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HISTORICAL RESUME

USAF AIRBORNE RADIO DIRECTION FINDING

ITS DEVELOPMENT AND USE

April 1962 - 31 May 1968



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6994TH SECURITY SQUADRON, TAN SON NHUT AIR BASE, VIETNAM

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Chapter 1

THE DEVELOPMENT OF ARDF

U.S. Army Pioneers Effort

(S) The U.S. Army has been conducting Airborne Radio Direction Finding (ARDF) operations for an unknown period. It is known that they were operating ARDF equipped U-6 and U-3 aircraft in South Vietnam as early as 1961. This effort was referred to as "Project Wine Bottle". During 1966 they conducted experimental operations with an ARDF equipped Caribou aircraft. This aircraft, which was equipped with additional target acquisition/collection equipment, was referred to as "Project Passometer". The U.S. Army ARDF operations are under the control of the 509th Radio Research Group, Tan Son Nhut AB, Vietnam. Their ARDF fleet consisted of 25 U-6/U-3 aircraft in February 1966. However, this number had increased to 58 by 31 May 1966.

USAF Directed to Develop ARDF System

(S) During April 1962, General Curtis E. LeMay called for the USAF to develop an ARDF system. The desired system would be all-electronic and would give instant bearings. After all, COMINT and TACAN navigational aids gave instant bearings, and through electronic phase measuring these systems eliminated the 180 degree ambiguity inherent in the U.S. Army ARDF system (see Chapter 2). Two projects evolved from this request.

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USAF's First Attempt - "Hilo Hattie"

(S) The first USAF attempt at ARDF, designated "Project Farm Gate" and "Project Hilo Hattie", consisted of a C-54 aircraft equipped with photographic, infra-red reconnaissance and a homing type radio direction finding system. The aircraft was deployed to Tan Son Nhut AB, Vietnam during (?) 1962. The project was under the operational control of the 2nd Air Division. The ARDF activities were integrated into the 3rd Radio Research Unit's (now 509th Radio Research Group) radio direction finding activities. The project met with little success and was subsequently abandoned. Little is known of the ARDF system employed or the ensuing results. Some items cited as major reasons for the lack of success of the endeavor were the size and lack of maneuverability of the C-54, unspecified technical problems within the systems and control problems with the U.S. Army agencies.

Joint U.S. Navy/USAF Effort - "Mona Hi"

(S) The second project, which was destined to lead to the development of the present USAF ARDF system, was a joint U.S. Navy and USAF project. Initially designated "Project Mona Hi", this project consisted of the development of a phase measure ARDF system (see Chapter 2) to be installed in a C-47 type aircraft.

"Mona Hi" Becomes USAF "Project Hawkeye"

(S) During August 1962, Project Mona Hi was transferred to

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the USAF and redesignated "Project Hawkeye". General John A. Nashua, New Hampshire designed and developed a prototype system and installed a "broadcast" version in a C-47 aircraft for feasibility demonstration purposes.

Hawkeye Tested in South Vietnam

(S) The Hawkeye aircraft was deployed to Tan Son Nhut AB, Vietnam during (early) 1964 to undergo testing in its intended operational environment. The project was placed under the operational control of 2nd Air Division. Tasking was accomplished and mission results evaluated through coordination with the U.S. Army's 3rd Radio Research Unit, Tan Son Nhut AB, Vietnam. Initial testing of the system met with limited success. During July 1964, the aircraft was returned to COMUS after the aircraft navigational system failed completely.

Improved Hawkeye Returns to South Vietnam

(S) During early 1965, emphasis was placed on getting the "Hawkeye" ARDF system operational by the Military Assistance Command, Vietnam (MACV) increasing demands for more and better ARDF support of the Vietnam conflict. The system had been undergoing continual design/capability improvements since its return from South Vietnam. It was operationally tested in Florida during June 1965 and plans called for its immediate deployment to South Vietnam. However, extended testing at the Florida test site forestalled its intended deployment until December 1965. This deployment

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was originally intended to be a 120 day test operation. However, it met with such success that the 7th Air Force (formerly 2nd Air Division) and MACV retained the aircraft in-country until the "Phyllis Ann" aircraft (which were being hastily developed after early results from "Hankeye" proved the system capable) arrived arriving. The first "Phyllis Ann" aircraft arrived in-country on 26 May 1966. The Hankeye aircraft flew its last operational mission on 9 July 1966. The equipment was subsequently removed from the airframes and the aircraft returned to COMUS for installation of the much improved "Phyllis Ann" ARDF system. It rejoined the USAF ARDF fleet in South Vietnam on 6 March 1967.

