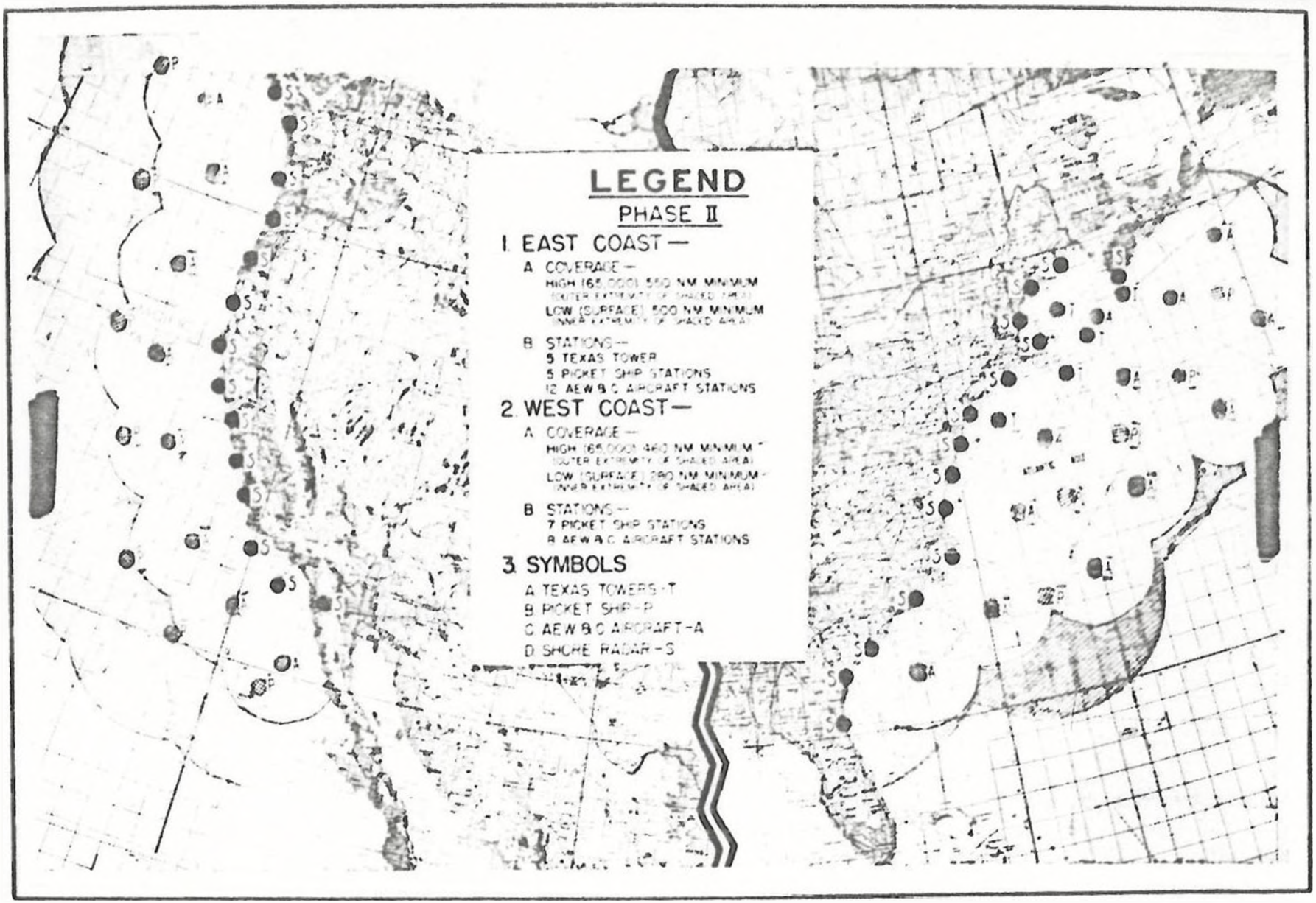

LEGEND
PHASE II
1. EAST COAST—
A COVERAGE—
HIGH (65,000) 550 NM MINIMUM
(OUTER EXTREMITY OF SHADED AREA)
LOW (SURFACE) 500 NM MINIMUM
(OUTER EXTREMITY OF SHADED AREA)
B STATIONS—
5 TEXAS TOWER
5 PICKET SHIP STATIONS
12 AEW&C AIRCRAFT STATIONS
2. WEST COAST—
A COVERAGE—
HIGH (65,000) 460 NM MINIMUM
(OUTER EXTREMITY OF SHADED AREA)
LOW (SURFACE) 290 NM MINIMUM
(OUTER EXTREMITY OF SHADED AREA)
B STATIONS—
7 PICKET SHIP STATIONS
8 AEW&C AIRCRAFT STATIONS
3. SYMBOLS
A TEXAS TOWERS-T
B PICKET SHIP-P
C AEW&C AIRCRAFT-A
D SHORE RADAR-S

250 nautical miles and at altitudes up to 65,000 feet; by 1960 of detecting missiles of 1/4 square meter reflecting area up to 100,000 feet and horizontally to 250 nautical miles.[2] However, CONAD noted that while these were its requirements, that the "State of the Art in Air Defense equipment development may not permit full realization of all requirements in the time-period 1957-1960."[3] But CONAD wanted the best equipment available to be used for the seaward extension elements.

As noted earlier, the EC-121's were limited to flight at between five and fifteen thousand feet, and were deployed to provide low altitude coverage. Their AN/APS-20 search radar was found by APGC to give warning at 173 nautical miles of jet targets at 40,000 feet and at 193 nautical miles at 20,000 feet of TU-4 type target. But the height finder had a much shorter range -- around 80 miles - according to the APGC.

Very limited range data was available on the performance of the picket ship radars, as ADC advised USAF in December 1955.[4] According to ADC's information, the SRa search radar had a range of 125 miles at 20,000 feet against a B-29, reduced to 90 miles at 10,000 and 30,000 feet. The AN/SPS-12 search radar had an estimated range of 150 miles at 20,000 feet on a B-29, reduced to 120 miles at 10,000 and 30,000 feet. It had only limited capability above 40,000 feet. The SPS-8A height finder had a maximum range of 150 miles against a B-29.

Only the Texas Tower would have radar with ranges approximating what CONAD wanted in its early seaward extension phase. The AN/FPS-3 search radar, when modified with the AN/GPA-27, would give coverage between 500 feet and 60,000 feet. Its range on a B-47 type target would be approximately 50 nautical miles at 500 feet and 200 nautical miles at 60,000 feet. The AN/FPS-6

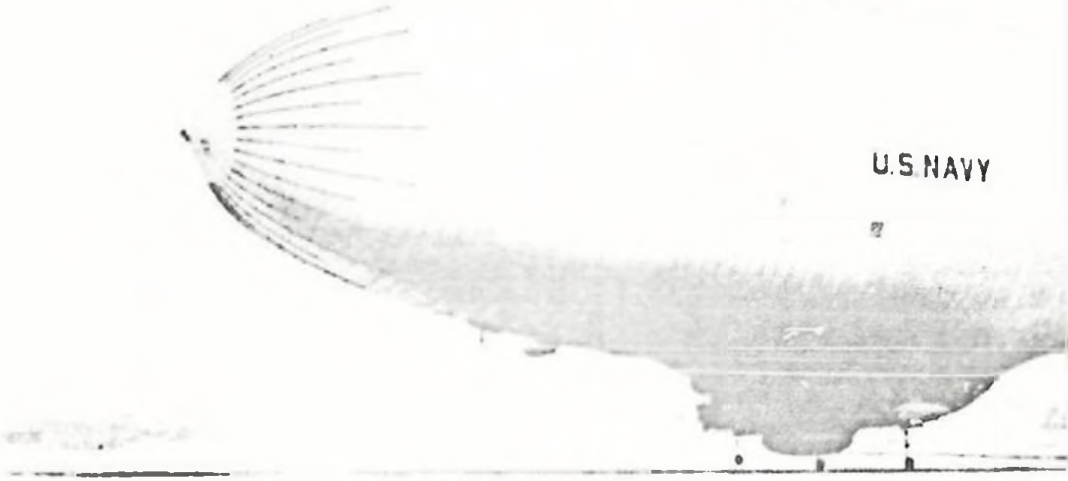
height finder had a range of approximately 200 miles between 50,000 and 60,000 feet.

