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**THE ADC
AIRBORNE
EARLY WARNING
AND
CONTROL PROGRAM
1946 - 1964**

by THOMAS W. RAY

JANUARY 1965

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First Faltering Steps - 1946-1949. Whether or not to add an airborne early warning and control (AEW&C) capability to the air defense structure -- so that radar-equipped aircraft might, with considerable regularity, fly off-shore patrols -- was a question first posed in the late 1940's. Much thoughtful deliberation was involved, since the difficulties in establishing such a system must be far out-proportioned by the dividends gained. Three emphatic advantages were foreseen if radar-carrying aircraft patrolled two to three hundred miles from shore: (1) radar coverage would be extended seaward hundreds of miles beyond that generated by coastal radars along the Atlantic and Pacific seaboard, spelling a gain of 30 extra minutes or more

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warning time of oncoming attacks by hostile bombers; (2) low-altitude off-shore coverage overlooked by coastal-based radars (because of line-of-sight radar characteristics) would be afforded by AEW aircraft because of their elevation thousands of feet above sea level, thus reducing, and perhaps eliminating, the prospect of successful low-level bomber attacks; (3) fighter interceptors dispatched to identify unknown targets would be enabled to intercept them farther seaward, where, if found hostile, they might be downed long before reaching bomber release lines. Weighed against these advantages were certain disadvantages. Besides the usual funding, manning and equipping problems, there was a glaring lack of experience in airborne radar operations from which ADC might profit. The Navy on the other hand, had engaged special radar-equipped aircraft since 1945 to detect and track attacking enemy airplanes, developed initially to combat "Kamikaze" fighters bent on destroying warships. The U.S. Air Force, and its predecessor, the Army Air Forces, had virtually no background along these lines.

This is not to say that the AAF lacked interest. Indeed, shortly before war's end, Air Materiel Command was delegated by AAF to investigate an Airborne Control Center System, particularly as one might apply to offensive operations.

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Soon after, in 1946, the Air Staff recommended that this effort be reoriented to serve air defense purposes. But this recommendation came to naught; budget and service manpower cuts following World War II brought an end to the project, leaving the Navy, in effect, sole agency for developing airborne early warning systems. The Navy pursued its AEW development program, adapting radars first to Navy Grumman torpedo bombers (TBM-3W's), then B-17's (PB-1W's).¹

While it was not until years afterward, in 1951, that an ADC-owned AEW&C force was authorized for continental air defense, proposals to this end, meantime, pelted USAF from above and below. An early air defense plan, named SUPREMACY, authored by USAF in 1947 for charting air defense growth to 1955 (but ignoring off-shore early warning facilities), faced immediate criticism from ADC and the JCS. Both complained of the absence of provisions for either radar-carrying naval picket ships or, more important, AEW aircraft. How else protect from sneak attack a nation whose industrial

1. USAF Historical Study No. 126, The Development of Continental Air Defense to 1 September 1954, p. 68 (hereafter cited as USAF Hist Study No. 126); ADC Historical Study No. 10, Seaward Extension of Radar 1946-1956, pp. 3-4 (hereafter cited as ADC Hist Study No. 10); Hist of ADC, Jul-Dec 1951, pp. 36-38.

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complexes, for the most part, were concentrated within 150 miles of its eastern and western shorelines? While not spelled out in so many words, this vulnerability to attack seemed the most telling argument underlying their reactions. In 1948, the JCS committee evaluating Plan SUPREMACY declared that, short of positioning nine picket ships and 16 AEW aircraft to police seaward approaches, the nation would be considerably shortchanged. ADC claimed need for an early warning belt composed of two fleets of AEW aircraft to guard the eastern flank from Greenland to Puerto Rico, and the western flank from Alaska to Hawaii. Upon further reflection, USAF was inclined to agree. But Plan SUPREMACY was rejected by Congress anyway, and in 1949, an even less ambitious one was adopted that, for reasons of economy, also failed to include an AEW force for offshore detection. Advocates of airborne radar patrols were constrained to bide their time until better days.

Groundwork for Future AEW Operations, 1950-1952. While thus thwarted in 1948-49, an AEW fleet was finally authorized for ADC in 1951. Strained cold war relations and eruption

2. USAF Hist Study 126, pp. 12, 68-70; ADC Hist Study 10, pp. 1-3.

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of the Korean conflict, combined with growth of a sizeable Soviet bomber force armed with atomic ordnance, cumulatively underscored the necessity for airborne early warning.

Meanwhile, interest in employing AEW for continental air defense had been manifested by the Navy months before the Korean conflict erupted in June 1950. Convinced of the important role played by its AEW aircraft in an anti-submarine warfare (ASW), the Navy wanted them tested in an off-shore surveillance capacity, too, for detecting and tracking, in conjunction with ADC's ground radar network, incoming "attacking" aircraft. In December 1949, accordingly, the Navy Department requested USAF's cooperation, and participation, in such tests. ConAC, in whom air defense responsibilities were vested at this time, singled out Western Air Defense Force (WADF) for conducting the tests in collaboration with Navy AEW aircraft of the PB-1W (converted B-17) variety. ConAC itself grew curious as to just how well Navy aircraft might compensate for the low-altitude coverage lost to its line-of-sight ground radars, then good for 150-mile ranges against medium and high-altitude targets, but only half this distance against low-altitude targets. The problem facing ConAC, in its air defense capacity (and later ADC), was one of simple arithmetic and timing. A Soviet

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TU-4 bomber, as then in production, conceivably would fly a low-altitude approach to the U.S. coastline that would slip unnoticed below the land-based radars until only about 78 miles from shore. Since, in 1950, the time consumed in completing all phases of hostile-target destruction (that is, detecting, identifying, scrambling, intercepting and destroying), averaged 49 minutes, during which time the TU-4 class bomber travelled practically 300 miles, it was evident that attacking bombers would likely be well over target before being met by a defending host, no matter at what altitude flown by the attackers, and particularly when flying at low altitudes.³

In July 1950, the tests were accomplished off the West Coast. In a week's time, one Navy PB-1W, equipped with the APS-20A search radar (having a maximum theoretical range of 220 miles), cranked out hours of airborne surveillance in conjunction with shore-based radars of the 28th Air

3. ADC Hist Study 10, pp. 7-8; Hist of ConAC, Jan-Jun 1950, Vol III, "The Development of an Air Defense System in Being," pp. 91-93; Hist of ADC, Jul-Dec 1951, pp. 41-42; Hist of ADC, Jan-Jun 1951, pp. 82-84, 360-64, 369-70; Ltr, USAF to CNO, "Use of Navy Airborne Early Warning in Air Defense Exercises," 30 Dec 1949 [DOC 1]; Ltr and Ind, USAF to ConAC, "Use of Navy Airborne Early Warning in Air Defense Exercises," 30 Dec 1949 [Doc 2 in Hist of ADC, Jan-Jun 1955, Docs Vol XII]; Hist of WADF, Jan-Jun 1950, pp. 112-13.

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Division and F-84 interceptors of the 78th Fighter Wing. Despite serious shortcomings with the Navy's AEW aircraft, results of the tests were favorable. Another AEW test conducted by the Navy proved similarly successful. Two PB-1W's simultaneously flying off-shore patrols 90 miles apart managed to vector F9F Navy jets to bomber-sized targets first detected 500 miles from shore, so the F9F's could intercept them 300 miles out to sea.⁴

In April 1951, notwithstanding mixed feelings expressed by both WADF and EADF, ADC (re-established 1 January 1951) forwarded to USAF a requirement for AEW aircraft. ADC saw a need for regular AEW patrols off both coasts. Since the Navy was neither disposed, nor able, to handle such an assignment (although willing to lend its few AEW aircraft in times of emergency), ADC was to assume the responsibility. According to General Ennis C. Whitehead, then commander of ADC,⁵ AEW aircraft:

...would be placed on patrol a sufficient distance

4. Ltr, Incls & Atchs, WADF to USAF. "Use of Navy Airborne Early Warning in Air Defense Exercises," 10 Jul 1950 [Doc 194 in Hist of ADC, Jan-Jun 1951]; Hist of WADF, Jul-Dec 1951, pp. 54-56; Hist of EADF, Jan-Jun 1951, pp. 125-29.

5. Ltr, ADC to USAF, "Requirement for Airborne Early Warning and Control Equipment," 9 Apr 1951 [Doc 195 in Hist of ADC, Jan-Jun 1951].

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beyond the coverage of our present radar system to detect the enemy in time for the interceptors to be scrambled so they could make first contact at near their maximum range....

Forty AEW aircraft, divided between the East and West coasts, would suffice for a start, according to ADC calculations. They would equip five squadrons with eight planes apiece.

USAF, rather than being startled by ADC's request for AEW aircraft, was apparently pleased at the prospect of furnishing them, and soon approved. USAF, too, had kept a sharp eye on Navy AEW aircraft development with a view to equipping ADC with them. To be sure, it was USAF, in November 1950, who told Air Proving Ground to keep close watch on tests undertaken by the Navy on a new, enlarged model of AEW aircraft, the Navy PO-1W, employing the Lockheed Constellation airframe specially modified to house the improved APS-20B search set, in combination with the APS-45 height finder. It was an improved version of this, the so-called Super-Constellation adapted to AEW needs, and equipped with the same radars, that was finally picked by mid-1951 for Air Force use in general, and ADC use in particular.

By November 1951, the first ten of them (designated RC-121's, later re-designated EC-121's) were ordered from Lockheed, followed not long after by orders for more. First deliveries, however, had to be postponed until 1953; and

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1956 would arrive before final deliveries were completed.

Rather than brook this delay without some interim protection, ADC and USAF considered refurbishing 30 B-29's for improvising AEW operations until ADC's EC-121 squadrons were readied. When learned, however, that the B-29's could not be modified and delivered sooner than mid-1953, at which time the first of the EC-121's were scheduled to trickle in, this idea was dropped. EADF, meantime, in collaboration with the Navy, carried on further AEW tests between July and December 1951, with results that, while mixed, showed considerable promise toward enhancing the future security of North America.⁶

If heavy, bulky radars not usually associated with airborne operations are crossed with a commercial transport not ordinarily identified with radar surveillance, something

6. Ibid., Hist of ADC, Jan-Jun 1951, pp. 244-50; Hist of WADF, Jul-Dec 1951, pp. 56-59; Memo for Record, Col. K.P. Bergquist, Dir P & R, "AEW," 20 Mar 1951 [Doc 19 in Hist of ADC, Jul-Dec 1951]; Ltr, WADF to ADC, "Use of Navy Airborne Early Warning in Air Defense," 27 Mar 1951 [Doc 20 in Hist of ADC, Jul-Dec 1951]; Ltr, EADF to ADC, "Use of AEW Aircraft to Augment the Air Defense System," 13 Mar 1951 [Doc 21 in Hist of ADC, Jul-Dec 1951]; Ltr, EADF to ADC, "Use of Naval Airborne Early Warning Equipment," 7 Mar 1951 [Doc 22 in Hist of ADC, Jul-Dec 1951]; Ltr, ADC to USAF, "Requirement for an Airborne Early Warning and Control Evaluation Study," 27 Nov 1951 [Doc 23 in Hist of ADC, Jul-Dec 1951]; ADC Hist Study 10, pp. 8-11; USAF Hist Study 126, p. 70; Hist of EADF, Jul-Dec 1951, pp. 69-73; Hist of ADC,

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must give. Inevitably, a strikingly hybrid aircraft will result. So it was with the EC-121.

It was not without reason that the EC-121 "Warning Star" earned the nickname "pregnant goose." While many of its characteristics were identical with the customary Lockheed Super-Constellation -- measuring in length 116.2 feet, with its single, tapering wing, which supported four 3,250 h.p. Wright engines, extending 126 feet long -- the super-structure directly above and below its mid-section bore conspicuous changes. Two radomes bulbously sprouted out, one on top, the other beneath. The top one was the taller, engineered especially to house the crescent-shaped radar dish and antenna of the APS-45 height finder. This addition gave the aircraft's profile a hump-backed shape. The bottom radome, the wider of the two in diameter (hence the "pregnant" aspect), contained the revolving APS-20B search radar antenna and dish measuring 17 feet long. The APS-20B, was said to spread radar coverage some 30 per cent farther than the "A" model, amounting to an effective radius of about 125 miles. Subsequent tests showed it able to detect

[Cont'd] Jan-Jun 1952, p. 47, f.n. 105; Ltr, ADC to USAF, "Interim Aircraft for Airborne Early Warning," 28 Feb 1952 [Doc 28 in Hist of ADC, Jan-Jun 1952].

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bomber-size targets 173 nautical miles away. The APS-45 height finder, on the other hand, manufactured by Philco Corporation, proved effective for distances only up to 80 miles away.

When mission-equipped, the EC-121 airplane weighed upwards of 143,000 pounds. It possessed a 1,000-nautical mile combat radius, cruised about 200 knots, and was confined to a combat service ceiling less than 24,000 feet.⁷

Inside, the airplane was compartmentalized into seven distinct chambers: the nose section; flight station; forward bunk area; galley; radar operating area; rear bunk area; and lavatory. The tons of electronic gear pocketed within the radar operating area, besides the APS-20B and APS-45 radars, included a battery of PPI scopes (for displaying search and height finder radar data), radar relay transmitters and receivers, an Airborne Moving Target Indicator

7. F.G. Swanborough, United States Military Aircraft Since 1909 (New York City: Putnam, 1963), pp. 298-301; USAF, Standard Aircraft Characteristics, Vol 1 (Green Book); Ltr, ADC to EADF, "Use of Airborne Early Warning Equipment in Air Defense," 14 Feb 1951 [Doc 4 in ADC Hist Study 10]; Ltr, EADF to ADC, "Use of Naval Airborne Early Warning Equipment," 7 Mar 1951 [Doc 22 in Hist of ADC, Jul-Dec 1951]; ADC, "A Plan for the Employment of Airborne Early Warning and Control," 7 Feb 1952 [Doc 24 in Hist of ADC, Jul-Dec 1951]; ADC Hist Study 10, pp. 10-11; Hist of ADC, Jul-Dec 1955, p. 61.

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(AMTI), Loran and other navigation gear, HF and UHF transmitters and receivers and other communications equipment, as well as IFF and ECCM apparatus. Total costs per fully-equipped aircraft approximated \$3,200,000. A maximum crew of 32 persons could be accommodated by each airplane, though considerably less were actually employed when operations got under way, numbering generally between 16 and 26.⁸

The two years intervening between consummation of contracts for EC-121's, and their delivery, were busily exploited planning AEW operations. A number of things required settling. There were the matters of determining how many airplanes to procure, in toto; where they should fly during off-shore patrols; and what AFSC's, precisely, to people them with. Solutions to these, in turn, would help answer the all-important question of where to base the aircraft and personnel, and how to organize them so as best to sustain skilled AEW operations and maintenance.