"Project Phyllis Ann" Evolves

(S) Two factors actually caused the culmination of the USAF ARDF program. The first, and most important, was the obvious superiority of the USAF ARDF system (AN/AR-34, formerly AN/AR-19) over the U.S. Army's AN/AR-15 system. The second factor was that when the Department of Defense presented a MACV requirement for increased ARDF resources during 1965, the U.S. Army could not meet the requirement without a significant increase in funding. Since the USAF had the aircraft in inventory the cost of increasing the ARDF resources was reduced significantly by giving the responsibility to the USAF. The USAF did not, however, receive the entire commitment; The U.S. Army was directed to increase its ARDF fleet from

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25 to 57 aircraft during the time spent allocated to the US 7th to develop its ARDF fleet (April - November 1966). The US 7th was initially programmed to meet a requirement for 35 ARDF aircraft. This was later increased to 47 (plus six not operationally assigned "NOA" aircraft). This joint force was to provide the capability for 16 hour per-day ARDF coverage for all of South Vietnam and the Laotian Panhandle. The USAF portion of the expanded ARDF program was designated "Project Phyllis Ann". During April 1967, it was redesignated "Compass Dart", and in April 1968 to "Combat Cougar".

Units Designated and Organized to Handle Phyllis Ann

USAFSS

(C) The USAF Security Service designated and organized the 6994th Security Squadron at Tan Son Nhut AB, Vietnam to accomplish the USAFSS portion of the ARDF program. The unit was activated 15 April 1966. Two detachments of the squadron, Detachment 1, Nha Trang AB, Vietnam and Detachment 2, Pleiku AB, Vietnam were activated on 1 July 1966 and 1 October 1966, respectively.

USAF

(C) Simultaneous^{DM} with the activation of the USAFSS units, three Tactical Electronic Warfare Squadrons (TEWS) were designated and organized by the USAF. These squadrons were colocated with the USAFSS units and were subordinate to the 460th Tactical Reconnaissance Wing, Tan Son Nhut AB, Vietnam. The 360th TEWS was at Tan Son Nhut AB; the 361st TEWS at Nha Trang AB, and the 362nd TEWS at Pleiku AB, Vietnam.

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Chapter 2

SYSTEM DESIGN AND CAPABILITY

U.S. Army and USAF Systems Differ

(S) Considerable difference exists in the design, capability and operational techniques of the two ADF systems in use in South Vietnam. The U.S. Army system, designated AN/ARD-15, employs an "Aural Null" technique and the USAF system, designated the AN/MP-34, (formerly AN/ARD-18), employs a "Phase Measure" technique to determine the line of position (LOP) of a target.

U.S. Army (AN/ARD-15) System

(S) The AN/ARD-15 "Aural Null" ADF system is basically a radio receiver which employs the aural null characteristic of an Adcock type antenna to determine the direction from which a radio signal is emanating. The Adcock effect is created by dipole antennas installed on each wing of the aircraft. When a radio signal is picked up on the antennas, a loop is formed between them. Therefore, when the aircraft is positioned directly toward or away from the signal source (transmitter) an aural null occurs in the incoming signal. To obtain an LOP, it is necessary for the pilot to monitor the target signal and maneuver the aircraft until this null occurs. At that point the transmitter is located either directly ahead or behind the aircraft. The exact position of the aircraft must then be manually computed and the LOP plotted.

U.S. Army Aircraft Configuration

(S) The AN/ARD-15 system is installed in comparatively small U-6

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(single engine) and U-8 (twin engine) aircraft. The basic configuration of the aircraft consists of only a target search/recognition position and air/ground communications equipment (including secure voice).

U.S. Army Aircraft Navigational Systems

(S) With the exception of three doppler equipped U-8's, the Army aircraft contain no special navigational equipment. The position of the aircraft must be determined by visual reference to known ground points. The navigational duties are performed by the co-pilot.

U.S. Army Fix Techniques

(S) When a target signal is acquired by the ARDF operator, the pilot monitors the signal and maneuvers the aircraft until the aural null occurs. At this time the co-pilot will determine and plot the position of the aircraft. (At this point the target could be located in either of two directions). The aircraft then turns abruptly at a right angle to the LOP and flies for several minutes. The signal is then nulled, as before, and another LOP obtained. A minimum of three LOP's must be obtained to establish (fix) a target's location. A spread of 30 degrees is desired between each LOP or a minimum spread of 30 degrees between all LOP's utilized to compute the fix.

U.S. Army System Has Disadvantages

(S) Several disadvantages are inherent in the AN/AGB-15 system.

1. The aural null is quite subjective, since some operators may detect the null at slightly different points.
2. Visually and manually establishing the location of the

22 - 7

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aircraft is slow and generally less accurate than the doppler method.

3. Considerable time is involved in maneuvering the aircraft and the air maneuvers required to position the aircraft into or away from the signal source. This time factor becomes critical on transmissions of extremely short duration.