The Shape Of Things To Come

In addition to the above items, a number of other developments were being considered for the future off-shore warning system. For airborne early warning, CONAD was considering a larger and improved model of the Lockheed Constellation, modification of the B-36, other four-engine aircraft, and the use of lighter-than-air airships.

Two squadrons of lighter-than-air airships (one for each coast) had apparently been programmed by the Navy for use in continental air defense beginning in 1956.[5] Each squadron was to be equipped with four airships, probably the ZPG-2W and the ZPG-3W (see photograph following of the ZPG-2W airship with a search radar antenna on the bottom and a height finder antenna on the top). CONAD had not developed an operational concept for these airships at the end of 1955, but it was likely that they would be used to supplement the inner row of AEW&C stations below the 40th parallel.

Other possibilities being looked at by CONAD's plans people included buoys that could be anchored in deep water (up to 12,000 feet) and could carry unattended radar,[6] and the so-called Armstrong platform. The latter derived its name from the man who had conceived of floating sea bases, primarily for aviation use. The Armstrong platform, as currently envisioned, would be manned and would be larger than the Texas Tower. Thought was being given to the possibility of its being armed with missiles. The Armstrong platform could be used in very deep water, possibly as much as 15,000 feet, by a system of floats and chain anchors.[7] Thus, it could provide a stable platform for radar far out to sea.



ZPG-2W AIRSHIP

SECRET

REFERENCE NOTES TO PAGES 1 - 7

1. Jt. Air Def. Bd. Proj. #4, Seaward Extension of AC&W for the Continental United States, April 1952 (HRF 208.1).

2. Memorandum by the Canadian-United States Military Cooperation Committee, "Air Interception and Air Warning Appendix to the Joint Canadian-United States Basic Security Plan," 2 Apr 1947 (Top Secret ADC, CA/C; The statement used in the narrative from this document is classified no higher than Secret).

3. 1st Ind, ADC to USAF, 8 Apr 1948 to USAF to ADC, "Aircraft Control and Warning Plan for the United States," 19 Jan 1948 (ADC, 1951A, Doc 19).

4. Report to the C/S USAF by the Air Defense Policy Panel estab. by the Chief Guided Missiles Group, DCS/O, 2 Feb 1948 (HRF 50.4).

5. Composite Squadron 11, U.S. Pac Flt Air Force, Historical Study, "Basic Concepts of AEW System," 7 Dec 1949 (Sq. 11 Files).

6. Ibid.

7. AFOC, Final Report on Phase I of OST of the RC-121 C&D AEW&C Aircraft, Proj. # APG/ADA/85-A-1, Appendix I, 5 Nov 1954 (HRF 208.2).

8. ADC, Memorandum by Col. K. P. Bergquist, Dir/P&R, ADC, "AEW Study," 20 Mar 1951 (ADC, 1951B, Doc 19).

9. "Functions of the Armed Forces and the Joint Chiefs of Staff, "Sec. V., Functions of the U.S. Navy and Marine Corps, Mar 26, 1948 (HRF 50.1).

10. CNO, "Interim State of the Policy of the CNO Concerning Emergency Employment of Naval Forces and Facilities in Air Defense of the United States," n.d., (ADC, 1951A, Doc 187).

11. Ibid.

12. ESF-EADF, "Joint Agreement for the Air Defense of the Eastern United States," 29 Dec 1949 (ADC, 1951A, Doc 188).

13. ESF-EADF, "Joint Agreement for the Training of Navy and Marine Corps Units in the Air Defense of the Eastern United States," 25 Sep 1950 (ADC, 1951A, Doc 190).

14. ESF-EADF, "Joint Agreement for the Training of Navy, Marine Corps and Air Force Units in the Air Defense of the Eastern United States," 12 Dec 1951 (EADF, 1951B, Doc 1060).

SECRET

REFERENCE NOTES TO PAGES 7 - 10

15. ESF-EADF, "Joint Agreement for the Air Defense of the Eastern and Central United States," 13 Dec 1951 (EADF, 1951B, Doc 1057).

16. WSF-WADF, "Bilateral Agreement for the Air Defense of the Western United States," May 1950 (ADC, 1951A, Doc 188).

17. WSF-WADF, "Bilateral Agreement for the Air Defense of the Western United States," 23 Nov 1951 (WADF, 1951B, Doc 313).

18. USAF to CNO, "Use of Navy Airborne Early Warning in Air Defense Exercises," 30 Dec 1949 (DOC 1).

19. USAF to ConAC, "Use of Navy Airborne Early Warning in Air Defense Exercises," 30 Dec 1949, w/1 Ind (DOC 2).

20. WADF to ConAC, "Use of Navy AEW in Air Defense," 10 Jul 1950 (DOC 3); 32d ADiv to EADF, "AEW Missions Utilizing Naval Aircraft," 22 Jan 1951 (EADF, 1951A, Doc 435); EADF, Report of Staff Visit to Patuxent NAS, 5 Feb 1951 (EADF, 1951A, Doc 436).

21. ADC to EADF, "Use of AEW Equipment in Air Defense," 14 Feb 1951 (DOC 4).

22. EADF to ADC, "Use of AEW Aircraft to Augment the Air Defense System," 13 Mar 1951 (EADF, 1951A, Doc 440); EADF to ADC, "Use of Naval Airborne Early Warning Equipment," 7 Mar 1951 (ADC, 1951B, Doc 22).

23. WADF to ADC, "Use of Navy Airborne Early Warning in Air Defense," 27 Mar 1951 (ADC, 1951B, Doc 20).

24. As in n 8.

25. ADC to USAF, "Requirement for AEW&C Equipment," 9 Apr 1951 (ADC, 1951A, Doc 195).

26. Dr. I.A. Getting, Off/Assist. for Dev. Planning, USAF, to Maj Gen C. T. Myers, VC, ADC, 13 Jul 1951 (DOC 5).

27. ADC, "A Plan for the Employment of AEW&C," 7 Feb 1952 (ADC, 1951B, Doc 24); Interview with Lt Col C. S. Glenn, ADC P&R, 14 Jul 1955.

28. Ibid., A Plan for Employment of AEW&C.

29. 1st Ind, ADC to EADF, 12 Sep 1951 to USAF to ADC, "Planning and Programming Data on Installations for the FY 1953 Public Works Program," 1 Sep 1951 (HRF 302).

REFERENCE NOTES TO PAGES 10 - 15

30. ADC, Current Planning Activities, Planning Committee Report # 11-52, 10 Jul 1952 (HRF 902).

31. ConAC to EADF, "Requirement for Radar Picket Stations to Supplement the Permanent Radar System," 10 Oct 1950 (ADC, 1951A, Doc 191).