The matter of aircraft quantity and organization was momentarily decided by USAF when it ordered 56 EC-121C's and D's for distribution between two squadrons, one on either coast. In formulating AEW deployment criteria, ADC first

8. Swanborough, op. cit., pp. 298-301; USAF, Standard Aircraft Characteristics, op. cit.

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believed 56 sufficient to maintain continuous surveillance every day of the year off both coasts. Scheduling three shifts of EC-121's, flying 8 hours on station per shift, would assure round-the-clock operations. By positioning four EC-121's simultaneously about 225 miles from shore, spaced at intervals 150 miles apart, ADC hoped to establish an AEW radar barrier some 800 miles long, extending 350 miles seaward, using four AEW stations positioned from southeast Nova Scotia to northeast of Norfolk, Virginia along the Atlantic seaboard, and five AEW stations positioned from west of Seattle to west of San Francisco along the Pacific seaboard. Station 3 of the five West Coast stations was to be manned only during emergencies. Beyond these two lines of AEW planes, a string of Navy picket vessels would operate to push off-shore radar coverage still farther seaward. Along the Atlantic seaboard, moreover, a row of Texas Towers was to be installed about 100 miles from the shoreline, so that the eastern AEW barrier, in essence, would fit between⁹ and run parallel with, the Texas Towers and picket vessels.

9. ADC, "A Plan for the Employment of Airborne Early Warning and Control," 7 Feb 1952 [Doc 24 in Hist of ADC, Jul-Dec 1951].

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Worried lest fatigue factors degrade AEW surveillance during the tedious eight-hour periods on stations, ADC, after careful study, planned to systematize scope watches so that relief operators would be on hand to stagger the work load. Rotation of radar operators from scope watching, after 45 minutes or so, to plotting, tracking or telling assignments, combined with regularly scheduled intervals of rest, was calculated to relieve the fatigue factor. Maximum time on scope was fixed at two hours per individual during any eight-hour flight.

ADC forecasted an average yearly flight time, per plane, amounting to 2,065 hours, or 170 hours per plane each month. ADC first believed it best to contract all EC-121 maintenance to the Lockheed Aircraft Corporation. This and like early planning, which plumbed the depths of AEW operations, were embodied in ADC's "Plan for the Employment of Airborne Early Warning and Control" (7 February 1952). Much of this early plan was realized in later years; portions, however, like the contract maintenance part covering all EC-121¹⁰ maintenance, never materialized.

10. Ibid.; Ltr, ADC to USAF, "Development of Airborne Moving Target Indicator Techniques," 17 Jan 1952 [Doc 25 in Hist of ADC, Jul-Dec 1951]; ADC Hist Study 10, pp. 10-11, 17.

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Acting with this February 1952 plan for a start, ADC embarked on its building program aimed at laying a foundation solid enough to support a future AEW force structured around 56 airplanes delivered between 1953 and 1956. Among the bases first considered by ADC were Hamilton AFB, California and Mitchel AFB, New York. Soon both were disqualified, however, when realized that their runways could not be suitably enlarged to accommodate AEW operations. Base selection thereupon shifted to four different possibilities: Otis AFB, Massachusetts, and three USAF bases in California -- Castle, Mather and McClellan. In mid-1952, AEW base selection was further complicated when ADC argued in favor of an expanded program. Instead of dividing the 56 airplanes between two squadrons, ADC wanted 60 divided among six squadrons, at 10 airplanes apiece. Because of sizeable funding and personnel savings that ADC stood to gain, only two bases would still be involved, so that three of the squadrons, together with a higher headquarters, would be stationed at an East Coast base and a like number at the West Coast base. Besides these, according to ADC's revised way of thinking, each of the two bases would house one electronic maintenance squadron and one periodic maintenance squadron. This changed plan spelled an increase in total personnel strength amounting

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to about 2,000, necessitating base support programs of much greater size than theretofore contemplated. By August 1952, ADC ruled out all but two bases: Otis and McClellan.¹¹

Hereupon ADC requested USAF to hasten approval for these two bases, together with accelerating funding for facilities construction at Otis, where hangar maintenance and warehouse storage space, along with parking aprons, were in short supply. Something of the urgency and magnitude of the situation were communicated in the recommendation forwarded to USAF in August 1952 by the then ADC Vice Commander, Major General Frederic H. Smith:¹²

The AEW&C program is one of our most critical requirements for improved air defense. This program, along with the closely related picket vessel requirement, is extremely costly in money, men, and resources, but there is no other way to provide defense for coastal targets -- if there was, we would certainly reconsider this program. This Command feels, in spite of the cost, we must implement

11. ADC, "A Plan for the Employment of Airborne Early Warning and Control," 7 Feb 1952 [Doc 24 in Hist of ADC, Jul-Dec 1951]; Ltr, ADC to USAF, "Airborne Early Warning Proposed T/O's" 31 May 1952 [Doc 10 in Hist of ADC, Jan-Jun 1955, Docs Vol XII]; Ltr and 1st Ind, ADC to USAF, "Selection of AEW&C Bases," 3 Jun 1952 [Doc 11 in Hist of ADC, Jan-Jun 1955, Docs Vol XII]; 2nd Ind, ADC to USAF, "Selection of AEW&C Bases," 3 Jun 1952 [Doc 12 in Hist of ADC, Jan-Jun 1955, Docs Vol XII].

12. 2nd Ind, ADC to USAF, 22 Aug 1952, to Ltr, ADC to USAF, "Selection of AEW&C Bases," 3 Jun 1952 [Doc 12 in Hist of ADC, Jan-Jun 1955, Docs Vol XII].

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the AEW&C aircraft program properly at the earliest possible date. Without picket vessels on station, and the AEW&C aircraft operating 24 hours per day, we stand an excellent chance of losing a war. To operate four AEW stations off each coast on a continual basis requires each of the assigned aircraft to fly approximately 172 hours per month. These aircraft, which are in essence flying electronic nightmares, cannot be maintained for this flying rate without adequate support facilities and replacement parts. While the monthly rate of 172 hours per assigned aircraft appears high, it is attainable; and is much less expensive than to operate at a rate of 100 hours and buy additional aircraft.

ADC could scarcely ask for better cooperation than it received from USAF. The next month, on 16 September 1952, the Air Force Council issued practically an across-the-board endorsement of ADC's revised six-squadron, two-base plan. Not only was location of the two bases authorized at McClellan and Otis, as requested, but also funds were expressly earmarked to facilitate construction projects at both McClellan and Otis. Even so, the Otis construction could not be readied during FY 1953, in time to accommodate the first AEW tactical squadron phasing in, which ADC was especially anxious to deploy to the East Coast. Northeastern U.S. offered the largest number of choice targets to attacking enemy aircraft; therefore ADC sought to start AEW operations on the East Coast first. But with Otis unprepared, ADC picked McClellan to activate the first AEW squadron in mid-1953, for transfer to Otis in 1954, when enough of the

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necessary construction was completed to accommodate the AEW mission. ADC's proposed manning tables, calling ultimately for a total AEW strength numbering 4,582 officers and airmen, which was part and parcel of the mid-1952 revised plan, was approved by USAF. All in all, each of the two bases would contain 578 officers and 1,713 airmen, divided up as follows:

<u>Activity Per Base</u>	<u>Final Strength</u>	
	<u>Officers</u>	<u>Airmen</u>
Group Headquarters	12	30
AEW&C Tactical Squadron	180	288
AEW&C Tactical Squadron	180	288
AEW&C Tactical Squadron	180	288
Periodic Maintenance Squadron	6	247
Electronic Maintenance Squadron	7	102
	565	1,243
Support Augmentation T/DA (Estimated as tenant unit & includes eight officers and 241 airmen required in Field Maintenance Squadron)	13	470
	578	1,713

Total military aggregate for one base -- 2,291
Total military aggregate for two bases -- 4,582

Since the aircraft would arrive on a staggered schedule,

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the personnel were likewise scheduled to phase in on a
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graduated basis.

Inasmuch as ADC wanted 10 EC-121's per squadron, USAF contracted to buy about half a dozen more to fill out the six squadrons, and furnish a few extra airplanes to absorb future attrition losses. The aircrews would number 2.5 per assigned EC-121, in order to squeeze out the 172 hours average monthly flight time predicated for each aircraft, yet rotate assignments so as not to overtax the crews. Each aircrew would total 18 persons, comprising a pilot, co-pilot, navigator, flight engineer, radio operator, ECM operator and ECM maintenance technician, two height finder operators, and three radar operators, intercept controllers and radar
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technicians.

Thus 1952 had proved a signal year, choked with planning and programming activities that saw a considerable portion of the AEW groundwork perfected. What was to follow, in large part, would be the product of two feverish years of hard planning, soul-searching, study and analysis. Insofar as other matters pertaining to AEW were concerned, two other significant events stood out. During 1952, a number of

13. IOC, P&R to DCS/M. et.al., "AEW&C Program,"
26 Nov 1952 [DOC 2].

14. Ibid.

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future EADF and WADF AEW radar operators were placed, at ADC's behest, in Navy AEW schools at San Diego, California, and Patuxent, Maryland, among the few places where such training was offered. By year's end, a formal 16-weeks course in basic electronic airborne equipment was planned under the joint aegis of the Navy's Bureau of Aeronautics and USAF's Air Training Command, to be centralized at the Navy's AEW training facility in San Diego. Those assigned this training were to benefit from instruction by Philco and General Electric technicians as well as from Navy and USAF instructors. The second event of importance occurred at Lockheed, where, by the end of 1952, 95 per cent of the engineering work was completed on the first EC-121 destined¹⁵ for AEW operations with ADC.

Years of Build-Up, 1953-1955. If 1952 was important for planning purposes, it was shortly outclassed by 1953, particularly if viewed in the perspective of physical accomplishments. For it was in 1953 when the first EC-121's

15. Hist of WADF, Jan-Jun 1952, pp. 46-48; Hist of WADF, Jul-Dec 1952, pp. 170-71; Ltr, ADC to Navy Special Devices Center, "Airborne Early Warning and Control," 1 Dec 1952 [Doc 142 in Hist of ADC, Jul-Dec 1952]; Hist of ADC, Jul-Dec 1952, pp. 143-54.

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arrived, the first AEW tactical squadron was organized, and the first formal AEW training began. While these were no mean accomplishments, they fell somewhat short, for various reasons, of the way ADC had envisioned them. Like fitting together all the scattered pieces to a giant jigsaw puzzle, ADC intended to integrate airplanes, personnel and equipments funnelling in from all parts of the country on a closely-timed schedule. The first AEW airplanes were supposed to commence arriving in March 1953; the first AEW tactical squadron was supposed to be activated 1 July 1953 -- both were to happen at McClellan, where field training would ensue until transfer to Otis early in 1954. The other unit activations, combined with, and correspondingly timed with, EC-121 deliveries, were to follow, both at McClellan and Otis, close on the heels of the first, so that all programmed units, by June 1955, would be fully manned, equipped, serviced, and trained for AEW duty.

Then lesser pieces to the puzzle turned up missing. General Electric, because of a labor strike, proved remiss in meeting the deadline dates for delivery of their APS-20B radars. By the first of 1953, it was known that November 1953, at the earliest, rather than March of that year, would arrive before fully equipped EC-121's were on hand; but even

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this forecast later proved optimistic, it being May 1954 before the first completed EC-121's actually made their appearance. At any rate, there threatened to ensue a chain reaction that ADC was anxious to avoid, in which scheduled implementation dates, like rows of falling dominoes, would tumble one after another.

Lockheed, at mid-1953, offered a compromise plan that ADC quickly seized on to forestall the impending chain reaction and salvage some vestige of its former timetable. Two radarless EC-121's were delivered by Lockheed to McClellan AFB near the end of 1953 expressly intentioned for flying and maintenance training. These same two radarless planes were to be returned to the factory for completion when fully equipped replacements arrived, according to the compromise plan.

Activation of the first AEW tactical squadron was correspondingly postponed from 1 July to 1 October 1953, when the 4701st AEW&C Squadron, as it was designated, was activated at McClellan. By mid-1954, the 4701st had acquired its full complement of officers and airmen as programmed for that time period, and 85 per cent of its support equipment. By October 1954, all ten aircraft were assigned. Seemingly, circumstances and weather colluded to keep the 4701st at

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McClellan a year longer than planned, however, rather than being transferred to Otis, where interim construction supposedly was being rushed to allow the 4701st to move there in 1954. Delayed settlement of a knotty land-ownership problem at Otis, combined with foul weather, impeded construction progress to an extent where it was 8 March 1955, rather than early 1954, before the 4701st, redesignated the 960th AEW&C Squadron, could officially take up residence at Otis. At least another year would skip by before construction was completed on permanent AEW facilities at Otis, where maintenance facilities, mobile nose docks, and living quarters were still in demand.

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Meantime, the five sister squadrons were activated not far off schedule as the 64 fully-equipped EC-121's, subsequently hiked to 81, trickled in by slow degrees from May 1954 until the end of 1956, at the rate of about two to four per month. Second after the 4701st (redesignated

16. Hist of ADC, Jul-Dec 1952, p. 149; ADC Hist Study 10, pp. 22-40; ADC Historical Study No. 17, Air Defense Command Unit Histories, 1 Jan 1951-31 Jun 1963; Hist of ADC, Jul-Dec 1953, pp. 49-52; Hist of ADC, Jan-Jun 1954, pp. 77-83; Hist of ADC, Jan-Jun 1955, pp. 30-31; Hist of EADF, Jan-Jun 1954, pp. 33-35; Hist of EADF, Jan-Jun 1955, pp. 57-63; Ltr, ADC to WADF, "Status of AEW Project," 24 Jun 1953 [Doc 77 in Hist of ADC, Jul-Dec 1953]; Msg ADOPR 1703, ADC to AMC, et. al., 3 Aug 1953 [Doc 78 in Hist of ADC, Jul-Dec 1953].

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960th) AEW&C Squadron, came the 4712th Squadron activated 1 March 1954 -- redesignated the 963rd AEW&C Squadron the following year (8 March 1955) -- followed next by 961st Squadron (activated 18 December 1954), the 964th Squadron (activated 8 March 1955), 962nd Squadron (activated 8 July 1955) and finally the 965th Squadron (8 August 1955).

Programmed support squadrons were activated besides, as well as the higher headquarters necessary for providing guidance -- activated not as two group headquarters as originally planned, however, but as two wing headquarters, since the responsibilities entailed were greater than group-strength headquarters could conveniently handle.