4. Extensive stress is placed on both the aircraft and crew in executing the "high G" turns while working a target.

5. The maneuvers of the aircraft often alert the target to the fact that the activity is directed toward it.

6. The system is suited for daytime VFR conditions, only.

USAF (NI/ALR-34) System

(S) The NI/ALR-34 is an all electronic Airborne Radio Direction unit that employs a "phase measure" technique to determine the direction from which a radio signal is emanating in relation to the heading of the aircraft. The system has the capability to determine the direction of the signal source regardless of its point of arrival at the aircraft. The unit is part of a system installed in F-4 type aircraft that are equipped for day/night, all-weather operations.

(S) Basically, the NI/ALR-34 couples three antennas to a phase angle discriminator. Through computing the time of arrival of the target signal at the antennas located on the aircraft wings and nose, the system (through a complex trigonometrical process) establishes the direction of the source of the signal. This information plus the aircraft position data from the doppler and the heading from the C-12

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compass is combined to produce the line of position of the target and the aircraft position. The information is presented, on a read-out to the operator, on a paper tape. The tape also contains a measure of the strength of the target signal. The time lapse for obtaining a print-out on a signal is less than one second after the operator has successfully "locked-on" a target.

(S) The system has a fly-by fix capability. However, some maneuvering of the aircraft is generally accomplished to facilitate obtaining a greater bearing spread between LOP's or to keep the aircraft within closer proximity of the target being worked.

USAF ARDF Aircraft Configuration

(S) The basic configuration of the ARDF equipped EC-47 consists of the ALP-34 console (commonly referred to as "X"), a target search/acquisition console (commonly referred to as "Y") and a navigator's position which consists of the printer, the distributor and all other associated navigational equipment (see chart). The aircraft is equipped with a KY-3 secure voice air/ground, air/air communications equipment to support the ARDF mission.

(S) The basic ARDF equipped EC-47 has been modified to include the installation of two additional search/acquisition positions (commonly referred to as "Z") on some aircraft. Also, the inventory includes six aircraft that are equipped with the basic ALP-34 system and two communications jamming positions (commonly referred to as "Q"). (see chart).

249

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Chapter 5

CONTROL, COMMAND, AND COORDINATION

Control

(S) A controversy has existed over who should exercise ultimate control over the USAF ARDF platforms since the USCF entered the program. The USAF position was that the total ARDF role was an Air Force mission and, therefore, full operational control should be exercised by the USCF. Certain cryptologic agencies felt that they should control the ARDF mission regardless of who flew the aircraft or how the collected data was used. JCS supported the USAF position, the Army did not. The USCF position was enhanced by the fact that during early 1966 the USCF Security Service (USAFSS) was given the Electromagnetic Warfare (EMW) mission. ARDF clearly falls within the confines of this mission, which states in part:

"....to support the development, planning, and conduct of electronic warfare operations, and to operate specialized intelligence collection systems as directed by the Chief of Staff, USCF."

This controversy still exists. However, it has had little or no effect on the actual employment of the USAF ARDF aircraft, due largely to the control and tasking procedures established by MACV.

Command

MACV Concept Outlined

(S) On 12 April 1966, MACV published a concept of operations for control of ARDF resources. This directive, which outlined the responsibilities of the two services concerned, placed the command of the U.S.

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Army resources with the Commanding Officer, 509th Signal Battalion and the command of the USAF resources with the Commander, 7th Air Force.

(S) Although operational control of the USAF and USAR resources was exercised by the respective commanders, the composite fleet was used in response to MACV requirements.

(S) The Commander, 7th Air Force designated the Commander, 699th Security Squadron as his executive agent for operational control of the USAFSS operation of the aircraft, and the Tactical Electronic Warfare Squadrons as executive agent for operational control of the "front end" crews.

MACV Delegates Responsibilities

(S) Responsibilities were delegated to the various activities involved in the ARDF effort as follows:

1. MACV-J2 was responsible for:
 - a. Acting for MACV as the intelligence requirements control authority.
 - b. Designating consumers for ARDF results.
 - c. Establishing procedures for supported commands to submit requirements for ARDF support.
 - d. Establishing procedures for allocating resources to meet commitments for ARDF support.
 - e. Disseminating ARDF results to supported commands.
2. The two commanders involved- 7th Air Force (with 699th Security Squadron as agent) and the 509th Radio Research Group- were

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responsible for:

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- a. Planning and coordinating a program for the JED effort.
- b. Reporting JED results to the command assigned by MACV-J2.
- c. Disseminating results and technical points on.
- d. Establishing and maintaining close liaison with each other in planning and employing JED resources.