32. ConAC to USAF, "Extension of Perm. Radar Net of the Continental Air Defense System," 5 Jan 1950 (ADC, CA/C Files).

33. As in n 31.

34. As in n 31.

35. EADF to ADC, "Status of Radar Picket Vessels," 13 Feb 1951, w/3 Incls (DOC 6); 1st Ind, WADF to ConAC, 17 Nov 1950 to ConAC to WADF, "Requirement for Radar Picket Stations to Supplement the Permanent Radar System," 10 Oct 1950 (DOC 7).

36. CNO to CINCLANTFLT, "Requirement for Radar Picket Vessels to Supplement the Eastern Air Defense Force Permanent Radar System," n.d. (DOC 8).

37. As in n 35, EADF to ADC (DOC 6).

38. EADF to ConAC, "Requirement for Radar Picket Stations to Supplement the Permanent Radar System," 22 Nov 1950 (DOC 9); As in n 35, 1st Ind, WADF to ConAC (DOC 7).

39. ConAC to USAF, "Radar Picket Vessel Utilization in Air Defense," 13 Dec 1950, w/1 Incl (ADC, 1951B, Doc 29).

40. USAF to ADC, "Picket Vessels," 29 Oct 1951 (ADC, 1951B, Doc 31).

41. EADF, Report of Staff Visit to Headquarters Eastern Sea Frontier, 10 Jan 1951 (EADF, 1951A, Doc 407).

42. 26th ADiv, "Report on Operations Tuna," 27 Apr 1951, pp 5-6 (26th ADiv, 1 Jan-31 Mar 1951, Doc 4).

43. Ibid., p 20.

44. Ibid., p 10.

45. Ibid., Annex E, p 9.

46. ADC to EADF, "Radio Communications Between AC&W Installations and Picket Vessels," 28 Feb 1951 (EADF, 1951A, Doc 419); ADC to WADF, "Radio Communications Between AC&W Installations and Picket Vessels," 19 Apr 1951 (WADF, 1951B, Doc 90).

REFERENCE NOTES TO PAGES 15 - 16

47. 2nd Ind, EADF to ADC, 3 Aug 1951 to EADF to 26th ADiv, "Picket Vessel Radio-Teletype Test," 17 Jul 1951 (EADF, 1951A, Doc 430).

48. WSF to WADF, "Emergency Reporting Frequencies," 19 Sep 1951, w/1 Ind WADF, 1951B, Doc 99). See also, 25th ADiv to WADF, "Evaluation of Communications Tests Between Naval Picket Ships and GCI Stations," 27 Aug 1951 (WADF, 1951B, Doc 97); WADF to 25th, 27th, and 28th ADivs, "Communications Tests Between Naval Picket Ships and GCI Stations," 5 Jul 1951, w/1 Ind (WADF, 1951B, Doc 98).

49. WADF, Operations Summary, Operations Plan 2-51, Feb 1951, 7 Mar 1951, pp 36-38 (HRF 60.5).

50. EADF, Summary of Conference Hd at ESF, 24 Jul 1951 (EADF, 1951B, Doc 188).

51. ADC to USAF, "Radar Picket Vessel Utilization in Air Defense," 27 Nov 1951, w/1 Ind (ADC, 1951B, Doc 32).

52. As in n 40.

53. As in n 51, 1st Ind, USAF to ADC, 14 Dec 1951.

REFERENCE NOTES TO CHAPTER TWO, PAGES 16 - 20

1. ADC, "A Plan for the Employment of AEW&C," 7 Feb 1952 (ADC, 1951B, Doc 24).

2. ADC, Current Planning Activities, Planning Committee Report # 8-52, 1 Apr 1952 (HRF 902).

3. ADC to USAF, "Airborne Early Warning Proposed T/O's," 31 May 1952 (DOC 10).

4. ADC to USAF, "Interim Aircraft for AEW," 28 Feb 1952 (ADC, 1952A, Doc 28).

5. Ibid.

6. 3d Ind, USAF to ADC, 8 Aug 1952 to ADC to USAF, "Interim Aircraft for AEW," 28 Feb 1952 (CA/C Files).

7. 1st Ind, USAF to ADC, 14 Jul 1952 to ADC to USAF, "Selection of AEW&C Bases," 3 Jun 1952 (DOC 11).

8. As in n 2, PCR # 15-52, 23 Sep 1952.

9. 2nd Ind, ADC to USAF, 22 Aug 1952 to ADC to USAF, "Selection of AEW&C Bases," 3 Jun 1952 (DOC 12).

REFERENCE NOTES TO PAGES 20 - 24

10. ADC, DF, P&R to Staff, "AEW&C Program, 26 Nov 1952 (DOC 13).

11. Ibid.

12. 2nd Ind, USAF to ADC, 12 Feb 1954 to ADC to USAF, "Operational Concept of the RC-121C&D," 17 Dec 1953 (DOC 14).

13. As in n 10.

14. EADF, DF, EAOPR to EAODO, "Major Change in AEW&C Program," 24 Nov 1952 (EADF, 1952B, Doc 10).

15. As in n 2, PCR # 17-52, 13 Nov 1952.

16. TWX, EADF to ADC, 28 Oct 1952 (EADF, 1952B, Doc 3).

17. ADC to AMC, "Activation of AEW&C Units," 3 Dec 1952 (DOC 15).

18. ADC,"Operational Concept, Seaward Extension of Radar," 1 Feb 1953 (DOC 16). See also, ADC, "Operational Concept, Seaward Extension of Radar," 15 Oct 1953 (DOC 17); ADC, "Operational Plan, Extensions to Seaward of Contiguous Coverage (AEW&CON)," 10 Mar 1954 (DOC 18); ADC to WADF, "Communications Requirements in Support of Picket Vessel & AEW&C Operations," 5 Jun 1954, w/1 Incl (WADF, 1954A, Doc 208); EADF to ADC, "Plan for Central Communications Facilities to Support PV & AEW&C Operations," 26 Jun 1954 (HRF 377); DF, P&R to DC&E, "Support Required for PV & AEW&C Programs," 20 Jul 1954 (DOC 19); WADF to ADC, "Emergency Back'Up for AEW&C & PV HF Radio Control and Reporting System," 24 Sep 1954 (DOC 20); ADC to EADF, "Operations Plan for PV & AEW&C Communications," 29 Nov 1954 (CONAD-ADC, 1954B, Doc 64); ADC to USAF, "Manpower for Maintenance Function of Ground Radio Station AEW&Con & PV's Program," 22 Mar 1955 (DOC 21).

19. As in n 18, ADC Operational Concept, Seaward Extension of Radar," 1 Feb 1953 (DOC 16).

20. APGC, Final Report on Phase II of the OST of the RC-121C&E AEW&C Aircraft, 20 Sep 1955, Part II (CA/C Files).

21. 1st Ind, USAF to ADC, 30 Jan 1953 to ADC to USAF, "Airborne Early Warning and Control," 2 Jan 1953 (DOC 22).

22. ADC to WADF, "Status of Airborne Early Warning & Control Squadron to be Activated at McClellan AFB," 14 May 1953 (ADC, 1953B, Doc 76); ADC to WADF, "Status of AEW&C Project," 24 Jun 1953 (ADC, 1953B, Doc 77); ADC, Command Council Meeting Notes, 3 Aug 1953 (DOC 23); ADC to WADF, "Status of AEW&C Project," 31 Aug 1953 (ADC, 1953B, Doc 73); ADC to EADF, "Status of AEW&C Project," 26 Aug 1953 (DOC 24).