The 551st AEW&C Wing was accordingly activated at Otis on 18 December 1954; the 552nd AEW&C Wing, at McClellan on 8 July 1955. Until both wings became strong enough to control their charges -- calculated at being sometime in 1956 -- the 8th Air Division headquarters, commanded by Brigadier General Kenneth H. Gibson, was activated at McClellan, effective 1 May 1954, expressly to shepherd all AEW units to maturity. The organizational complexion of

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the AEW force hatching from 1953 to 1955, thus grew to
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assume the following shape:

Hq 8th Air Division (AEW&Con)

<u>Unit</u>	<u>Base</u>	<u>Activation Date</u>
Hq 552 Wing	McClellan AFB	8 July 55
552 Elec Maint Sq	McClellan AFB	18 Dec 54
552 Period Maint Sq	McClellan AFB	18 Dec 54
963 AEW&C Sq	McClellan AFB	8 Mar 55: (Redesignated from 4712 AEW&C Sq Activated 1 Mar 54)
964 AEW&C Sq	McClellan AFB	8 Mar 55
965 AEW&C Sq	McClellan AFB	8 Aug 55
Hq 551 Wing	Otis AFB	18 Dec 54
551 Elec Maint Sq	Otis AFB	18 Dec 54
551 Period Maint Sq	Otis AFB	18 Dec 54
960 AEW&C Sq	Otis AFB	8 Mar 55: (Redesignated from 4701 AEW&C Sq Activated at McClellan 1 Oct 53)
961 AEW&C Sq	Otis AFB	18 Dec 54
962 AEW&C Sq	Otis AFB	8 Jul 55

17. ADC Hist Study 10, pp. 28-50; Hist of ADC, Jan-Jun 1954, pp. 77-83; Hist of ADC, Jul-Dec 1954, pp. 18-23; Hist of ADC, Jan-Jun 1955, pp. 27-28; Hist of ADC, Jul-Dec 1955, pp. 58-59; Hist of WADF, Jan-Jun 1954, pp. 336-349, 353-356.

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For some time in the 1953-55 time period, ADC dreamed of doubling the size of its AEW force by the end of the decade, with USAF apparently willing to go along. At first, ADC was contented to add only one more squadron, to make seven, which USAF approved for activation on the East Coast at Seymour-Johnson AFB, North Carolina. Next, ADC upped its objectives, as USAF looked approvingly on, aiming for an even dozen AEW squadrons, in all, by 1960, with three of the required six new squadrons, together with another wing headquarters, based at Seymour-Johnson, two more squadrons based at McChord AFB, Washington, and the last at Hunter AFB, Georgia. USAF nodded approval in early 1955, then later the same year approved of still another AEW squadron, to comprise the thirteenth, for activation at Dover AFB, Delaware. Hereupon CONAD conjured grandiose visions of AEW patrols by the score by 1960, with AEW airplanes simultaneously plying all of 20 off-shore stations, 12 off the East Coast and eight off the West, utilizing this strengthened 13-squadron AEW force for the instrument. But as things eventually worked out, this expansion plan never materialized (discussed in detail below, see pages 44- 48): the two-base, two-wing, six-squadron structure continued unaltered, for the most part, until 1962, when

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only one squadron was, in a sense, tacked on for reasons
18
of emergency.

Until Air Training Command and ADC could establish formal AEW course work, the collaborative programs at the Navy radar school, San Diego, and the Lockheed school at Burbank, starting in 1953, served to qualify AEW radar specialists and to introduce and orient pilots and flight engineers to EC-121 operations. By February 1954, some 40 pilots had received training at the Lockheed school while a like number of airmen had been graduated from the Navy school.

Soon after activation of the 4701st AEW Squadron, familiarization flights commenced and, by June 1954, routine radar training missions were flown, focused around a single station some 150 miles off the West Coast. The next month, several EC-121's participated in Exercise CHECK POINT, but without achieving noteworthy success because of faulty communications. A few weeks later, beginning 1 August 1954, regular daily eight-hour patrols were ordered flown at one of the West Coast stations, and regular patrols

18. ADC Hist Study 10, pp. 31-50; Hist of ADC, Jul-Dec 1954, pp. 18-23; Hist of ADC, Jul-Dec 1955, pp. 58-61.

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of a second station began 17 September 1954. By the end of 1955, one West Coast and one East Coast station were manned around-the-clock full-time. During a two-month period, EC-121's patrolling the West Coast station reported over 800 incoming tracks, 547 of which warranted forward telling to higher headquarters for further action. The training, maintenance and operational activities on station repeatedly revealed a number of shortcomings with the new system, for the most part revolving around crew staffing and training problems, electronic maintenance, and air-to-ground communications. The Sacramento Air Materiel Area (SMAMA), which had been designated to furnish EC-121 materiel support, was unable to keep abreast of demand for supplies. Certain units lacked nearly half their authorized personnel, with shortages of qualified persons especially acute in the radar maintenance and operator fields. Ground ACW stations had trouble plotting and correlating tracks fed to them by AEW aircraft. Participation of EC-121's in Exercise CRACKER JACK, December 1955, proved practically futile in view of the failure of the airborne radars to disclose the whereabouts of SAC bombers pressing an "attack" from the Pacific.

Few, if any, of the problem areas troubling the recently formed units looked insurmountable, however; so

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a concerted effort was launched to correct them. Another round of training classes got under way in 1955 at both the Navy and Lockheed schools, and in April of that year, Air Training Command inaugurated, at Keesler AFB, Mississippi, USAF basic and specialized training courses in maintenance¹⁹ of AEW radars.

Between August 1954 and May 1955, Air Proving Ground Command (APGC) conducted vigorous evaluation tests of the EC-121. USAF and ADC had accepted the EC-121 prior to evaluation tests for two reasons: the Navy had already found it acceptable for performing similar duty; and the urgency of establishing off-shore AEW patrols necessitated, as a matter of expediency, scheduling the evaluation tests concurrently with the phasing in period. While the EC-121, as a flying platform, seemed adequate enough with respect to airframe and engine design, it was sharply criticized by APGC for (1) the lack of certain de-icing apparatus to enable it to possess an all-weather flying capability:

19. Hist of ADC, Jul-Dec 1954, pp. 22-23; Hist of ADC, Jul-Dec 1955, pp. 66-67; Hist of EADF, Jul-Dec 1953, p. 13; Hist of EADF, Jan-Jun 1955, pp. 62-63; Hist of EADF, Jul-Dec 1955, pp. 68-73; Hist of WADF, Jul-Dec 1953, pp. 36-39; Hist of WADF, Jul-Dec 1954, pp. 125-72; Hist of WADF, Jul-Dec 1955, pp. 4-6; ADC Hist Study 10, pp. 32-48; USAF Hist Study 126, pp. 70-71; Hist of WADF, Jan-Jun 1954, pp. 349-65; Hist of WADF, Jan-Jun 1955, pp. 85-86.

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(2) the limited 80 mile range and questionable accuracy of the APS-45 height finder; (3) insufficient navigation equipment; and (4) faulty air-to-ground communications. The EC-121, to be sure, was pronounced unsuitable for its air defense role. APGC conceded, however, that the EC-121 was purposeful for performing AEW service on an interim basis, until a better system should come along. But this offered little solace to ADC, which had discovered for itself that EC-121 flying time, because of maintenance workloads involved, must be lowered from 172 to 140 hours a month per plane. This called for rearranging objectives to accord with decreased capabilities, so that, instead of patrolling four stations continuously, per wing, off each coast, the two AEW wings were to man as many of the four as allowable within the reduced time framework. These and other complications influenced ADC to postpone target dates for operational readiness of the 551st Wing at Otis until 15 October 1956, and of the 552nd Wing at McClellan until 15 December 1956, prolonging the lifetime of the 8th Air Division in the bargain. Furthermore, ADC immediately clamoured for concerted "fixes" that, as a formally constituted modification program costing about \$27 million, would correct many of the EC-121's faults. USAF, by the end of

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1955 approved of such a modification program; a tentative schedule was drawn up calling for 12 EC-121's at a time to undergo first-phase modifications entailing some 160 changes,²⁰ between late 1956 and mid-1957.

Operations, 1956-1959. During the next four years, the AEW picture brightened in some respects, but darkened in others. Wanted improvements were sometimes accepted, and other times rejected. By the first of 1956, as noted, the path AEW was to take for years ahead had been clearly charted and, in part, firmly implemented. Two bases, McClellan and Otis, were refurbished or in process of refurbishment to support the AEW mission: AEW units up and down the line were organizing and becoming fully peopled; AEW aircraft, except for 1956 deliveries, were on hand; training programs were tangibly in force; and limited operations, after a fashion, had commenced. Progress characterizing AEW development was manifestly in evidence, inching ever nearer to a fully operational status.

20. ADC Hist Study 10, pp. 43-50: Hist of ADC, Jan-Jun 1955, pp. 28-32; Hist of ADC, Jul-Dec 1955, pp. 60-67; Hist of EADF, Jan-Jun 1955, pp. 64-65; Hist of WADF, Jul-Dec 1954, pp. 143-49.

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Personnel build-up, designed to round out approved AEW manning tables, proceeded fairly much as planned. Both wings, by late 1956, possessed nearly 85 per cent of the AFSC 1324C pilots and co-pilots authorized (50 per squadron; 300 total for the six squadrons). The observer-navigator specialty (AFSC 1534A) was overflowing: 233 poured in to fill 150 slots (25 per squadron) authorized. Radar maintenance technicians and radio operators were similarly plentiful, with 325, in the former instance, assigned to fill 300 spaces, and 266, in the latter, to fill 150 spaces. With regard to the radar maintenance technicians, however, there existed a painful shortage of seven-level supervisors, which rigorous training programs and experience eventually would soothe. ECM-operator, flight-engineer, and radar-operator fields, while somewhat less in number than the total prescribed, were not seriously undermanned. Worst of all, with respect to personnel manning, was the weapons controller field, which characteristically suffered from acute shortages throughout the command. So drastic, to be sure, was the controller shortage at ground ACW units, that both AEW wings, in February 1956, were milked of all but 25 of their controllers, to shore up a sagging pipeline ordinarily feeding the ground radar network. Of 444 such

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spaces authorized for AEW operations, only 49 -- equivalent²¹
to 11 per cent -- were on hand by the end of 1956.

Aircraft deliveries, like the personnel build-up, had kept close pace with revised production schedules. By the end of 1956, the last of 81 EC-121's arrived from the Lockheed assembly line. Discounting one EC-121 lost February 1954 in an accident, the EC-121 fleet tallied at 80, 71 of which were of the EC-121D variety outfitted with 600-gallon wing-tip tanks, and nine of which were of the EC-121C type without them. Simultaneously, base improvement projects at both McClellan and Otis were completed, or nearing completion, to further facilitate AEW operations. Costs for each of the six AEW squadrons came near \$50,000,000 as the initial outlay (exclusive of airplanes), for spare parts, tools, equipment and facilities peculiar to the AEW mission. Thereafter costs ran about \$12,000,000 annually for operating expenses.

Having been assigned most all its aircraft and personnel (now swelled to about 2,500 officer and airmen

21. ADC, Air Defense Command Summary, Dec 1956, pp. 3-0.20, 3-3.00 and Jan 1957, p. 2-6.30 [HRF]; Hist of WADF, Jul-Dec 1956, p. 82; Ltr, 8 AD to ADC, 3 Oct 1956 [Doc 22 in Hist of ADC, Jul-Dec 1956]; Hist of ADC, Jul-Dec 1956, pp. 31-32, 40; IOP, ADC, O&T to M&O, "Operationally Ready Dates," 16 May 1956 [Doc 208 in Hist of ADC, Jan-Jun 1956]; Hist of EADF, Jul-Dec 1956, p. 54.

spaces per wing), each AEW wing was enabled by late 1956 to patrol full-time three of its assigned off-shore AEW stations, and a fourth part-time, as envisioned by mission requirements. Consequently, the two AEW wings achieved an operational readiness status in October 1956 -- two months ahead of schedule for the 552nd Wing, and right on schedule for the 551st Wing. EC-121's on patrol pursued an oval racetrack pattern 100 miles long, 50 miles on either side of their designated stations. The flights were coordinated so that EC-121's on station maintained approximately the same relative distance between each other.²²

Next to be decided was the fate of the 8th Air Division, which had been created 1 May 1954 expressly to oversee completion of these two AEW wings. Ostensibly, the mission for which the 8th Air Division had been proposed was ended when the 551st and 552nd Wings became operationally ready. Accordingly, the 8th Air Division was supposed to be inactivated, according to original plans, and the two AEW wings reassigned to EADF and WADF.

22. ADC Hist Study 10, pp. 23-24; Hist of ADC, Jul-Dec 1956, p. 34; ADC, "Weapons and Surveillance Cost Factors," 1 Jul 1956, p. 26 [HRF].

But the complexities of two years of AEW activities altered ADC's perspective on this matter. Both Brigadier General Kenneth H. Gibson, 8th Air Division Commander, and General Earle E. Partridge, ADC/CONAD Commander, asked that the 8th Air Division's lifetime be perpetuated. As General Partridge phrased it, "the AEW&Con program has been found to be so different from other air defense operations that it does not lend itself to ready adoption by and as a part of the air defense forces as originally visualized." Nothing less than indefinite retention of²³ the 8th Air Division would do.

For a time, USAF appeared to agree. Words to this effect, in fact, filtered down from USAF headquarters. Then in February 1957, about five months after the 551st and 552nd AEW Wings were pronounced operationally ready, the 8th Air Division's uncertain future was unequivocally foretold: USAF directed its inactivation in four months. Accordingly, effective 1 July 1957, the 8th Air Division

23. Ltr, ADC to USAF, "Airborne Early Warning and Control (AEW&Con) Organization," 22 Jun 1956 [Doc 130 in Hist of ADC, Jan-Jun 1956]; Msg ADOOT-C 00800, ADC to 8 AD, 13 Apr 1956 [Doc 133 in Hist of ADC, Jan-Jun 1956]; Ltr, 8 AD to ADC, 4 Jan 1957 [Doc 108 in Hist of ADC, Jan-Jun 1957]; Hist of ADC, Jan-Jun 1956, pp. 34-35; Hist of ADC, Jul-Dec 1956, pp. 32-33.