REFERENCE NOTES TO PAGES 24 - 27

23. As in n 22, ADC to EADF, 26 Aug 1953 (DOC 24).

24. As in n 22, ADC to WADF, "Status of AEW&C Project," 24 Jun 1953; WADF, GO 39, 17 Sep 1953 (WADF, 1953B, Doc 12); WADF, Reg # 24-12, 10 Nov 1953 (WADF, 1953B, Doc 13).

25. 4701st Hist, 1954A, p 22.

26. Ibid.

27. ADC, DF, DMP to PPM, "Activation of 4701st AEW&C Squadron," 19 Aug 1953 (DOC 25).

28. ADC to WADF, "AEW&C Manning," 13 Sep 1953 (DOC 26); WADF, Report of Staff Visit to 4701st AEW&C Squadron, 15 Mar 1954, (WADF, 1954A, Doc 211).

29. USAF to ATRC, "AEW&C Training," 16 Jan 1953 (DOC 27; ADC to ATRC, "AEW Training," 3 Feb 1953 (DOC 28); ADC, DF, ADTR-B to O&T, "AEW&C Training Program," 1 Mar 1954 (DOC 29).

30. ADC, DCS/P, Dir/Trng, Memo, "AEW&C Training Summary," n.d. (ca. Mar 1954) (DOC 30).

31. As in n 25.

32. Ibid., p 7.

33. 8th ADiv to WADF, "Progress Report," 10 Mar 1955 (DOC 31); 8th ADiv to WADF, "Otis AFB," 10 Mar 1955 (DOC 32); ADC, DF, Dir/Instls to O&T, "AEW&C Facilities for the ADC Command," 15 Sep 1954 (DOC 33); ADC, DF, Dir/Instls to O&T, "Summary of AEW&C Facilities," 28 Sep 1954 (CONAD-ADC, 1954B, Doc 32); 1st Ind, ADC to USAF, 9 Aug 1954 to ADC to EADF, 23 Jul 1954 (DOC 34); ADC, DF, DCS/O to DCS/M, "EADF Conference on 551st AEW&C Wing," 2 May 1955 (CONAD-ADC, 1955A, Doc 69).

34. ADC, DF, O&T to DCS/O, "Support Facilities for AEW&C Unit at Otis AFB," 18 Dec 1953 (DOC 35); ADC, Command Council Meeting, 28 Apr 1954 (DOC 36); EADF, Staff Study, 31 Dec 1953 (EADF, 1953B, Doc 23-1); TWX, ADC to EADF, 5 Mar 1954 (DOC 37); ADC to ARDC, "ADC Proposal for RC-121D Aircraft," 17 Jun 1954 (ADC, 1954A, Doc 2).

35. ADC, DF, DCS/M to VC, "8th ADiv Monthly Progress Letter," 4 Aug 1955 (DOC 38).

36. ADC, DF, DCS/O to O&T, M&O, DCS/M & DCS/P, "Revision of AEW&C Program," 5 Apr 1954 (DOC 39).

37. EADF, GO #11, 25 Feb 1954 (EADF, 1954A, Doc 1).

[redacted]

REFERENCE NOTES TO PAGES 27 - 32

38. EADF to 4707th Def Wg, "Movement Orders, 4712th AEW&C Sq," 8 May 1954 (EADF, 1954A, Doc 3).

39. WADF to ADC, "Establishment of Cadre Personnel for the 4712th AEW&C Squadron," 15 Mar 1954 (DOC 40); As in n 28, WADF, Report of Staff Visit.

40. ADC to USAF, "AEW&C Organization," 26 Mar 1954, w/2 Incls (ADC, 1954A, App. III, Doc 3).

41. Ibid.

42. TWX, USAF to ADC, 16 Apr 1954 (DOC 41).

43. 1st Ind, USAF to ADC, 25 Jun 1954 to ADC to USAF, "AEW&C Program," 21 May 1954 w/5 Incls (ADC, 1954A, App. III, Doc 4).

44. Ibid.

45. As in n 40.

46. ADC, GO 12, 30 Apr 1954 (ADC, 1954A, App. III, Doc 6).

47. As in n 40.

48. ADC to EADF, "AEW&Con Program," 16 Jun 1954 (ADC, 1954A, Doc 7).

49. ADC, "Revised AEW&C Program," 28 Apr 1954 (DOC 42).

50. As in n 43, ADC to USAF, "AEW&C Program," 21 May 1954.

51. As in n 18, ADC, "Operational Plan, Extensions to Seaward of Contiguous Coverage (AEW&Con)," 10 Mar 1954, p 12 (DOC 18).

52. TWX, ADC to EADF, WADF, 18 Feb 1954 (DOC 43).

53. TWX, ADC to USAF, 9 Jan 1954 (ADC, App. III, Doc 1).

54. As in n 52.

55. 8th ADiv to ADC, "Progress Report," 30 Jun 1954 (DOC 44).

56. 8th ADiv Hist., 1954A, p 5.

REFERENCE NOTES TO CHAPTER THREE, PAGE 33

1. ADC, "Air Defense Requirements, 1954-1960," Annex A, App. 2, 1 Jul 1954 (HRF 51.4).

[redacted]

REFERENCE NOTES TO PAGES 33 - 38

2. ADC, DF, ADVER to Staff, "Projected AEW&C Program," 23 Sep 1954 (CONAD-ADC, 1954B, Doc 37).

3. Ibid.

4. USAF to ADC, "Air Defense Requirements, 1954-1960," 1 Dec 1954 (DOC 45).

5. USAF, Program Guidance, PG-57-1, Jan 1955 (CA/C Files).

6. JCS, Memorandum for C/S Army, CNO, USAF & Comm Marine Corps, SM-688-54, "Continental Air Defense Command," 2 Aug 1954 (CONAD-ADC, 1954B, Doc 55).

7. CONAD, "Operational Plan for Seaward Extension of the Air Defense Combat Zone," 20 Jun 1955 (CONAD-ADC, 1955A, Doc 33).

8. TWX, ADC to JWADF, 5 Jul 1955 (CONAD-ADC, 1955A, Doc 44).

9. As in n 7.

10. As in n 7; ADC to USAF, "Base Deployment for AEW&C Aircraft," 9 Aug 1955 (DOC 46).

11. USAF to ADC, "Constitution and Activation of the 960th & Certain Other Airborne Early Warning & Control Squndrons," 8 Dec 1954 (DOC 47).

12. ADC, DF, DCS/C to Asst. for Prog., "Progress Report #5 FD 55-3, 965th AEW&C," 12 Aug 1955 (DOC 48).

13. ADC to WADF, "Constitution & Activation of the Hqs, 552d AEW&C Wg & 962d AEW&C Sq," 20 Apr 1955 (CONAD-ADC, 1955A, Doc 52); ADC, GO #16, 4 May 1955 (CONAD-ADC, 1955A, Doc 49).

14. 8th ADiv to WADF, "Request for Provisional Organization," 7 Dec 1954 (CONAD-ADC, 1954B, Doc 36); ADC, GO #47, 28 Dec 1954 (CONAD-ADC, 1954B, Doc 35); ADC, GO #19, 24 May 1955 (CONAD-ADC, 1955A, Doc 50); ADC, GO #29, 17 Aug 1954 (DOC 49).

15. EADF to ADC, "Request for a Planning Staff for Phase-in of AEW&C Wing at Otis AFB," 19 Aug 1954, w/1 Ind (DOC 50); ADC, GO #40, 24 Nov 1954 (DOC 51); USAF to ADC, "Constitution & Activation of the 551st E/M & the 551st P/M Sq.," 1 Nov 1954 (CONAD-ADC, 1954B, Doc 30); USAF, T/O, #1-2123, 1 Oct 1954 (DOC 52); USAF, T/O #1-2121, 1 Oct 1954 (DOC 53); USAF, T/O 1-2124, 1 Oct 1954 (HRF 208).

16. USAF to ADC, "Constitution & Activation of the Hq 551st AEW&C Wg & Certain Other USAF Units," 11 Oct 1954 (CONAD-ADC, 1954B, Doc 29).

17. Ibid.

REFERENCE NOTES TO PAGES 38 - 42

18. WADF, GO #1, 10 Jan 1955 (ADC, M&O Files).

19. As in n 13; ADC, "Approved AEW&C Program," 22 Sep 1954 (CONAD-ADC, 1954B, Doc 31).

20. TWX, 8th ADiv to ADC, 15 Jun 1955 (CONAD-ADC, 1955A, Doc 47); TWX, ADC to 8th ADiv, 11 Jun 1955 (DOC 54).

21. As in n 20; 8th ADiv to ADC, "Proposal to Activate the 966th AEW&C Sq at McClellan AFB," 11 May 1955 (CONAD-ADC, 1955A, Doc 45).

22. TWX, ADC to USAF, 18 Jun 1955 (DOC 55); TWX, ADC to 8th ADiv, 10 Aug 1955 (CONAD-ADC, 1955A, Doc 48).

23. TWX, ADC to USAF, 27 Sep 1955 (DOC 56).

24. ADC to USAF, "AEW&C Organization," 28 Feb 1955, w/4 Incls (CONAD-ADC, 1955A, Doc 58).

25. TWX, ADC to WADF, EADF, 8th ADiv, n.d. (CONAD-ADC, 1955A, Doc 60).

26. 8th ADiv to ADC, "Progress Report," 7 Jan 1955 (CONAD-ADC, 1955A, Doc 54).

27. 8th ADiv to ADC, "8th ADiv Assignment," 14 Jan 1955 (CONAD-ADC, Doc 53).

28. ADC, GO #10, 4 Apr 1955 (CONAD-ADC, 1955A, Doc 56); ADC to USAF, "Reorganization of 8th ADiv (AEW&Con)," 5 Jul 1955 (CONAD-ADC, 1955A, Doc 59).

29. ADC, DCS/P, Briefing Notes, "Personnel Presentation on AEW&C," 22 Sep 1954 (DOC 57); ADC to USAF, "Expansion of AEW Program," 6 Dec 1954 (DOC 58).

30. As in n 29, Personnel Presentation on AEW&C.

31. WADF Hist, 1954B, pp 128-129.

32. 8th ADiv to WADF, "AEW&C Training Program," 2 Nov 1954, w/2 Inds & 1/Incl (DOC 59); WADF, "Personnel Portion of Briefing for 8th ADiv," 27 Oct 1954 (WADF, 1954B, Doc 146).

33. As in n 32, 2nd Ind, ADC to WADF, 21 Dec 1954 to 8th ADiv to WADF (DOC 59).

34. Maj Gen F. H. Smith, ADC VC to Maj Gen W. E. Todd, WADF Cmdr, 18 Dec 1954 (DOC 60); ADC DF, DCS/M to DCS/P, "Evaluation of 8th ADiv Training Proposal," 13 Dec 1954 (DOC 61).

REFERENCE NOTES TO PAGES 42 - 45

35. ADC, DCS/P, Dir/Trng, Memo, "AEW&C Training Program," n.d. (ca. Feb 1955) (DOC 62); Interview with A/1C Peyton, Dir/Trng, DCS/P, 17 Aug 1955.

36. As in n 35, DCS/P Memo.

37. ADC, Final Report, Exercise Check Point, 15 Oct 1954 (HRF 60.17); 8th ADiv, Presentation on Check Point, n.d. (WADF, 1954A, Doc 239).

38. WADF, Operations Order #5-54, 29 Jul 1954 (WADF, 1954B, Doc 184); ADC, DCS/O, Proj Rpts, 1 Oct 1954, p 9 (HRF 908).

39. TWX, 8th ADiv to WADF, 21 Sep 1954 (WADF, 1954B, Doc 189).

40. Interview with Capt H. C. Dewey, O&T AEW&C Proj Off, 18 Oct 1955.

41. WADF to 8th ADiv, 28th Air Div, "Interim Operating Procedures for AEW&C Air/Ground Communications," 28 Dec 1954 (WADF, 1954B, Doc 187); WADF to 25th Air Div, "Radio Operating Procedure for AEW&C HF Circuits," 1 Jul 1954 (WADF, 1954B, Doc 185); WADF to 27th ADiv, "Operating Procedure for Activation of AEW&C HF Radio Circuits," 19 Aug 1954 (WADF, 1954B, Doc 186).

42. As in n 38, WADF Ops Order #5-54; WADF Operations Plan #3-55, 1 Jan 1955 (WADF, 1954B, Doc 209). See also, ADC to WADF, "Mission and Responsibilities of 8th ADiv (AEW&Con)," 4 Dec 1954 (CONAD-ADC, 1954B, Doc 33); ADC, DF, O&T to DCS/O, "Mission and Responsibilities of 8th ADiv (AEW&Con)," 23 Nov 1954 (CONAD-ADC, 1954B, Doc 34); ADC to EADF, "8th ADiv (AEW&Con) Mission and Assignment," 6 Apr 1955 (CONAD-ADC, 1955A, Doc 55); & ADCR 24-12, "Organization & Mission of the 8th ADiv (AEW&Con)," 20 Jun 1955 (CONAD-ADC, 1955A, Doc 57).

43. APGC, Final Report on Phase II of OST of the EC-121 C&D AEW&C Aircraft, Part II, pp 152-153, 20 Sep 1955 (CA/C Files).

44. As in n 40.

45. For details of this communications plan, see Section VII and Incl 2 of this plan (CONAD, "Operational Plan for Seaward Extension of the Air Defense Combat Zone," 20 Jun 1955) (CONAD-ADC, 1955A, Doc 33).

46. ADC to USAF, "Frequency Requirements for Seaward Extension of the Air Defense Combat Zone," 31 Aug 1955 (DOC 63).

47. Ibid.

48. Interview with Mr. M. F. Sanders, ADC C&E, 8 Aug 1955 & 19 Oct 1955 and with Maj. McDaniels, ADC C&E, 19 Oct 1955.

REFERENCE NOTES TO PAGES 45 - 49

49. ADC, "Operational Concept Seaward Extension of Radar," 1 Feb 1953 (DOC 16).

50. APGC, Final on Phase II of OST of the RC-121C&E AEW&C Aircraft, Part I, p 6, 20 Sep 1955 (CA/C Files).

51. Ibid., p 14.

52. Ibid., p 16.

53. Ibid., p 24.

54. USAF, IG, "Report of a Survey Conducted by the Dir/Readiness & Materiel Inspection," 11-26 Apr 1955 (CONAD-ADC, 1955A, Doc 65).