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withdrew from the air defense scene. The 551st Wing (Otis) was reassigned to Eastern Air Defense Force (EADF); the 552nd Wing (McClellan), to Western Air Defense Force (WADF). The number of AEW personnel spaces, per wing, was correspondingly hiked to 2604 (527 officers and 2059 airmen) to compensate for increased responsibilities devolving from the defunct 8th Air Division.²⁴

Remaining yet unsolved was the matter of how best to perfect AEW operations, considered first in terms of improving the existing AEW airplane, the EC-121, recently discredited by evaluation tests. Four months before the AEW effort officially went operational, the EC-121 fleet, about a dozen aircraft at a time, commenced the modification program planned the previous year. Starting 9 July 1956, and continuing several years, the modification program, accomplished at the Lockheed Aircraft Service (Ontario, California), ameliorated many of the defects originally found wrong with the EC-121. The list of improvements waxed large, particularly for the first-phase period, involving ECP's (Engineering Change Proposals) ranging from

24. Hist of ADC, Jan-Jun 1957, pp. 81-82; Hist of ADC, Jan-Jun 1956, pp. 34-35; ADC Summary, Sep 1957, p. 3-0.00 [HRF].

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toilet, air-conditioning and lighting improvements to galley repairs. Over a dozen discrete ECP's dealt with radar changes; alterations to navigation facilities numbered 18 separate ECP packages. Airborne radio teletype (RATT), among other communications changes, was to be installed. No less than 78 ECP's were marshalled to combat airframe and engine deficiencies. Items of importance missed in the first go-around of modifications were reserved for the second-phase, following close on its heels in late 1957. This second, and final phase was not concluded until 1959.²⁵

While EC-121's were thus treated to the modification program, ADC still remained dissatisfied with them, and for good reason. Notwithstanding their programmed improvements, the EC-121's persistently fell short of expectations, lacking the altitude and endurance capabilities ADC most prized. The modification program, to be sure, was something less than an aircraft renovation; it was designed more as a patch up program to heal aircraft ailing on arrival from the factory. APS-20 search set changes, many as these

25. Ltr and Incl, ADC to AMC, "RC-121 Modification Program," 25 Nov 1955 [Doc 138 in Hist of ADC, Jul-Dec 1955]; Msg ADCMA 2198, ADC to USAF, IAF-V14 Report as of 1200 hrs, 26 Jan 1959, 29 Jan 1959 [HRF]; Hist of ADC, Jul-Dec 1956, pp. 34-35; Hist of ADC, Jan-Jun 1956, pp. 35-36; Hist of WADF, Jan0Jun 1958, pp. 20-21; Hist of WADF, Jul-Dec 1958, p. 21.

were -- reconfiguring it from the "B" to the APS-20 "E" version -- promised to enhance detection and tracking reliability no more than to 70 per cent effectiveness, at best. And 70 per cent, obviously, was still not good enough for an early warning system aiming to achieve near infallibility. True, the two EC-121 wings, when first operational, managed in late 1956 to detect about 85 per cent of all air traffic. Similarly, tests conducted in September 1956 resulted in 83 per cent detection of some 560 known movements. While higher, ostensibly, than the 70 per cent effectiveness prediction, these 83 and 85 per cent figures were deceptive. The air traffic alluded to was commercial air transport flying at intermediate altitudes, for whom flight plans were customarily filed long in advance, detailing courses, altitudes and time sequences for ADIZ penetrations. So such information would be on hand to facilitate enemy bomber detection. Besides, hostile bombers, most likely, would approach from either extremely low or extremely high altitudes, either one of which compounded detection and tracking problems. Later, the 70 per cent effectiveness prediction came true even for conventional air traffic, as reflected in the experience of the 552nd

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Wing during the first six months of 1958, when exactly 70 per cent of all known flights were actually detected and tracked.

For one thing, the nemesis of sea clutter persistently plagued APS-20E reception. Radar tracks of ordinary targets approaching within 60 to 90 miles radius of the EC-121 quite often were swallowed up in sea clutter registering vividly on PPI scopes, particularly when seas were rough. Still worse was the low-flying target, for which the EC-121 was particularly on alert, and which seldom was sighted by the APS-20E until about 100 miles away, only to become brushed aside by sea clutter in a matter of seconds. Effective control for vectoring ADC interceptors to targets within 60 to 90 miles range of the EC-121 was virtually barred by this sea clutter problem; for which reason, combined with APS-45 height finder problems (discussed below) and the command-wide scarcity of qualified controllers, the interceptor control function was suspended a good part of the time.

26. Majors L.J. Bonanno and T. Hennessey, "Seaward Extension Deployment - East," C&E Digest, Vol IX, No. 11 (Nov 1959), pp. 37-38; 1st Ind, 8 AD to ADC, 11 May 1956 to Ltr, ADC to 8 AD, "Operationally Ready Dates," 1 May 1956 [Doc 128 in Hist of ADC, Jan-Jun 1956]; Hist of ADC, Jul-Dec 1956, p. 32; Ltr, WADF to ADC, "Change of AEW&C Mission," 19 Nov 1957 [Doc 130 in Hist of ADC, 1958]; Msg WDOTN-A85-8040.

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Other factors, apart from APS-20E limitations, affected EC-121 performance detrimentally. Nearly as bad was APS-45 height finder performance. Weather, too, took a hand in fouling AEW operations. As regards the APS-45 height finder, its range was initially not much farther -- about 80 miles -- than normal APS-20E sea clutter extended, where control of interceptors could not be depended on anyway. The APS-45, moreover, operated on a frequency band that often interrupted or impaired APS-20 reception, hindering EC-121 surveillance that much more. The APS-45, furthermore, was known to be as much as 7,000 feet off in target height measurement. It was a difficult piece of equipment to maintain, besides. The 552nd Wing, for instance, complained bitterly of how the APS-45 suffered chronically high in rate of component breakdown, how certain sub-assemblies were inaccessible for accomplishing in-flight maintenance, and how AEW operations and maintenance personnel, in effect, had probably grown apathetic to the APS-45,

[Cont'd] WADF to ADC, 31 Oct 1958 [Doc 129 in Hist of ADC, 1958]; Msg WDOTE 858970, WADF to ADC, 10 Oct 1958 [Doc 128 in Hist of ADC, 1958]; Hist of EADF, Jul-Dec 1956, pp. 66-67; Hist of WADF, Jul-Dec 1958, p. 20; Hist of WADF, Jan-Jun 1956, p. 115; Hist of WADF, Jul-Dec 1956, p. 83; Hist of WADF, Jan-Jun 1958, p. 22.

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due, no doubt, to their loss of confidence in its performance and maintainability. By 1958, certain APS-45 "fixes" were developed, application of which promised to correct some of its faults.²⁷

Weather, as mentioned above, contributed its share to hampering AEW operations. Both wings were beset by adverse weather conditions from time to time. The 551st Wing (Otis), especially, was pestered by storms and foul weather over the Atlantic -- so much so, in fact, that the 8th Air Division headquarters, before passing out of existence, sought to equip Kindley AFB, Bermuda with AEW turnaround facilities for use as a staging area, because of the frequency with which EC-121's were forced, by weather conditions, to divert there. Still another plan hatched by 8th Air Division headquarters due to the weather situation involved the procurement of a mobile maintenance facility, composed of six C-121C transports -- three for either wing -- equipped for flying supplies and technicians wherever bad weather might force mission EC-121's to alight. While ADC endorsed this

27. Msg WDOTS 8S 8970, WADF to ADC, 10 Oct 1958 [Doc 128 in Hist of ADC, 1958]; Msg WDOTN-A 8S 8040, WADF to ADC, 31 Oct 1958 [Doc 129 in Hist of ADC, 1958]; Ltr, WADF to ADC, "Change of AEW&C Mission," 19 Nov 1957 [Doc 130 in Hist of ADC, 1958]; Hist of WADF, Jul-Dec 1959, p. 27.

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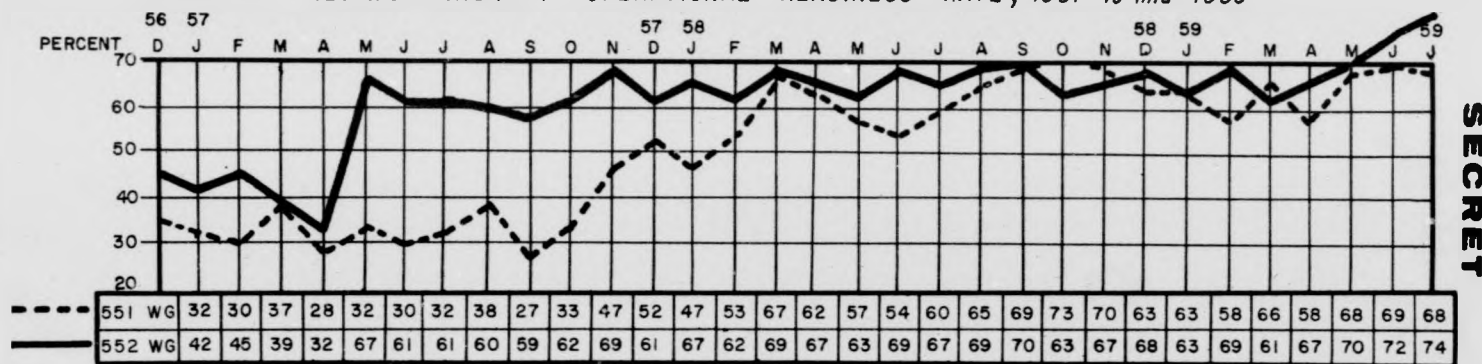
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latter proposal, and viewed favorably a compromise plan of the Kindley proposal, USAF, though sympathetic, was unable to comply with the Kindley plan because of fund limitations.

Despite the weather handicap, despite APS-20E shortcomings, despite a number of other piddling harrassments, the two AEW wings, over the years, managed to log a respectable amount of on-station time compared with that expected. The EC-121 operational readiness (OR) rate, fitting hand-ir-²⁸ glove with time on-station capability, improved steadily from 1956 to 1959 (see Chart A), as a result of the modification program, of improved supply, of increasing maintenance experience by ground crews, and of OJT combined with other formal training programs effected for both ground and air crews. Averaging at first about 40 per cent OR rate of possessed EC-121's during the first year of operation, ground maintenance and servicing crews, by 1959, built up to the 70 per cent OR level sought by ADC. A

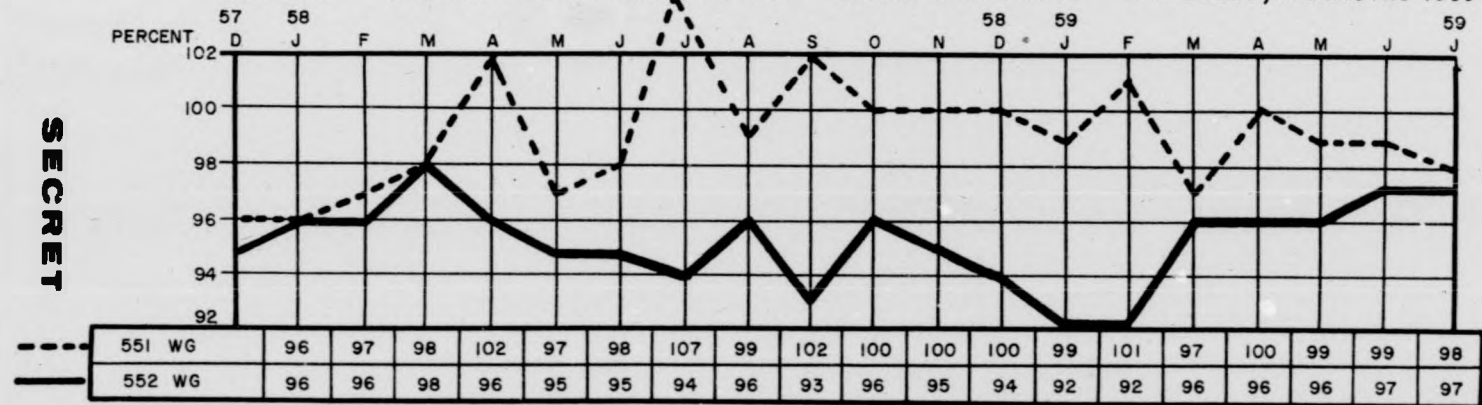
28. Ltr and Inds, 8 AD to ADC, "Request for C-121C Aircraft," 7 Sep 1956 [Doc 31 in Hist of ADC, Jul-Dec 1956]; Ltr and Ind, 8 AD to ADC, "AEW&C Support Facilities at Kindley AFB," 6 Feb 1957 [Docs 103, 104 in Hist of ADC, Jan-Jun 1957]; Hist of ADC, Jul-Dec 1956, pp. 39-40; Hist of ADC, Jan-Jun 1957, pp. 77-78; Patrolling three stations full-time, a fourth part-time, off each coast, was predicated on a factor of 9.7 EC-121's per station, for which a conspicuously high OR rate was needed. ADC, Command Summaries, 1956, 1957, 1958, 1959 [HRF]; Hist of ADC, Jul-Dec 1956, p. 34.

CHART "A" - AEW&C AIRCRAFT OPERATIONAL READINESS RATE, 1957 to mid 1959



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CHART "B" - PERCENT SCHEDULED AEW&C HOURS EFFECTIVELY PATROLLED, 1958 to mid 1959



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unique maintenance problem cropping up in 1958, caused by failing propellers that occasioned engines to rip off at least two EC-121's during flight, was soon put to rest in early 1959, when improved replacement propellers were manufactured and installed. Scheduled on-station hours effectively patrolled (i.e., without APS-20E equipment malfunctioning), which in large measure was predetermined by OR rates, seldom, if ever, dipped below 92 per cent effectiveness level (see Chart B), averaging, from 1958 to mid-1959, about 97 per cent.

Keeping operational EC-121's on station was one thing; perfecting them to detect unannounced massed bomber attacks, proved quite another. Insuring sustained patrols did not correspondingly assure APS-20E and APS-45 efficacy, as noted above. This was dramatically pointed up in an Operational Readiness Inspection (ORI) of the 552nd Wing conducted in September 1958. Fourteen flights of target aircraft, numbering three to six "fakers" per flight, "attacked" the West Coast where a string of EC-121's (positioned an average of 275 miles off-shore) waited to spot them. A good part of the time, APS-45 height finder information, because of the usual outages, was unavailable. The sea clutter problem persisted obscuring APS-20E reception. Half

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of the flights -- 7 out of 14 -- escaped detection. As regards the other half detected, tracking was often times erratic. While the AEW intercept control function was not tested, the inspectors surmised that any such effort would have proved futile, anyway. The 552nd Wing, for various reasons -- not the least of which was poor APS-20E reception joined by practically no APS-45 capability -- was declared unable to accomplish its assigned mission.

By and large, these results boiled down to the question of how to sound an alarm on attacking bombers that, in too many cases, were slipping past, unnoticed by the very electronics equipment installed to "see" them. This and like questions had haunted ADC planners from the time of the EC-121's inception.²⁹

ADC found two solutions. The first was simply to buy a better airplane rigged with improved equipment. The second was to substitute an improved search radar for the clutter-afflicted APS-20E. The first solution ADC regarded as manifestly most important. The EC-121, in ADC's view, was not the all-weather surveillance platform best adapted

29. Msg AFCDI-C-079, USAF to ADC, 24 Sep 1958 [Doc 127 in Hist of ADC, 1958]; Hist of WADF, Jan-Jun 1959, pp. 25, 29; Hist of WADF, Jul-Dec 1958, p. 19.