55. 8th ADiv to ADC, "Report of AF-Navy AEW&C Conference 7, 8 and 9 March 1955," 16 Mar 1955 (CONAD-ADC, 1955A, Doc 63).

56. Roth to Gibson, 3 May 1955 (CONAD-ADC, 1955A, Doc 64).

57. 1st Ind, ADC to Dep IG, Norton AFB, 20 Jul 1955 to IG Report, (CONAD-ADC, 1955A, Doc 65).

58. Ibid.

59. Ibid.

60. 8th ADiv to ADC, "AEW&C Mission Aircraft Requirements," 13 May 1955, w/1 Ind & 1 Incl (CONAD-ADC, 1955A, Doc 71).

61. ADC, DF, O&T to DCS/O, "Flying Hour Requirements," 29 Mar 1955 (CONAD-ADC, 1955A, Doc 74).

62. As in n 60, 1st Ind, ADC to 8th ADiv, 17 Aug 1955.

63. 8th ADiv to ADC, "8th Air Division AEW&C Aircraft Program," 29 Aug 1955, w/7 Incls (DOC 64).

64. Interview with Capt H. C. Dewey, ADC O&T AEW&C Proj Off, 14 Oct 1955.

65. TWX, ADC to WADF, EADF, 8th ADiv, 17 Sep 1955 (DOC 65).

66. TWX, ADC to 8th ADiv, 17 Sep 1955 (DOC 66).

67. ADC to USAF, "Request for Change in Aircraft Authorization for AEW&Con Wings," 28 Dec 1955 (O&T).

REFERENCE NOTES TO PAGES 49 - 50

68. Maj Gen H. A. Parker, ADC DCS/O to Brig Gen K. M. Gibson, Comdr 8th Adiv, 30 Dec 1955 (HRF 208).

69. As in n 23 (DOC 56).

70. USAF to ADC, "Draft General Operational Requirement for An Airborne Early Warning and Control Support System," w/1 Ind & 1 Incl, 19 Nov 1954 (DOC 67).

71. ADC to 4620th Air Def. Wg, "Accelerated Test of UHF AEW Radar," 21 Sep 1955 (DOC 68); Maj Gen F. E. Smith, ADC VC to Lt Gen T. S. Power, Comdr ARDC, 21 Sep 1955 (DOC 69); ADC to 8th ADiv, "Development of UHF Radars for AEW&CON," 21 Sep 1955 (DOC 70), MIT to 8th ADiv, "AEW&C Radar - Installation of APS-70 (XD-1) in USAF Airplane RC-121-D," 22 Sep 1955 (DOC 71); 8th ADiv to ADC, "HF Radar with Range Comparable to Search Radar Plus Providing Simultaneous Height Data," 29 Sep 1955 (DOC 72); ADC to ARDC, "Airborne Moving Target Indicator," 26 Oct 1955 (DOC 73).

72. 2d Ind, 8th ADiv to CONAD, 22 Nov 1955 to EADF to 8th ADiv, "AEW&C Program," 19 Oct 1955 (CA/C Files).

REFERENCE NOTES TO CHAPTER FOUR, PAGES 51 - 53

1. CNO to Dist., "Interim Statement of the Policy of the CNO Concerning Emergency Employment of Naval Forces and Facilities in Air Defense of the U.S.," n.d. (ADC, 1951A, Doc 187).

2. CNO to Dist., "Responsibilities and functions of naval commanders with regard to air defense of the United States under emergency conditions," 23 Sep 1952 (OPNAV 003320.3) (AIC Historical Study #5, Doc 34).

3. Ibid.

4. 1st Ind, ADC to USAF, 20 Nov 1952 to USAF to ADC, "CNO Function Letter (OPNAV Instruction 003320.3)." 29 Oct 1952 (ADC, 1952B, Doc 12).

5. CNO to Dist., "Naval Picket Forces, Atlantic and Pacific," 23 Sep 1952 (OPNAV Notice 003320) (ADC, 1952B, Doc 146).

6. Ibid.

7. TWX, USAF to ADC, 12 Sep 1952 (ADC, 1952B, Doc 143).

8. Interview with Cmdr T. E. Russell, NAVFORCONAI, 12 Oct 1955.

9. ESF to EADF, "Report; forwarding of," 20 Mar 1953 (EADF, 1953A, Doc 26).

[redacted]

REFERENCE NOTES TO PAGES 54 - 56

10. ESF, Briefing, "Forces and Facilities," May 1953 (EADF, 1953A, Doc 15).

11. ADC, Staff Visit Report of Lt Col C. H. Price, 2 Jul 1953 (ADC, 1953B, Doc 61); EADF, DF, EAOOT to Staff, "Primary Mission of PV," 12 Aug 1953 (EADF, 1953B, Doc 2).

12. As in n 11, Staff Visit Report.

13. ADC to EADF, "Radio Frequencies for Radar Picket Ships," 3 Jun 1952, w/1 Ind & 2 Incls (EADF, 1952B, Doc 14).

14. As in n 13, 1st Incl. USAF to CNO, "Request for Radio Frequencies for Radar Picket Ships," 12 Apr 1952.

15. As in n 13, 2nd Incl, CNO to C/S USAF, "Radio Frequencies for Radar Picket Ships," 30 Apr 1952.

16. ESF to EADF, "Picket Vessel Communications," 6 Nov 1952 (EADF, 1952B, Doc 26-2).

17. As in n 9. See also, EADF, DF, EAOCE to EAODO, "Picket Vessel Communications," 11 Jun 1953 (EADF, 1953B, Doc 4); DF, EAOCE to EAOOT, "PV Communications Test Conference," 7 Nov 1952 (EADF, 1952B, Doc 20); CORTRON 16 to ESF, "Report on operation with 3 PV's on station," 23 Nov 1953 (EADF, 1953B, Doc 5); ESF to Dist., "Radar Picket Vessels," 2 Feb 1953 (EADF, 1953A, Doc 36-2); EADF, Staff Study, "Tact. Communications - EADF & Elements of USN," 30 Mar 1954 (EADF, 1954A, Doc 27).

18. EADF, Communications & Electronics Conference, 5-6 May 1954, pp 43-44 (HRF); NAVFORCONAD, Briefing, Picket Vessel Communications, 19 Nov 1954 (CONAD-ADC, 1954B, Doc 61).

19. As in n 18, NAVFORCONAD Briefing.

20. As in n 11, Staff Visit Report; 32d ADiv, Conference Report, 23 Jun 1953 (32d ADiv, 1954A, Doc 56-8).

21. CORTRON 16 to ESF, "Training of Escort Sqdn 16 in control of Air Force interceptor fighter aircraft," 7 Aug 1954 (32d ADiv, 1954A, Doc 65-2).

22. EADF, SOP #55-18, 16 May 1952 (EADF, 1952A, Doc 10). See also, EADF SOP #55-12, 26 Nov 1951 (EADF, 1951B, Doc 204); EADF SOP #55-19, 16 May 1952 (EADF, 1952A, Doc 12); ESF, Instruction 03320.2, to Cmdr Destroyer Force Atlantic Fleet, "Radar PV's under operational control of COMEASTSEAFRON; instructions for," 17 Apr 1953 (DOC 74); EADFR #55-27, 12 Jan 1954 (EADF, 1954A, Doc 25).

[redacted]

REFERENCE NOTES TO CHAPTER FIVE, PAGES 57 - 61

1. USAF to ADC, "A Memorandum of Agreement Concerning Contiguous Radar Coverage and the Seaward Extension of the Early Warning System," 9 Jan 1954, w/1 Incl (CONAD-ADC, 1954B, Doc 54).