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to reckon with the manned bomber threat. Ever since the 1955 evaluation test reports disparaged the EC-121, ADC thought in terms of procuring a new model. ADC, moreover, foresaw a time in the 1960's when the EC-121, from sheer fatigue, would wear out, for which reason alone replacements of an improved variety were needed.

Scarcely had the ink dried on the EC-121 evaluation report when General Operational Requirement (GOR) 97, dated 10 June 1955, was drafted, calling for a follow-on AEW aircraft. The new airplane, according to the GOR specifications, should accommodate two shifts of personnel, totalling about 30 persons: it should cruise between 20,000 and 30,000 feet; and most important, it should be endowed with a capacity to fly from 20 to 24 hours uninterrupted, preferably without requiring in-flight refueling.

Cognizant of the time lag, stretching often into years, from airplane contract time to delivery time, ADC started immediately to shop around for possible follow-on models. Several types came under scrutiny: Douglas models C-133 and DC-7, the Boeing KC-135, the Convair B-36, and Lockheed models CL-344-2 and CL-410 were all studied with a view to adapting them to AEW operations.

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Whereas USAF, in times past, had been cooperative regarding most AEW matters, this time it turned a deaf ear to ADC's pleas. Over and over ADC hammered on the theme of how badly it needed a follow-on AEW aircraft by the early 1960's. So unequivocally important was it, in ADC's mind, that it deserved first-priority treatment for the nation's air defenses. Lieutenant General Joseph H. Atkinson, the ADC Commander, said as much in February 1958 and again in May of that year; Lieutenant General Roy H. Lynn, then ADC Vice Commander, said so in June and again in July of 1958. Still USAF would not budge. USAF could not bring itself to authorize the funds this entailed, to the tune of \$5,000,000 to \$8,000,000 per airplane, depending on the kind and the number procured. Altogether, USAF stood to pay all of one billion dollars to buy a follow-on AEW aircraft fleet -- a prospect that USAF did not relish.

ADC reminded USAF of the EC-121's inefficiency, and of the fact, long known, that of all U.S. targets most attractive to attacking forces (SAC bases especially), 60 per cent were within easy striking distance of the two coasts. "Until an advanced AEW&C is available," said General Atkinson, "SAC and the populace cannot rely on more than

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chance warning of an enemy force approaching via coastal areas." Lockheed's CL-410 model was described as the possible panacea -- the better to brace the country for bomber attacks -- offering early warning to SAC bases for as much as one and one-half hours against sub-sonic, and 40 minutes against Mach 2 enemy bombers. Without a suitable follow-on aircraft, ADC maintained, it would be foolhardy to expand to the 13 squadron AEW strength approved by USAF.

While this and other arguments were considered by USAF, none was sufficiently telling to change USAF's mind. USAF, indeed, needled ADC, in a sense, by suggesting the unthinkable: that ADC study the possibility of handing the entire AEW mission over to the Navy. Already a fleet of Navy blimps was being readied for patrolling each of the two southernmost AEW stations off either coast, reduced subsequently to only the one AEW station off the Atlantic coast (and eventually dropped altogether). While ADC welcomed this kind of Navy help, it was, for good reasons, properly appalled at the notion of presenting the Navy with a gift of the whole AEW operation, EC-121 airplanes and all.

ADC quickly convinced USAF not to tamper with the existing AEW organization, since it must remain in ADC's hands for vectoring fighter and BOMARC interceptions off-shore.

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But whether it liked it or not, ADC had to bow to USAF's dictum that no follow-on AEW aircraft was coming, the final word to this effect being said on 16 July 1959. The AEW expansion program from 6 to 13 squadrons, as described previously, was accordingly written off as an academic exercise.
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30. ADC, Command Summaries, 1959 [HRF]; Hist of ADC, Jul-Dec 1956, pp. 32-34; Ltr, ADC to USAF, 6 Jul 1956 [Doc 131 in Hist of ADC, Jan-Jun 1956]; Msg ADOOT-C 00800, ADC to 8 AD, 13 Apr 1956 [Doc 133 in Hist of ADC, Jan-Jun 1956]; Ltr, 8 AD to ADC, 4 Jan 1957 [Doc 108 in Hist of ADC, Jan-Jun 1957]; Ltr, ADC to 8 AD, 14 Feb 1957 [Doc 108 in Hist of ADC, Jan-Jun 1957]; Ltr, ADC to CONAD, "Navy AEW&Con Activities," 22 May 1957 [Doc 109 in Hist of ADC, Jan-Jun 1957]; Ltr, ADC to USAF, 5 Feb 1958 [Doc 133 in Hist of ADC, 1958]; Ltr, ADC to USAF, 1 Jul 1958 [Doc 135 in Hist of ADC, 1958]; Msg ADLAN-S-163, ADC to USAF, 14 Apr 1958 [Doc 139 in Hist of ADC, 1958]; Msg ADCMA 2067, ADC to USAF, 28 Mar 1958 [Doc 140 in Hist of ADC, 1958]; Ltr, ADC to USAF, 18 Jul 1958 [Doc 141 in Hist of ADC, 1958]; Ltr, ADC to USAF, 1 Jul 1958 [Doc 142 in Hist of ADC, 1958]; Ltr, ADC to USAF, "FY 59 Finding," 6 May 1958 [Doc 142A in Hist of ADC, 1958]; Ltr, USAF to ADC, 29 May 1958 [Doc 143 in Hist of ADC, 1958]; Ltr, ADC to USAF, "FY 59 AEW&Con Funding," 20 Jun 1958 [Doc 145 in Hist of ADC, 1958]; Msg ADLSI-E 0393, ADC to USAF, 27 Jun 1958 [Doc 146 in Hist of ADC, 1958]; Msg ADLAN-G-S 227, ADC to USAF, 12 Aug 1958 [Doc 154 in Hist of ADC, 1958]; Ltr, ADC to NORAD, "USAF AEW&C Program," 4 Aug 1958 [Doc 155 in Hist of ADC, 1958]; Msg AFXPD-PY 53949, USAF to ADC, 31 Jul 1958 [Doc 153 in Hist of ADC, 1958]; Msg AFDRQ 50086, USAF to ADC, et.al, 24 Oct 1958 [Doc 156 in Hist of ADC, 1958]; Ltr, ADC to USAF, "Comments Relative to WADC System Development Plan 214L," 20 Dec 1956 [Doc 28 in Hist of ADC, Jul-Dec 1956]; Hist of ADC, Jan-Jun 1957, p. 75; Hist of ADC, 1958, pp. 112-26; USAF GOR 97, "General Operational Requirement for a Continental Airborne Early and Control Support System," 10 Jun 1955 [DOC 3]; ADC, Memo f/Comdr, "Comparison of AEW&C Proposals,"

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More rewarding by far was USAF's response to ADC's proposal that good new radars be exchanged for bad. Just such a radar had, in fact, become available by 1956: the UHF APS-70 search radar developed by MIT's Lincoln Laboratory. Tests of the APS-70 revealed the new search set as vastly superior to the old APS-20E in service. The UHF band AMTI associated with the 425 megacycle APS-70 radar, unlike the S-band AMTI connected with the APS-20E, enabled detection and surveillance functions to be carried out considerably less bothered by the vexing sea clutter problem. The APS-70, too, was practically free of influence by bad weather, and could readily be adapted for operations with SAGE. Essentially, it would serve, in conjunction with other equipment, for maintaining effective control of CIM-10B long-range BOMARC missiles. It presented large, easily discernible "blips" on the scopes. For once, continuity of target skin-painting could be relied on from the extreme outer limits of radar range to the very vicinity of the EC-121, and on. While the APS-70 contained no height finder capability, as such, it did enhance the EC-121's capacity for simultaneously

[Cont'd] n.d., ca. Aug 1958 [DOC 4]; Ltr, USAF to ADC, 14 Apr 1959 [DOC 5]; Ltr, ADC to CINCNORAD, "Off-Shore Surveillance and Weapons Control," 4 Aug 1959 [DOC 6]; Hist of ADC, Jan-Jun 1959, pp. 43-51.

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detecting high and low-altitude targets. Early estimates foresaw costs amounting to \$96,000 per EC-121, or \$7,680,000 for the entire EC-121 fleet, for an APS-70 retrofit program. In view of the improved AEW situation anticipated, ADC considered it well worth the expense, as well as the sacrifice of removing from service several EC-121's at a time to undergo a retrofit program. In December 1956, and again in April 1957, ADC asked USAF to authorize just such a retrofit program, to start in late 1957.

While USAF first dragged its feet over the issue, mostly because of sticky funding problems, it was, after a year of haggling, at last convinced by ADC's arguments. AEW operations must be dramatically upgraded, if not by a new follow-on AEW airplane, then by substitution of a surveillance radar worthy of the name. In March 1958, USAF approved installation of an improved version of the APS-70, redesignated the APS-95. This newer model incorporated the TACCAR AMTI feature (Time Averaged Clutter Coherent Airborne Radar with Airborne Moving Target Indicator) to reduce even further any trace of sea clutter. Consequently, EC-121's, if need be, could fly at twice the 8,000-foot altitudes theretofore restricted to for purposes of keeping APS-20E sea clutter at a minimum. Not only would the EC-121 "see"

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clearer and farther, but also higher. Once APS-95 radars were installed, the EC-121, flying at 10,000 to 15,000-foot altitudes, was expected to detect incoming targets from sea level to 80,000 feet, for as far as 247 nautical miles on large-sized targets, practically doubling the surveillance spectrum of its previous coverage.

Something else doubled besides -- the cost of the modification program. Instead of \$7,680,000 as originally supposed, costs were to amount to \$15,000,000, at least, divided for funding purposes between Fiscal Years 1959 and 1960. Costs could climb to \$21,000,000, according to later estimates. But this was still relatively cheap compared with the one billion dollars that a fresh, new AEW fleet would cost.

Also under consideration for further EC-121 improvement, but not wholly determined at this time, was installation of two other packages: the Airborne Long Range Input system (ALRI) for automating target detection and interception functions; and certain electronic counter-countermeasure "fixes" (ECCM) to help combat electronic countermeasures (ECM) generated by hostile bombers to evade detection -- both explained in greater detail below.

31. Msg ADOOT-C 1078, ADC to 8 AD, 21 May 1956 [Doc 129

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Long before the two AEW wings were forced to swallow the disconcerting fact that no follow-on airplane was in the offing, they ventured to better conditions in other ways. One of the more successful attempts, in this vein, involved realigning AEW stations off-shore. Rather than position EC-121's about 200 miles from shore (between the string of picket vessels and the coastline) both the 552nd and the 551st independently tried placing them beyond the picket chain, about 450 miles from shore, to constitute

[Cont'd] in Hist of ADC, Jan-Jun 1956]; IOC, DCS to Vice Cmdr, "Procurement of APS-70 (UHF Radar)," 8 May 1956 [Doc 129 in Hist of ADC, Jan-Jun 1956]; Ltr, ADC to USAF, "Comments Relative to WADC System Development Plan 214L," 20 Dec 1956 [Doc 28 in Hist of ADC, Jul-Dec 1956]; Ltr, ADC to AMC, "Proposal for Class V Modification of AEW&C Aircraft," 20 Dec 1956 [Doc 29 in Hist of ADC, Jul-Dec 1956]; Ltr, ADC to USAF, 7 Feb 1957 [Doc 106 in Hist of ADC, Jan-Jun 1957]; Msg WDOTN-A888040, WADF to ADC, 31 Oct 1958 [Doc 129 in Hist of ADC, 1958]; Ltr, NORAD to USAF, "Increased Airborne Early Warning Capability," 23 Dec 1957 [Doc 131 in Hist of ADC, 1958]; Ltr, ADC to USAF, 29 Apr 1957 [Doc 132 in Hist of ADC, 1958]; Ltr, ADC to USAF, 5 Feb 1958 [Doc 133 in Hist of ADC, 1958]; Ltr, USAF to ADC, "FY 59 AEW&C Funding," 18 Jul 1958 [Doc 147 in Hist of ADC, 1958]; Hist of ADC, Jan-Jun 1957, p. 78; Hist of ADC, 1958, pp. 108-12; Hist of WADF, Jul-Dec 1959, pp. 27-28; Hist of WADF, Jan-Jun 1959, p. 27; Hist of WADF, Jan-Jun 1956, p. 115; ADC, C&E Digest, Vol IX, No. 11 (Nov 1959), pp. 37-38; Msg EAMAC-5A 220, EADF to ADC, 30 Jan 1959 [Doc 11 in Hist of ADC, Jul-Dec 1959]; Hist of ADC, Jul-Dec 1959, p. 33; Ltr, ADC to USAF, 19 Jun 1957 [DOC 7]; Schedule, SMAMA, "APS-95 Retrofit Plan RC-121D (Mod 880)," 20 Feb 1959 [DOC 8].

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the first line of surveillance. The advantage gained was in the promise of farther and better low-to-medium-level off-shore radar coverage, with consequent earlier "early warning." In September 1956, the 552nd AEW Wing experimented along these lines, as did the 551st some few months later. Just such a test proved so successful in January 1958, during an ORI of the 28th Air Division, that the 28th Air Division commander was informed of "attacking fakers" 500 to 700 miles before reaching the coast. EADF and WADF enthusiastically endorsed, then forwarded, for ADC's and NORAD's approval, proposals calling for permanent AEW station deployment outboard of the picket detachments.

At first, ADC and NORAD were reluctant to grant this authority. Already, it was hard enough to induce interceptor pilots to fly the regular 200 miles or so from shore so that EC-121's on station could practice interceptor controlling. Making them fly out more than twice as far, where interceptors would be nearing the extent of their combat radius, would even be harder, thereby worsening matters respecting weapons control training. But as a matter of fact, if not theory, interceptor control in the 1958-59 period had been relinquished anyway, mostly because of the sea clutter problem afflicting the APS-20F, combined

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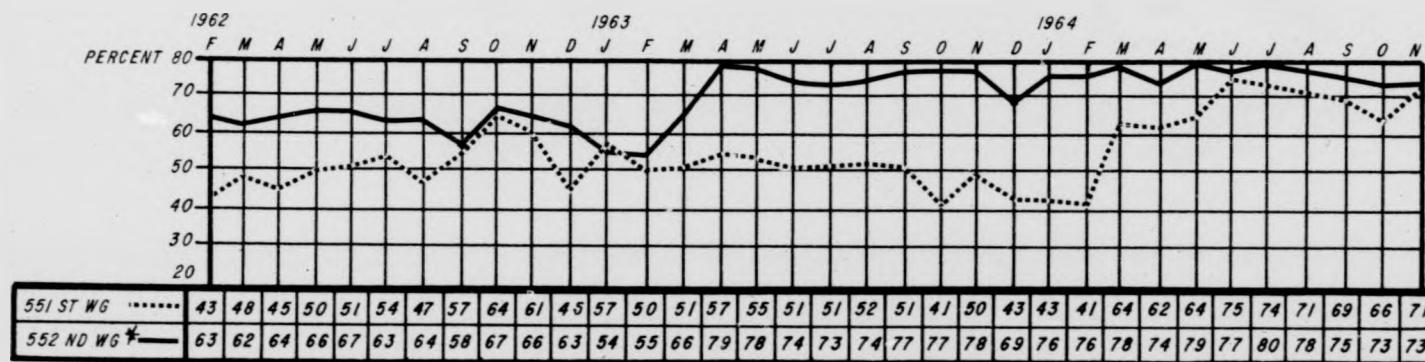
with APS-45 shortcomings, as discussed above. So, on the strength that early warning surveillance would be extended, though control, as a certainty, would be sacrificed, CINCNORAD, on 8 September 1958, authorized WADF and EADF commanders to deploy EC-121's as they saw fit to meet tactical requirements. In 1959, therefore, WADF and EADF began manning AEW stations outbound of the picket chain, with WADF managing to patrol four stations full-time, and EADF, its usual three and one-third.

Prospects for the Sixties. By the start of the decade, expectations for improvement of the AEW fleet were firmly polarized around internal changes to the same old, but mechanically reliable, EC-121 airframe. Having little more than seventy airplanes, the EC-121 fleet was not left

32. Hist of WADF, Jul-Dec 1956, pp. 86-88; Jul-Dec 1957, p. 12; Jan-Jun 1958, pp. 22-24; Jul-Dec 1958, p. 18; Jan-Jun 1959, p. 27; Jul-Dec 1959, pp. 26-30; Hist of EADF, Jul-Dec 1956, pp. 64-65; Jan-Jun 1958, pp. 45-46; and 1959, pp. 102-06; Msg WDOTN 8S8970, WADF to ADC, 10 Oct 1958 [Doc 128 in Hist of ADC, 1958]; Msg ADOOP-EM 603, ADC to WADF and EADF, 26 Nov 1958 [DOC 9]; Msg WDOTN-A 8S9175, WADF to 552 AEW&C Wg, 5 Dec 1958 [DOC 10]; Msg ADPPA-O 1856, ADC to USAF, 15 Apr 1959 [DOC 11]; ADC, ADLSI-E, Weekly Activities Report, 27 Aug 1958 [HRF].

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CHART "C"—AEW&C AIRCRAFT OPERATIONAL READINESS RATE, 1962 to NOV. 1964



* INCLUDING THE 966 TH SQUADRON AFTER JULY 1963

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much room for attrition losses. Fortunately, the fleet had weathered four to six years without wearing thin from the aging ordeal. Of the original 81 airplanes, practically all 71 of the "D" variety (having wing-tip gas tanks for greater range) were still in service by 1960. For a variety of reasons, not the least of which was expert and timely maintenance -- including the Periodic Aircraft Reconditioning Cycle [PARC] lasting two to six weeks, depending on amount of work done -- attrition was kept surprisingly low considering time spent in the air. To be sure, EC-121 attrition figured about one airplane for every 100,000 hours of flight time accomplished, earning a reputation for being one of the safest airplanes in ADC's inventory, if not the safest. By mid-1961, an EC-121D of the 552nd Wing became first to log 10,000 flying hours -- the equivalent of a full year, one month and two weeks of uninterrupted, round-the-clock flying -- a mountain of flying time by any standards. With continued good maintenance and average good luck, the EC-121 fleet, for planning purposes, promised to last out the remainder of the decade. By the early 1970's, ADC hoped that an Airborne Warning and Control System (AWACS) would become available to replace it. The AWACS system, if ever approved and funded, would employ an aircraft/radar combination capable

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of detecting and tracking nuclear missiles fired by bombers and submarines from hundreds of miles away. Besides coping with an advanced threat posed by air, surface, and subsurface-launched ballistic missiles, while patrolling far out at sea, the AWACS was to be versatile enough to operate over land, for filling in interceptor-control functions where ever ground radar units were put out of action. But as of October 1964, the proposed AWACS substitute had not been approved by higher headquarters. And some doubt existed whether it would ever be approved, in which case, the EC-121 fleet was destined to continue into the early 1970's, for as long as a manned-bomber threat obtained.

Meanwhile, improvements were scheduled, and more were proposed, for the EC-121. Certain improvements, like the APS-95 radar replacement (designated modification 880), had by 1959 been approved and, in part, funded, only to await installation during the 1960-61 time period. Hazeltine Electronics Corporation (Little Neck, New York), to whom this task was entrusted, commenced installation in early 1960. Aircraft of the 552nd Wing were worked on at SMAMA; those belonging to the 551st received the APS-95 retrofit at LASNY (Lockheed Air Service Facility in New York) and SMAMA. Working up to a rate of about eight EC-121's per

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month, the technicians accomplished the program by 1961, but not without coming to grips with new problems.

The six-and-a-half ton APS-95, because of increased power generated (three megawatts in contrast to one-and-seven-tenths megawatts generated by the APS-20), was supposed to enhance surveillance performance dramatically, as noted above. But the newly installed apparatus was first troubled by a flock of defects. Among them were numbered: external arcing of the antenna; "holes" in radar coverage; unsatisfactory target video display on the scope of the APA-56 operator console; faulty performance and limited lifetime of the APS-95 TU-2153 magnetron tube; and as regards future EC-121 systems, incompatibility with components of the Airborne Long Range Input (ALRI) program. A Product Improvement Program (PIP) was thereupon launched, from which certain "fixes" were soon fabricated and applied to correct most of these, and other, defects.

Once most of these problems were ironed out in 1962-63, increased APS-95 efficiency and reliability were patently demonstrated, particularly during specially assigned projects testing the limits of EC-121 surveillance (discussed below). DC-8 sized targets were "sighted" by

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the APS-95 an average of 208 nautical miles away, with
 maximum pickup range extending 250 nautical miles.

Airborne Long Range Input (ALRI) System for the 551st.

AEW operations could not, and indeed, were never intended to function in a vacuum. They comprised an important link in a sizeable chain of closely integrated air defense systems, the total sum of which was responsible for detecting, tracking, intercepting, and when necessary, destroying any and all unknown aerial targets threatening U.S. security.

33. NOFORN EX CANADA, Msg ADOOP-WI 2481, ADC to USAF, RCS: 1AF-V14 Rpt as of 1200 hrs, 31 Aug 1960, 6 Sep 1960 [HRF]; ADC Staff Study, "Minimum Number of Follow-On Aircraft Acceptable," 24 Mar 1959 [Doc 22 in Hist of ADC, Jan-Jun 1959]; Hist of ADC, Jan-Jun 1960, pp. 38-40; Hist of ADC, Jul-Dec 1960, pp. 52-60; Hist of ADC, Jan-Jun 1961, pp. 55-56; NORAD, "Staff Study to Determine the Number, Type and Disposition of Off-Shore Radar Units Required in the 1965 Time Period," 24 Apr 1959 [DOC 12]; Msg ADLPR-P-S 110, ADC to USAF, 2 Nov 1959 [DOC 13]; Hist of ADC, Jul-Dec 1961, pp. 69-78; NOFORN EX CANADA, Msg ADMDC 709, ADC to SMAMA, 13 Mar 1962 [DOC 14]; Air Force Times, 23 Aug 1961; NOFORN, Msg ADCIG 1636, ADC to USAF, 15 Jun 1962 [DOC 15]; Msg ADOAC-EE 1441, ADC to 4754 Rdr Eval Sq, 28 Apr 1964 [DOC 16]; ADC, ADOAC, Weekly Activities Report, 9-15 Feb 1962 [HRF]; Hist of ADC, Jan-Jun 1963, pp. 18-23; Hist of ADC, Jul-Dec 1963, pp. 18-23; Msg ADLDC 89, ADC to USAF, 16 Jan 1961 [DOC 17]; QOR, ADC to USAF, "Qualitative Operational Requirement for an Airborne Surveillance and Control System (QOR ASACS)," 19 Oct 1962 [DOC 18]; Msg AD4PL-2-79-E, ADC Cmd Cont Def Sys to ADC, 7 Feb 1963 [DOC 19]; Msg AFSMECA 75888, USAF to AFLC, 3 Jul 1963 [DOC 20]; Msg ADCCS 5707, ADC to USAF, 22 Nov 1963 [DOC 21]; Msg ADLPC 422, ADC to USAF, 6 Feb 1963 [DOC 22]; Msg ADCCS 2482, ADC to 26 and 28 AD, 6 Aug 1964 [DOC 23].

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Owing to its unique peculiarities and demands, AEW operations enjoyed a small measure of autonomy as regards organizational makeup; but because AEW operations comprised one of a multitude of interconnecting links, it behooved ADC planners to update them in conjunction with modernization of the other component links. Just such a step upwards was incorporation of the ALRI system, which represented a technological advance designed to keep AEW operations abreast of newly evolving systems elsewhere in the air defense structure. So that long-range BOMARCs and long-range interceptors then being phased into ADC might be vectored off shore the full length of their range capacity; so that early warning communications might be automated to accelerate target detection, interception and destruction processes; so that the EC-121 fleet might be adapted to new ground environment systems -- tuned in, so to speak, to the newly evolving SAGE network -- ALRI was desired and recommended.

Like most technological improvements, ALRI contained roots traceable years back in the air defense business. Need for such a system was recognized as early as 1957 if AEW operations were expected to dovetail snugly in the SAGE format of semi-automated air defense, as contemplated for

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the late 1950's and early 1960's. ADC formally requested an ALRI-like system in a Qualitative Operation Requirement (QOR) prepared in September 1958. Feasibility tests, employing prototype equipment, were conducted by MITRE Corporation in late 1958, resulting in the value of an ALRI-type system being thoroughly established. USAF encouraged ADC to submit a Communications and Electronics Implementation Plan (CEIP) in mid-1959, which was approved 28 October 1959, and covered the aspect of adapting certain coastal radar stations to ALRI. This comprised merely the ground package of a system anticipated to cost over 76 million dollars, in toto, to equip the entire EC-121 fleet. On 12 November 1959, Burroughs Corporation was awarded a development engineering contract and designated primary contractor of ALRI. An operational date was set for mid-1961, to coincide with the phasing in of CIM-10B BOMARC sites. Systems testing was to begin January 1961.

The readjustments involved were many. Dehumanizing AEW operations, that is, ridding them of the contagion of human error and (by Cold War standards) human sluggishness, meant substituting machines for people, entailing a host of changes to both EC-121's and the ground-based radar stations

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they reported to. One of the modifications devised was the Time Division Data Line (TDDL) communications -- designed for use inside EC-121's and at pre-selected shore-based ACW units linked to SAGE centers. Aside from TDDL, certain changes to the APS-45 height finder were in the offing to extend range and height, and to improve accuracy, re-shaping it to the APS-103 configuration. New navigation equipments were to be added, as well. The APA-56 scope, never too trustworthy anyway, was to be replaced. Added to these innovations was to be a new data processor machine.

All this and other apparatus combined, once installed, would work wonders. Not only would ALRI hasten the whole air defense process, insofar as AEW was concerned, but it would multiply the accuracy and reliability of electronic reports to shore-based units, and expand the scope of air targets manageable from the ground. In the vernacular of the electronics engineer, "radar data obtained from the APS-95 equipped EC-121 will be quantized, put in digital form by an airborne data processor, and transmitted by means of UHF to...shore." Raw height finder information and IFF data would receive similar treatment, being converted to automatically transmitted signals for assimilation by SAGE computers when so requested at SAGE centers.

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Hence, the entire detection function would become automatized, along with those of interception and command control at SAGE centers, where ALRI-generated target tracks would undergo instant comparison and correlation with existing flight plans on file -- all done automatically by SAGE computers in a fraction of the time required by the manual system. Accordingly, data-link equipped fighter interceptors and BOMARC missiles -- particularly those vectored to intercept low-altitude targets -- would remain under SAGE control when far out of reach of coastal-based radars, with ALRI-outfitted EC-121's serving as relay stations, of a sort.

Everything affecting AEW operations stood to gain, ostensibly. To obtain these advantages, however, one significant sacrifice was occasioned: EC-121's, perforce, would have to patrol stations positioned nearer to shore. Like in days when AEW operations first got underway, EC-121's would fly between shore and the line of picket ships, because employment of UHF data link was predicated on AEW stations about 120 miles from shore, where upwards of 80 per cent line-of-sight communications with prime coastal radar sites would obtain. Off-shore coverage, consequently, would extend from 250 to 350 miles seaward, depending on

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target size, at altitudes ranging from sea level to 80,000 feet. As before, EC-121's would fly a racetrack pattern, varying from 80 to 100 miles in length, around assigned AEW stations. This time, however, they would fly at ³⁴ 15,000 feet altitude.

The original ALRI program called for ten ground stations, five on either coast, with the entire EC-121 fleet becoming ALRI equipped. This, in March 1960, USAF curtailed on grounds of costs involved. USAF directed that one AEW wing alone be rigged with ALRI components, and that coastal stations, correspondingly, be reduced from ten along two coasts to four along one. It had

34. Majors L.J. Bonanno and T. Hennessey, "Seaward Extension Deployment - East," *C&E Digest*, Vol IX, No. 11 (Nov 1959), pp. 39-40; *Hist of WADF*, Jul-Dec 1959, pp. 28-29; NORAD, "Staff Study to Determine the Number, Type and Disposition of Off-Shore Radar Units Required in the 1965 Time Period," 24 Apr 1959 [DOC 12]; ADC Work Paper, "ALRI System Description," n.d., ca. Sep 1959 [DOC 24]; ADC, *Weekly Activities Report*, 3-9 Nov 1959 [HRF]; *Hist of ADC*, Jul-Dec 1959, pp. 36-42, Jan-Jun 1959, pp. 51-58, Jan-Jun 1960, pp. 32-38, 46-48, Jul-Dec 1960, pp. 46-52 and Jan-Jun 1961, pp. 56-62. For an explanation of ALRI modifications involved (AJN-10 navigation system; AYQ-1 data processor; TDDL; ART-40 data link transmitter; and APS-103 height finder), and their respective functions, see article by Col. R.B. Walters, "Airborne Long Range Input or ALRI," *AU Review*, Vol XV, No. 4 (May-Jun 1964), pp. 60-65.

happened before to BOMARC, it had happened to the proposed advanced F-108 interceptor, now it happened to ALRI. Less than half the ALRI package initially sought was to be finally realized.