2. JCS, Memorandum to C/S Army, CNO, C/S USAF, & Com. Marine Corps, SM-688-54, "Continental Air Defense Command," 2 Aug 1954 (CONAD-ADC, 1954B, Doc 55).

3. CNO to Distribution, "Continental Air Defense Command and Naval Forces, CONAD; establishment of," 17 Aug 1954 (DOC 75).

4. CNO to Distribution, "Continental Defense," 11 Oct 1954 (DOC 76).

5. ADC, "Air Defense Requirements 1954-1960," Annex A, App. 2, 1 Jul 1954 (HRF 51.4).

6. CONAD to C/S USAF, "CONAD Operational Plan for Seaward Extension of the Air Defense Combat Zone," 23 Jun 1955 (DOC 77).

7. ADC to EADF, "Requirement for Seaward Extension of Contiguous Radar Coverage (1954-1956)," 11 Feb 1954 (DOC 78).

8. TWX, EADF to ADC, 27 May 1954 (CONAD-ADC, 1954B, Doc 58).

9. EADF to ADC, "Picket Ship Requirements," 8 Jun 1954 (EADF, 1954A, Doc 21).

10. TWX, ADC to EADF, 5 Jun 1954 (CONAD-ADC, 1954B, Doc 59), 1st Ind, ADC to EADF, 9 Jul 1954 to EADF to ADC, "Picket Ships Requirement," 8 Jun 1954 (CONAD-ADC, 1954B, Doc 60).

11. As in n 3.

12. CORTRON to ESF, "Training of Escort Squadron 16 in control of Air Force interceptor-fighter aircraft," 7 Aug 1954 (3rd ADiv, 1954A, Doc 65-2).

13. Interview with Cmdr T. E. Russell, NAVFORCONAD Operations Div., 8 Aug 1955.

14. NAVFORCONAD, "Forces and Deployments Barrier and Contiguous Systems for Continental Defense (Tentative)," 13 Aug 1954 (CONAD-ADC, 1954B, Doc 56). See also, WADF to WSF, "Requirement for Seaward Extension of Contiguous Radar Coverage 1954-1956," 25 Mar 1954 (WADF, 1954A, Doc 203); WSF to WADF, "Requirements for Seaward Extension of Contiguous Radar Coverage (1954-1956)," 9 Apr 1954 (WADF, 1954A, Doc 204); CNO to C/S USAF, "Requirements for Seaward Extension," 18 May 1954 (DOC 79); C/S USAF to CNO, "Requirements for Seaward Extension," 18 Jun 1954 (DOC 80), CNO to C/S USAF, "Requirements for Seaward Extension...." 29 Jul 1954 (DOC 81).

[redacted]

REFERENCE NOTES TO PAGES 62 - 66

15. COMNAVFORNEASTCONAD to Dist., "Commander Naval Forces, Eastern Continental Air Defense Command Operation Plan No. 1-55," 17 May 1955 (HRF).

16. TWX, CINCONAD to JEADF, JWADF, 4 Nov 1955 (DOC 82).

17. Ibid.

18. COMNAVFORCONAD, "Picket Vessel Performance," 5 Apr 1955 (CONAD-ADC, 1955A, Doc 104).

19. USS Skywatcher (YAGR 3) to COMNAVFORNEASTCONAD. "Picket Vessel Final Summary Report for period 8 through 25 Jul 1955," 27 Jul 1955 (CONAD-ADC, 1955A, Doc 105).

20. 1st Ind, ADC to WADF, 21 Oct 1955 to WADF to ADC, "High Frequency Requirements for Picket Ship Operation," 26 Sep 1955 (DOC 83).

21. Ibid.; ADC to WADF, "Operational Feasibility of Radioteletype for Picket Ship Plot-telling," 3 Nov 1955 (DOC 84); USAF to ADC, "Picket Vessel Frequencies," 15 Aug 1955 (DOC 85); TWX, EADF to ADC, 26 Oct 1955 (DOC 86); ESF to Dist., "Radar Picket Vessels," 23 Aug 1954 (DOC 87).

22. CONAD-ADC, History, Jul-Dec 1954, pp 27-32.

23. Interview with Maj W. D. Morrison, Log Plans, DCS/M, 14 Nov 1955 and Maj J. C. Elledge, P&R, DCS/O, 14 Nov 1955.

24. As in n 22, pp 32-36.

25. 3rd Interim Report, Canada-United States Military Study Group, 3 Jun 1954 (HRF 404.3).

26. Report of USAF-RCAF Military Characteristics Committee, 7 Sep 1954 (HRF 405.1).

27. As in n 25.

28. USAF to ADC, "Mid-Canada Early Warning System," 11 Oct 1954 (CONAD-ADC, 1954A, Doc 51).

29. USAF to ADC, "Implementation of the DEW Line," 21 Jan 1955 (CONAD-ADC, 1955A, Doc 109).

30. As in n 22, p 33.

31. 1st Report of the Location Study Group, DEW Group, 12 Nov 1954 (HRF 405.1)

32. TWX, CINCONAD to C/S USAF, 15 Dec 1954 (CONAD-ADC, 1954B, Doc 53).

[redacted]

REFERENCE NOTES TO PAGES 66 - 69

33. Ibid.

34. Ibid.

35. USAF, Summary Control Statement, 22 Dec 1954, p 24 (CA/C Files).

36. As in n 29.

37. JCS Presentation by Maj Gen F. H. Smith Jr., 22 Jun 1955 (CONAD-ADC, 1955A, Doc 111).

38. Ibid.

39. TWX, USAF to CINCONAD, 15 Aug 1955 (CONAD-ADC, 1955A, Doc 114).

40. Ibid.

41. TWX, CINCONAD to C/S USAF, 5 Aug 1955 (CONAD-ADC, 1955A, Doc 112); TWX, USAF to CINCONAD, 27 Jul 1955 (CONAD-ADC, 1955A, Doc 113).

42. TWX, USAF to CINCONAD, 13 Sep 1955 (DOC 88).

43. TWX, CINCONAD to C/S USAF, 27 Sep 1955 (DOC 89).

44. ADC, Diary #220, 20 Dec 1955 (HRF 901); Interview with Col R. B. Hughes, P&R, 20 Jan 1956.

REFERENCE NOTES TO CHAPTER SIX, PAGES 71 - 73

1. ARDC to ADC, "Project Texas Towers," 26 Sep 1952 (DOC 90).

2. ADC to USAF, "Extension of Radar Coverage in the Northeast Coastal Area," 24 Sep 1952 (DOC 91).

3. Ibid.

4. As in n 2, 1st Ind, USAF to ADC, 27 Oct 1952; USAF to ADC, "Seaward Extension of Radar Coverage," 23 Mar 1953, w/1 Ind (ADC, 1953B, Doc 80).