But even half a loaf was preferably to none. So ADC contented itself to implement ALRI at the 551st Wing for East coast usage, particularly since BOMARC units previously earmarked for the west coast had been cancelled, anyway. All earlier considered ALRI coastal sites were dropped but four on the Atlantic seaboard: P-10 at North Truro AFS, Mass.; P-45 at Montauk AFS, N.Y.; P-56 at Cape Charles AFS, Va.; and M-115 at Fort Fisher AFS, N.C. By the end of 1960, surveys of the four ground sites were accomplished and ALRI equipment installation was underway, with a view to their completion between late 1961 and mid-1962.³⁵

While the ground ALRI program thus appeared well on its way toward fulfillment, the airborne elements ran into all kinds of trouble. The 1960-61 time period saw the ALRI program (to convert the EC-121D to the EC-121H configuration) clogged with management difficulties, funding

35. Hist of ADC. Jan-Jun 1959, pp. 51-58; Jul-Dec 1959, pp. 36-42; Jan-Jun 1960, pp. 32-38, 46-48; Jul-Dec 1960, pp. 46-52; Jan-Jun 1961, pp. 56-62.

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shortages, test problems, and time table slippages, to name some. ALRI came under the executive management of Air Materiel Command's Aeronautical Systems Center (ASC). Wright Air Development Division (WADD) acted as prime development and technical agency for ALRI systems. Air Force Command Control Development Division (AFCCDD) was delegated responsibility for integrating ALRI systems into those of SAGE. Burroughs, as mentioned above, was made prime contractor. With so many chefs cooking the stew, how could there help but be delays and postponements for lack of coordination and cross-fertilization of effort? ADC complained of this time and again, asking that management reforms be enacted to ameliorate these matters, and craving in particular that USAF designate a single manager upon whom responsibility for all facets of the program could be unequivocally fixed. Finally, in 1961, Air Force Systems Command was handed this responsibility, after which, matters involving coordination of effort improved, but not to the degree sought by ADC.

Technical difficulties, too, were rife. Worst of all, the newly-installed APS-95 was found incompatible with the data processor, causing added delays and prolonging the

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whole testing process. All these problems combined, plus others, figuratively blew the original time table to smithereens. Instead of becoming operational on time, as first scheduled for mid-1961, the operational date slipped next to December 1962, then to May 1963, and finally to late 1963.³⁶

The APS-95/ALRI compatibility problem, meanwhile, was tentatively solved so that SAGE/ALRI integration tests began on 1 February 1962 -- about a year late. Once underway, the tests demonstrated that "fixes" fabricated to mend their incompatibility were effective enough for adoption.

During the spring of 1962, the ALRI modification project for 551st aircraft got under way, continuing into 1963 before ending. Compatibility "fixes" were added the same time ALRI equipments were installed. On 1 March 1963, the first airborne ALRI station and associated ground station became operational, followed by a second ALRI station on 9 April. All four ALRI stations were operational

36. Hist of ADC, Jan-Jun 1960, pp. 32-38, 46-48; Jul-Dec 1960, pp. 46-52; Jan-Jun 1961, pp. 56-62; Jul-Dec 1961, pp. 69-78; Msg ADLDC 2663, ADC to USAF, 5 Oct 1962 [DOC 25]; Msg SCSEW 9-10-62, AFSC to USAF, 9 Oct 1962 [DOC 26].

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by September 1963, and four months later, in December 1963, the airborne ALRI modification program was brought to a close. In thus converting from manual to automated operations, the 551st was enabled to save some 400 personnel spaces, reducing from the 2,600-plus personnel force formerly needed to operate manually, to about 2,200 spaces.³⁷

Improvements to the 552nd. That cherished ALRI improvements were directed strictly toward the 551st East Coast Wing did not mean the 552nd West Coast wing went

37. RESTRICTED DATA, USAF, Current Status Reports for Mar 1962, p. 3-20, Jun 1962, p. 3-18, Aug 1962, p. 3-17, Mar 1963, p. 3-18, Apr 1963, p. 3-20, Nov 1963, p. 3-23 [HRF]; ADC, IAF-V14 Reports for 1962-63 [HRF]; NORAD Hist Summary, Jul-Dec 1963, p. 45; Msg ADCMO-G 624, ADC to USAF, 5 Feb 1962 [DOC 27]; NOFORN EX CANADA, Msg ADLSP 2563, ADC to 26 AD, 25 Sep 1962 [DOC 28]; Msg 26LPR 0605-C, 26 AD to ADC, 23 Nov 1962 [DOC 29]; Msg ADOOP-EI 3321, ADC to 26 AD, 30 Nov 1962 [DOC 30]; Msg ADLDC 89, ADC to USAF, 10 Jan 1963, [DOC 31]; Msg 551 LPR-AL 63-14, 551 AEW&C Wg to 26 AD, 30 Jan 1963 [DOC 32]; NOFORN EX CANADA, Msg ADLSP 310, ALC to USAF, 30 Jan 1963 [DOC 33]; NOFORN EX CANADA, Msg ADLSP 407, ADC to USAF, 6 Feb 1963 [DOC 34]; NOFORN EX CANADA, Msg ADLSP 481, ADC to USAF, 13 Feb 1963 [DOC 35]; NOFORN EX CANADA, Msg ADLSP 548, ADC to USAF, 21 Feb 1963 [DOC 36]; Msg 551MME-C 63-31, 551 AEW&C Wg to ADC, 25 Feb 1963 [DOC 37]; Msg NOOP-E X-108, CINCNORAD to JCS, 15 Mar 1963 [DOC 38]; Msg AFXOPN 69053, USAF to ADC, 10 Jun 1963 [DOC 39]; NOFORN EX CANADA, Msg ADOOP-EI 2992, ADC to USAF, 20 Aug 1963 [DOC 40]; Msg 26LPR 6405-262, 26 AD to 26 CONAD Rgn, 5 May 1963 [DOC 41]; Msg ADOOP-EI 2093, ADC to CINCONAD, 24 Jun 1964 [DOC 42]; ADC ADOAC, Weekly Activities Report, 28 Sep-2 Oct 1962 [HRF].

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neglected. All the while the 551st profited from the new ALRI modification program, the 552nd made gains of its own for improving the traditional manual AEW system, from which the 551st, in certain areas, benefited, as well.

As noted above, the APS-95 search set received the Product Improvement Program at both wings to rid it of undesired afflictions. Various things were attempted to improve air-to-ground and air-to-air communications in the 552nd's manual environment, since HF radio voice was prone to outages and garbled transmissions. Beginning in 1959, ADC experimented with a Dualex Tapewriter Communications System, with results so poor that it was removed from further use in 1962. For awhile ADC contemplated use of Single-Sideband (SSB) radio for improving primary communications, but later focused attention on UHF voice communications, instead. With the 552nd's off-shore stations, like those of the 551st, once again drawn inboard of the picket ships, line-of-sight operations with coastal stations resumed, restoring the environment in which UHF voice communications best flourished. Efforts at bettering communications were thereafter concentrated on perfecting UHF voice systems. The latest step in this direction was introduction of two

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50 watt AN/ARC-85 UHF transceivers to replace less powerful AN/ARC-27 models, as part of a comprehensive EC-121D modification program starting around late 1964. Other important improvements included in this same program were: Modification 880 to further enhance APS-95 reception (particularly with respect to AMTI performance) and increase detection capability with newly-installed parametric amplifiers; and modification 1242, displacing APA 56 indicator consoles with APA 159 models.

ECCM. Less successful, from ADC's standpoint, was the much desired, but seemingly bypassed, ECCM package for APS-95 and APS-45 radars on both coasts. So that EC-121's on patrol would not be fooled into missing hostile raids because of ECM generated by enemy bombers, ADC peppered USAF with numerous requests for installation of ECCM devices to cope with enemy ECM. About a dozen components

38. Hist of EADF, Jan-Jun 1958, pp. 46-48; Hist of WADF, Jan-Jun 1959, p. 28 and Jul-Dec 1959, p. 30; Hist of ADC, Jan-Jun 1961, pp. 52-53; Hist of ADC, Jul-Dec 1961, pp. 64-68; Msg EAOCE-CR 056, EADF to ADC, 8 Jan 1959 [DOC 43]; Msg ADOOP-EI 1405, ADC to MOADS, 24 Apr 1964 [DOC 44]; ADC, ADOAC, Weekly Activities Report, 2-8 May 1962, 23-29 Mar 1962, 6-12 Apr 1962, 13-19 Apr 1962, 11-17 May 1962 and 24-30 Jan 1964 [HRF]; FORMERLY RESTRICTED DATA, USAF, Current Status Report, Mar 1962, p. 3-20 [HRF]; NOFORN, Msg ADCIG 1636, ADC to USAF, 15 Jun 1962 [DOC 15].

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were originally involved. First ADC asked for, on 4 November 1958, the following seven items for the APS-95:

(1) auxiliary velocity notch (with complete gating capability in azimuth and range); (2) RF DPCA (Displaced Phase Centered Antenna Circuitry); (3) Dicke Fix; (4) Side Lobe Cancellation with AVA; (5) Logarithmic Receiver with FTC; (6) Cross-gating; (7) Jam Alarm; and (8) Temco Video Correlator. For the APS-45 height finder, ADC had in mind four of those named above, i.e., items 3, 4, 5 and 6, plus CFAR and Image Frequency Rejection.

Reviewing the cost involved for a retrofit program of this magnitude, USAF was dismayed enough to issue, in October 1959, a flat "no," but not without encouraging ADC to resubmit a condensed, less costly version of its proposed AEW ECCM program (designated Modification 1090). The very least required to render the APS-95 immune to enemy ECM, according to ADC's next calculations, were the Dicke Fix, the Temco Video Correlator, RF DPCA receiver, and strobe reporting. ARDC's Wright Air Development Division (WADD) agreed that, insofar as the APS-95 was concerned, Dicke Fix and RF DPCA receiver, were necessary for 70 AEW aircraft. WADD, moreover, emphasized the urgency of

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installing them in the ALRI half of the EC-121 fleet for purposes of insuring BOMARC control in an ECM environment. The QRC-94 Temco Video Correlator, which had failed to receive WADD's endorsement, was still coveted by ADC because it promised to reduce or eliminate remaining traces of sea clutter, mutual interference, chaff, and electronic jamming, together with increasing, somewhat, the EC-121's radar detection range. But tests to this end were subsequently conducted with results not sufficiently impressive, in ADC's estimation, to warrant their procurement after all.

By October 1962, ADC had grown so anxious over USAF's procrastination that it reiterated the importance of installing ECCM "fixes" to the APS-95, both ALRI and manual types. As regards the APS-45 height finder, some ECCM packages were incorporated in those converted to the APS-103 configuration for operation with ALRI.

This time, ADC's proposed retrofit program named five distinct components as desirable for the APS-95: Dicke Fix, Side Lobe Suppression, Logarithmic Receiver with FTC, Video Processor (either of an improved Correlator type or of the Accumulator type), and a Preamplifier Image

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Rejector. Still USAF refused to yield, possibly because SMAMA had predicted two to three year slippages in the program due to technical complications involved. Finally, in August 1963, USAF cancelled the whole Modification 1090 program.

Undaunted by this setback, ADC, in February 1964, pressed anew for an AEW ECCM package differing somewhat from the previous one. ADC wrote that the APS-95 radar, for sake of prudence, should be equipped with broad band pulse-to-pulse frequency agility and CFAR receiver. Other ECCM "fixes," besides, were under consideration. Whether or not USAF, which had designated the revised program Modification 1637, would actually underwrite it, was unknown as of October 1964.

39. Msg ADLSI-E 0418, ADC to ARDC, 12 Nov 1959 [Doc 15 in Hist of ADC, Jul-Dec 1959]; Msg SIDA-12-101-E, ADSID to WADS, 1 Dec 1959 [Doc 18 in Hist of ADC, Jul-Dec 1959]; Hist of ADC, Jul-Dec 1959, pp. 34-36; Jan-Jun 1960, pp. 40-46; Jul-Dec 1960, pp. 60-66; Interview w/Maj Kelley, 6 Nov 1964; Msg ADOCE-EW 4703, ADC to ARDC, 22 Jan 1959 [DOC 45]; Msg ADLDC 2237, ADC to USAF, 8 Aug 1960 [DOC 46]; Msg ADLPC 880, ADC to SMAMA, 22 Mar 1963 [DOC 47]; Msg ADLDC 2669, ADC to USAF, 5 Oct 1962 [DOC 48]; Msg ADOOP-EI 1173, ADC to 26 AD, 2 Apr 1964 [DOC 49]; Msg ADLPC 1142, ADC to 26 AD, 1 Apr 1964 [DOC 50]; Msg ADMME-CC 2249, ADC to SMAMA, 10 Jul 1964 [DOC 51]; Msg ADLPC 2814, ADC to USAF, 4 Sep 1964 [DOC 52]; ADC, ADOAC, Weekly Activities Reports, 23-30 Aug 1962 and 28 Sep-2 Oct 1962 [HRF]; Msg AFSMLCA 75888, USAF to AFLC, 3 Jul 1963 [DOC 20].

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966th AEW Squadron. To plug a leak in radar coverage in the Florida area, the seventh and final AEW squadron, the 966th, was created in 1962. Theretofore, ADC had reconciled itself to the fact that, despite its original intention to enlarge the AEW force, no other AEW squadron would be activated beyond the rock-bottom AEW force six squadrons strong, then in service. But the political climate in Cuba changed so drastically not long after Castro's assumption of power, that a change of heart was soon effected. Cuba, obviously, was being drawn ever tighter into the Communist sphere of influence. For this and other reasons, the U.S. broke diplomatic relations with Cuba in January 1961. Already Florida's vulnerability to low-level attack had been amply demonstrated when an armed B-26 Cuban bomber, piloted by two defecting Cubans, managed to fly unchallenged and undetected from Cuba to Florida, then alight at the Daytona Beach Airport.

Concerned lest Cuba instigate nuisance air raids against Florida, CONAD Operation Plan 1-61 SOUTHERN TIP, 5 January 1961, was drafted calling for instant augmentation of fighter and airborne surveillance forces in the area of southern Florida. As regards the AEW contribution to this

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plan, Navy WV-2 aircraft -- the Navy version of the EC-121 -- were first to make an appearance. By mid-1961, however, the AEW responsibility was transferred to USAF, thence to ADC; whereupon the JCS, in August 1961, called for an AEW detachment permanently deployed to southern Florida. One AEW station was designated above the Florida Straits that ADC was expected to man. In behalf of this effort, the Navy offered, and subsequently delivered, seven of its WV-2's, which a short while afterward were modified in keeping with ADC's standard EC-121 configuration.

ADC first hoped that MacDill AFB would serve as home base for the SOUTHERN TIP AEW detachment. When informed that MacDill was unavailable, however, ADC picked McCoy AFB. In late 1961 five EC-121D's, two from the 551st and three from the 552nd, flew to McCoy, where in November 1961 they commenced operations as Detachment 1, 551st AEW Wing. Effective 1 February 1962, the 966th AEW&C Squadron was officially activated under administrative control of the 551st AEW&C Wing. The squadron was manned by a personnel contingent of 475 persons. Being the only AEW unit required to furnish uninterrupted, round-the-clock surveillance service during this period, it was necessary to have

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on hand from seven to 12 operational EC-121's at a time. Since the 966th was not, and never would be, ALRI-equipped for automated operations with SAGE, the squadron, effective 1 May 1963, was transferred to the custody of the 552nd⁴⁰ AEW&C Wing.

Operations. Not long after the beginning of the decade, ADC implemented the "random manning" concept for AEW patrols. The pool of available EC-121's for mission flights kept steadily dwindling, due mainly to (1) the extensive modification programs mentioned above, (2) the burdensome obligation to furnish EC-121's for special projects (described below), (3) the necessity to supply the 966th with operating EC-121's until those provided by the Navy were properly modified, and (4) the systematized programs for scheduled maintenance, including PARC and Time Compliance Technical Orders (TCTO's). In 1962, the R3350-91 series engine was replaced by the improved R3350-93 type, causing more EC-121 time to be consumed in other than mission-oriented flights.

40. Hist of ADC, Jan-Jun 1961, pp. 63-68; Jul-Dec 1961, pp. 287-90; ADC Historical Study No. 15, The Air Defense in the Cuban Crisis, October-December 1962, pp. 4-10, 18-19, 139; ADC, ADOAC, Weekly Activities Report, 25-31 May 1962 [HRF].

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Beforehand, ADC discovered that, during periods of normal readiness at least, the amount of on-station time could be lessened to lighten the workload. Vigilance at the four ALRI stations on the east coast and the five Pacific coast stations could be relaxed, so long as DEFCON 5 conditions obtained. Effective 1 October 1962, one and one-half stations off either coast were randomly picked for daily patrols, with the understanding that full manning would resume at all stations upon declaration of an emergency. In March 1963, NORAD codified AEW on-station requirements as, "Random manning minimum of 30 per cent of assigned stations." Up to and including 1964, the four east coast and five west coast AEW stations were maintained in a status calling for patrols randomly manned 50 per cent of the time. All this while, however, the single SOUTHERN TIP station between Florida and Cuba was given the full-⁴¹ time, round-the-clock treatment by the 966th Squadron.

41. NORAD/CONAD Reg 55-3, 22 Mar 1963; Hist of ADC, Jul-Dec 1960, p. 44; Jan-Jun 1961, p. 51; Jul-Dec 1961, pp. 57-59, 64-69; Msg ADOOP-EI 997, ADC to 26 & 28 AD, 13 Apr 1962 [DOC 53]; Msg ADOOP-EI 1071, ADC to USAF, 19 Apr 1962 [DOC 54]; Msg 26NOOP-PR W62-6905, 26 NORAD Rgn to NORAD Sect N.Y., 17 Aug 1962 [DOC 55]; ADC, ADOAC, Weekly Activities Report, 21-27 Sep 1962 [HRF]; Msg ADOOP-EI 2963, ADC to 26 AD, 14 Aug 1963 [DOC 56]; Msg AFXOPN 69051, USAF to ADC, 10 Jun 1963 [DOC 57]; Msg ADOOP-EI 528, ADC to USAF, 15 Feb 1964 [DOC 58]; NOFORN EX CANADA, Msg ADOOP-EI 733, ADC to USAF,

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The number of special projects responsible for depleting ADC's EC-121 pool waxed large in the early 1960's. In certain instances, they aided other agencies and commands; other times, they tested AEW air defense capacities under specified conditions. Often, the results were unusually good. Among the more important ones, "Green Olive," conducted from 7 to 14 July 1961 by the 552nd Wing, demonstrated once and for all that EC-121D's could, indeed, effectively control fighters by the manual system, providing EC-121's were stationed close enough to shore to communicate air-to-ground (as well as air-to-air), via line-of-sight UHF frequencies. Of 127 interceptions attempted, 115 were successfully accomplished. A few months after "Green Olive," the last of the five west coast AEW stations, like the four ALRI stations on the east coast, were repositioned inboard of the picket vessels, completing the return of the weapons control function to EC-121's patrolling all AEW stations. Additional UHF frequencies were provided in 1962 to enhance communications reliability

[Cont'd] 20 Feb 1964 [DOC 59]; Msg ADJOP-EI 1463, ADC to USAF, 30 Apr 1964 [DOC 60]; Msg ADODC 2759, ADC to Air Divs, 1 Sep 1964 [DOC 61]; FORMERLY RESTRICTED DATA, USAF, Current Status Report, Mar 1964, p. III-28 [HRF]; Msg 2600P-GO 0591-S, 26 AD to CINCNORAD, 8 Sep 1960 [Doc 43 in Hist of ADC, Jul-Dec 1960].

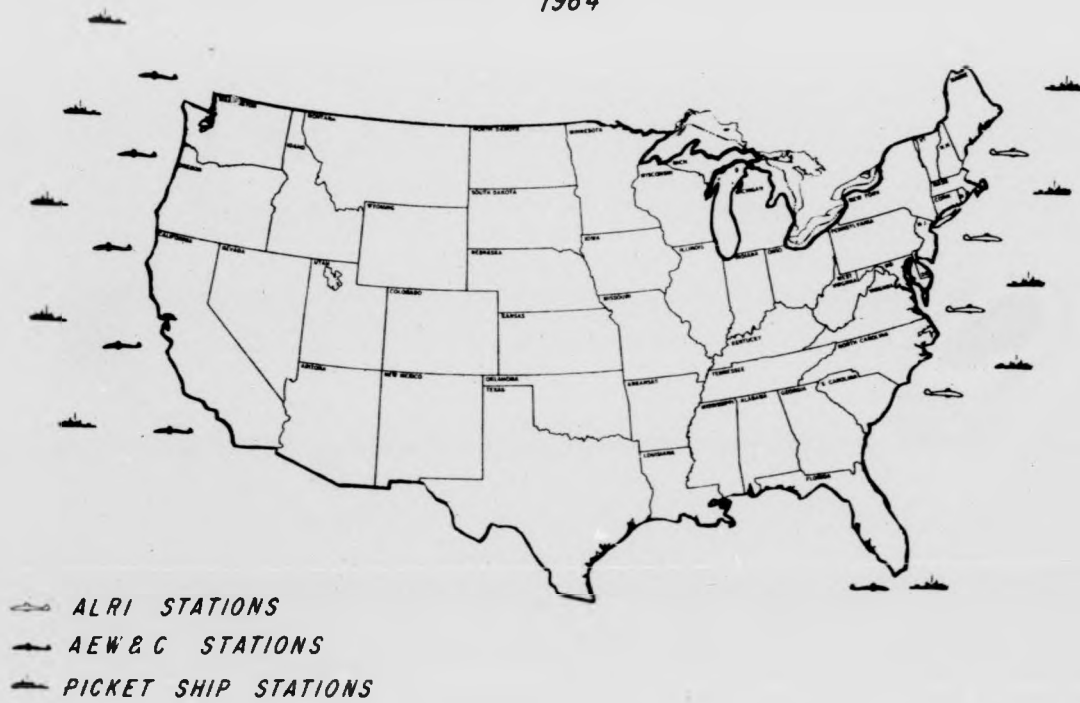
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thereafter. Projects "Mickey Mouse" and "Fly Speck," conducted in the autumn of 1962 by the same wing, showed the APS-95 to good advantage by demonstrating the EC-121D's ability to track and direct intercepts on small, low-altitude targets in the former case, and on very high-altitude targets of the U-2 variety in the latter. Again in late 1962, while participating in Project "Dominic" to help recover a manned Mercury capsule returning to earth, the APS-95 proved its worth by detecting the 9,000 m.p.h. capsule 193 nautical miles away. Even this performance was spectacularly outclassed in early 1963 when an EC-121 of the 966th AEW&C Squadron managed to detect and track a Saturn missile for much of its 200-mile flight, including that part of the flight from post-launch to 300,000 feet or so altitude. But in practically all of these and other projects, APS-45 height finder performance left much to be desired. What with ALRI modification and testing, and support of special projects, going into 1963-64, it was little wonder that the toll exacted on ADC's reserve of operational EC-121's continued unrelentingly high, affecting capabilities to a point where, as mentioned above, nine

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of ten AEW stations were manned but half the time, on a
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randomly selected basis.

Despite this rash of special projects support, combined with regular patrol missions, the EC-121 fleet did not suffer abnormally from attrition losses. The fleet did, however, experience several close episodes, including another case of a dropping engine during flight (21 December 1960); an instance of an APS-45 radome shearing off in flight (12 October 1962); a time when a propeller fell off during a landing (2 January 1963); another when half the APS-95 radome tore off during a take-off (27 January 1963); and on this same day, loss, during flight, of a four-foot, 27-pound access door. All in all, none were serious enough to disable the EC-121's involved which managed to alight
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without further incident all five times.

42. Hist of ADC, Jul-Dec 1961, pp. 63-69; ADC Hist Study 15, pp. 139-44; ADC, ADOAC, Weekly Activities Reports 19-25 Jan 1962 and 28 Sep-2 Oct 1962 [HRF]; NOFORN, Msg ADOOP-EI 3406, ADC to USAF, 7 Dec 1962 [DOC 62]; NOFORN, Msg ADOOP-EI 2846, ADC to 966 AEW&C Sq, 24 Oct 1962 [DOC 63]; Msg 966OOP 385, 966 AEW&C Sq to ADC, 31 Mar 1963 [DOC 64]; ADC, ADC Prime System Statement: Tactical Activity and Support AEW and Con Prime Units, for Apr 1964, n.d. [DOC 65]; and for Sep 1964, n.d. [DOC 66]; Msg ADCCS 2482, ADC to 26 and 28 AD, 6 Aug 1964 [DOC 23].

43. ADC, Daily Staff Digest No. 80, 11 Aug 1961 [HRF]; Msg 552CSA 1425, 552 AEW Wg to USAF, 17 Oct 1962 [DOC 67]; Msg 551CSA-F 1-134, 551 AEW Wg to USAF, 9 Jan 1963 [DOC 68];

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By far worse than danger from shedding engines, propellers, radomes and hatches, however, was the ever present threat of a sudden enemy ICBM shower that, in one stroke, would wipe out the flower of the EC-121 fleet. To guard against a calamity of this magnitude, ADC inaugurated planning action to include the EC-121 fleet in its overall dispersal program calculated to save ADC resources from the first onslaughts of atomic war, so, by surviving, they could contribute toward replusing ensuing waves of atomically-armed manned bombers. To this end, ADC, from 1962 to 1964, studied several methods for AEW dispersal (including the flushing of EC-121's on 15 minutes warning), inclining more and more to favor techniques like those planned for the fighter interceptor force, with a view to saving at least one-third the AEW fleet. As of October 1964, however, all plans in this regard were still tentative.

[Cont'd] Msg 551CSA-F 1-484, 551 AEW Wg to Dep IG FS (Norton AFB), 29 Jan 1963 [DOC 69]; Msg 552CSA 0124, 552 AEW Wg to USAF, 30 Jan 1963 [DOC 70].

44. See ADC Historical Study No. 25, Interceptor Dispersal, 1961-1964; Msg 28OPP-PL 2S1148, 28 AD to 552 AEW Wg, 8 Oct 1962 [DOC 71]; Msg ADOOP-EI 2940, ADC to 26 AD, 13 Aug 1963 [DOC 72]; Msg 28OPP 11 1082, 28 AD to ADC, 13 Nov 1963 [DOC 73]; Msg ADOOP-EI 1315, ADC to USAF, 15 Apr 1964 [DOC 74]; ADC List Study No. 25, p. 54.

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One of the most important methods for measuring AEW effectiveness was ADC's testing program. Tactical evaluations and Operational Readiness Inspections (ORI's) were conducted periodically with just this purpose in mind. Since the 551st AEW&C Wing, however, was transitioning to ALRI automated operations during most of this period, a moratorium, of sorts, was imposed on East Coast AEW tests -- but not without the 551st first taking an ORI in July 1960, and passing with an 81.9 per cent score. The 552nd AEW&Con Wing, upon whom the bulk of ADC's testing activity was levied, experienced varying results. In January 1960, the 552nd satisfactorily passed a Tactical Evaluation/ORI by detecting and reporting eight of nine SAC "faker" strikes composed of 23 B-57's and B-52's.

What happened during the next ORI, conducted from 10 to 19 January 1962, ended with less satisfying results. Unfortunately, the 552nd was still depending on the Dualex Tapewriter for transmitting surveillance data to the SAGE sector concerned. Despite the presence of enthusiastic, highly motivated aircrews, efforts of the 552nd to detect and report "attacking" fakers were frustrated by equipment failures. APS-95 search sets, not long out of the Product

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Improvement Program, were generally not accurately calibrated, besides lacking the ECCM "fixes" ADC had requested, but never got. Moreover, atmospheric conditions peculiar to this region, including temperature inversion, hampered APS-95 reception. Therefore, when the target force penetrated at varying times with 57 B-57's, F-89J's, and T-33's (employing evasive maneuvers, ECM and Chaff), only 32 were actually detected and tracked. The APS-45 height finder turned in its usual bad performance, acquiring height information on only eight of the 32 tracks. About a fourth of the surveillance data transmitted via air-to-ground communications was so faulty and garbled that SAGE computers rejected it. The 552nd Wing, accordingly, was declared to have "demonstrated an unsatisfactory capability to perform⁴⁵ its assigned mission."

When the 552nd next gained a chance to redeem itself, conditions had markedly improved. The APS-95 was fully tuned and calibrated; Dualex Tapewriter apparatus had been discarded; and air-to-ground UHF channels (with AEW stations

45. Hist of ADC, Jul-Dec 1960, p. 44; NOFORN, ADC Rpt, "ORI of 552nd AEW&Con Wg," 19 Jan 1962 [DOC 75]; ADC Rpt, "ORI of 26 Air Div," 22 Jul 1960, pp. H-1 to H-5 [Doc 246 in Hist of ADC, Jul-Dec 1960].

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correspondingly positioned closer to shore), were in full operation. From 27 to 28 March 1963, consequently, the 552nd Wing, during a Tactical Evaluation, detected 87 per cent of all faker aircraft involved. It scored 100 per cent in reliability of ground-to-air and air-to-air UHF communications, resulting, therewith, in a 95 per cent success rate for all interceptions attempted, and earning for itself, a satisfactory rating. The 966th AEW&C Squadron at McCoy, when its turn came from 16 to 22 January, 1964, similarly demonstrated an impressive performance in practically every area of its activities.

46. Msg ADOOP-EI 2896, ADC to USAF, 7 Aug 1963 [DOC 76]; Rpt, ADCIG-R to 966 AEW&Con Sq, "Memorandum Report, 966 AEW Con Sq," 22 Jan 1964 [HRF].

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