5. Ibid., 1st Ind, ADC to USAF, 29 Apr 1953.

6. ADC to USAF, "Texas Towers," 24 Aug 1953, w/1 Incl (DOC 92).

7. USAF, DCS/O, Operational Plans Div., "Planning Guide for Implementation of Texas Towers," 16 Nov 1953 (DOC 93).

[redacted]

REFERENCES NOTES TO PAGES 73 - 79

8. USAF to ADC, "Air Defense Program Requirements," 11 Jan 1954 (DOC 94).

9. USAF to Du. Yds & Docks, "FY 1955 Advance Planning Directive - Texas Towers," 8 Mar 1954 (DOC 95).

10. ADC, Bi-Weekly AC&W Status Report, 17 Dec 1954 (CA/C Files).

11. ADC Diary #7, 17 Dec 1954 (HRF 901).

12. George F. Tait, "Texas Towers," The Military Engineer, XLVII (Nov-Dec 1955), 436-439.

13. As in n 10.

14. As in n 12.

15. As in n 12.

16. TWX, ADC to EADF, 14 Jul 1955 (DOC 96); ADC to MAAMA, "Operating Date for Texas Tower No. 2," 1 Apr 1955 (CONAD-ADC, 1955A, Doc 77).

17. ADC, Command Data Book, Jul 1955 (HRF 903).

18. ADC, Operational Plan for Texas Towers, 20 Jul 1954 (CONAD-ADC, 1954B, Doc 66).

19. TWX, ADC to USAF, 4 Aug 1954 (DOC 97).

20. ADC to USAF, "Tropospheric Radio Communications to Texas Towers," 15 Nov 1954 (CONAD-ADC, 1954B, Doc 69).

21. Ibid.

22. EADF, "Operational Plan Texas Tower No. 2," 1 Sep 1955, p 3 (DOC 98). See also, TWX, ADC to USAF, 31 Jan 1955 (DOC 99); MAAMA to ADC, "Tropospheric Scatter Radio for Texas Towers," 24 Aug 1954, w/7 Inds (CONAD-ADC, 1955A, Doc 93).

23. ADC to ARDC, "Radar Video Remoting," 12 Jan 1955 w/1 Ind (CONAD-ADC, 1955A, Doc 97).

24. TWX, ADC to RADC, 1 Dec 1954 (CONAD-ADC, 1954B, Doc 67).

25. 1st Ind, ADC to RADC, 3 Dec 1954 to RALC to ADC, "Improvement and Modifications to Production AN/GPA-37," 19 Oct 1954 (DOC 100).

26. As in n 23.

[redacted]

REFERENCE NOTES TO PAGES 79 - 83

27. Ibid.

28. Ibid., 1st Ind, ARDC to ADC, 12 Apr 1955.

29. Ibid.

30. TWX, ADC to RADC, 13 Jan 1955 (CONAD-ADC, 1954B, Doc 68).

31. RADC to ADC, "Use of AN/GPA-37 with Texas Towers," 21 Feb 1955 w/1 Incl (CONAD-ADC, 1955A, Doc 99); TWX, ADC to ARDC, 15 Apr 1955 (CONAD-ADC, 1955A, Doc 98).

32. USAF to ADC, "Operational Plan for Texas Towers," 17 Jun 1955, w/1 Ind (CONAD-ADC, 1955A, Doc 80).

33. ADC, "Operational Plan for Texas Towers," 15 Apr 1955 (ADC, M&O Files).

34. ADC, DF, M&O to Staff, "Change to Detachment Manning to be for Texas Towers," 27 Jan 1955 (DOC 101); As in n 33.

35. TWX, ADC to EADF, 11 Oct 1954 (CA/C Files).

36. ADC to USAF, "Texas Tower Manning," 10 Jun 1955, w/1 Ind 7 1 Incl (DOC 102).

37. Ibid., 1st Ind, USAF to ADC, 30 Jun 1955.

38. As in n 18.

39. As in n 32.

40. Ibid., 1st Ind, ADC to USAF, 23 Jul 1955.

41. TWX, ADC to EADF, 29 Nov 1955 (DOC 103); ADC Diary #223, 23 Dec 1955 (HRF 901).

42. Interview with Capt R. E. Parfitt, DCS/P, PR&T, 29 Nov 1955.

43. As in n 33.

44. Incl to EADF to 32d ADiv, "Texas Tower Status," 22 Jul 1955, p 7 (JEADF-EADF, 1955A, Doc 112).

45. Ibid., p 18.

46. As in n 18.

REFERENCE NOTES TO PAGES 83 - 85

47. ADC to USAF, "Cross-Servicing Agreement for Texas Towers," 3 Jan 1955 (CONAD-ADC, 1954B, Doc 71).

48. TWX, USAF to ADC, 23 Feb 1955 (CONAD-ADC, 1955A, Doc 82).

49. USAF to ADC, "Logistic Support for Texas Towers," 25 Mar 1955 (CONAD-ADC, 1955A, Doc 83); TWX, ADC to USAF, n.d. (DOC 104); 1st Ind, ADC to USAF, 30 Apr 1955 to USAF to ADC, "Logistics Support for Texas Towers," 25 Mar 1955 (DOC 105).

50. TWX, USAF to ADC, 28 Apr 1955 (CONAD-ADC, 1955A, Doc 85); ADC, DF, ADMEL to DCS/P, "Log. Spt. for Texas Towers," 20 Apr 1955 (CONAD-ADC, 1955A, Doc 86); ADC, DF, ADMAC to ADMEL, "Log. Spt. for Texas Towers by H-21's," 13 Apr 1955 (DOC 106).

51. 3rd Ind, ADC to USAF, 29 Apr 1955 to USAF to ADC, "Supply Ships for Texas Towers," 10 Jan 1955 (CONAD-ADC, 1955A, Doc 87). ADC, DF, ADMEL to ADMSV, et al, "Special Clothing for Texas Tower Personnel," 13 May 1955 (CONAD-ADC, 1955A, Doc 89); TWX, ADC to TTAF, 11 Aug 1955 (CONAD-ADC, 1955A, Doc 90).

52. EADF, "Logistics Plan Texas Tower No. 2," 22 Jul 1955 (CONAD-ADC, 1955A, Doc 92); ADC to Dist., "Logistic Support Plan for Texas Tower No. 2," 25 May 1955 (CONAD-ADC, 1955A, Doc 91).

53. ADC, DF, ADMEL-3 to ADMEL, "Trip Report - Texas Towers," 26 Sep 1955 (DOC 107).

54. TWX, USAF to ADC, 19 Oct 1955 (DOC 108).

55. TWX, CINCONAD to C/S USAF, 25 Oct 1955 (DOC 109).

56. As in n 41, TWX, ADC to EADF.

REFERENCES NOTES TO CHAPTER SEVEN, PAGES 88 - 90

1. Interview with Maj R. J. Lloyd, ADC P&R, 12 Dec 1955.

2. CONAD, "Operational Plan for Seaward Extension of the Air Defense Combat Zone," 20 Jun 1955, pp 2-3 (CONAD-ADC, 1955A, Doc 33).

3. Ibid.

4. TWX, ADC to Asst Sec of Def, 23 Dec 1955 (DOC 110).

5. ADC to USAF, "Lighter-than-Air Airships in Air Defense," 14 Dec 1955 (DOC 111).

REFERENCE NOTES TO PAGE 90

6. ADC to USAF, "CW Doppler System for Overwater Early Warning," 23 Mar 1954 (ADC, 1954A, Doc 4); ADC, DF, AD00A to C&T, "Status Report on Buoy Mounted Radar Doppler Fence," 13 Apr 1954 (ADC, 1954A, Doc 5).

7. Col E. F. Carey Jr., ADC MIT Liaison Office to Maj Gen F. H. Smith Jr., ADC VC, 24 Feb 1954 (DOC 112); Brig Gen W. A. Matheny, ADC MIT Liaison Office to Maj Gen F. H. Smith, Jr., 24 Nov 1954 (DOC 113).