3. The U.S. Army commander had the additional responsibility for:

- a. Insuring appropriate cryptologic tasking in support of technical requirements. This was necessary to insure that the intel base was current.
- b. Providing technical support for the JED resources.

MACV Establishes Tasking Procedures

(S) In conjunction with the delegating of responsibilities, MACV established the procedures to accomplish the necessary tasks. The activities involved and their tasks were:

1. MACV-J2
 - a. Receive, validate, and approve requirements submitted by the various elements engaged in the war effort. The validation and approval was to be accomplished by a coordinating committee composed of representatives of NRV, MACV, 7th Air Force, the 699th Security Squadron and the 509th Radio Research Group.

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b. Issue the approved requirements to the 1st and 2nd Force ARDF elements.

c. Establish a list of requirements in order of priority.

d. Indicate special pre-emptive requirements by designating specific targets or areas of interest in support of current operations.

e. Issue specific instructions on handling reports.

(Subordinate units would be required to submit requests for support through channels for validation and levy at least 72 hours prior to the anticipated requirement).

2. 7th Air Force (6994th Security Squadron)

a. Forward results of Air Force missions to the 509th REG for analysis and reporting to MACV-J2.

b. Provide ARDF reports to local tactical commanders during close support operations.

c. Report any visual sightings or targets of opportunity to local tactical commanders.

3. 509th REG

a. Analyze and forward ARDF mission results to MACV-J2.

b. Provide MACV-J2 with a daily activity report to include the following day's planned activity.

c. Provide reports on results of ARDF missions.

d. Provide immediate reports to local tactical commanders during the close support operations.

(S) This concept was given final approval by the JCS with only minor

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changes.

ARDF Management/Coordination Group Formed

(S) The MACV concept of operations placed certain responsibilities with the Commander, 6934th Security Squadron and the Commander, JPRG Radio Research Group that were to be accomplished as a joint effort. The units subsequently formed a joint operations center to accomplish these responsibilities. The unit was initially formed on 1 July 1964. However, it was not approved by MACV until October 1966. The unit was initially designated the Joint Platform Management Group, but was later redesignated as the ARDF Coordination Center (ACC). The mission of the ACC ultimately became:

"to provide for the coordinated management of the ARDF program in South Vietnam and other areas as directed by the Commander, USMACV".

(S) To accomplish this mission, the ACC promulgated and issued directives that governed all phases of the ARDF operation that involved both services and were suited for standardization.

(S) The ACC was manned jointly by the two services. The command duties were shared by an Officer-In-Charge from each service.

Tasking

(S) The procedures for tasking the ARDF aircraft were:

(S) The requirements for ARDF support are submitted to MACV by the various field commanders. Each Tuesday MACV-J2 consolidates the requests, assigns priorities to the tasks and allocates sorties (by service) to satisfy the requirement. (MACV-J2 specifies the area, by coordinates, in which the sorties are allocated). Each Wednesday a

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delegation consisting of representatives from the 1st AF, 1st AF
Squadron; 460th TAD; 509th TAD; 2nd AF; 7th AF and 1st AF
MACV-J2 to discuss and finalize the tasking. The tasking is then
approved and forwarded to the JCS. The JCS develops the tasking
into specific tasking for each service (see below). A tasking
classified is also prepared and forwarded to 7th AF (1st AF) for use in
developing the USAF frag schedule. (See chart for graphic display of
tasking cycle).

JCS Role in Tasking

(S) The JCS received general tasking from MACV-J2 (see tasking)
and translated it into specific JCS tasking. The JCS tasking was, in
actuality, an outline of JCS requirements that was formulated based
on the consumers requirements and the JCS resources available. The JCS
was responsible for insuring that the resources were utilized to the
maximum effectiveness in fulfilling these requirements. In achieving this
they:

- a. Established specific time over target.
- b. Selected specific targets for designated priority systems.
- c. Arranged for proper distribution of technical data.
- d. Monitored and managed the distribution of encryption keys
to the subscribers of the JCS air/ground communications nets.
- e. Distributed specific tasking to the U.S. Army aviation
units and the 7th Air Force.

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Chapter 3

ARDF SUPPORT OF TACTICAL OPERATIONS

General Use of ARDF

(S) ARDF results are passed from the aircraft to Direct Support Units (DSU's). These DSU's are located near the combat elements and are in direct contact with the tactical command. When the DSU receives the information from the aircraft, it is passed immediately to the tactical commanders. The tactical commanders react to the information differently, dependent on the known significance of the target, the immediate tactical situation and the proximity of the target to friendly military forces. Some commanders have ordered that a minimum of three rounds of heavy artillery be placed on each fix location. If the target is of known tactical significance, the commander may order an immediate tactical air strike against the location. It is also common practice to direct a forward air controller (FAC) into the area for reconnaissance purposes.

(S) Information provided by the 1st Marine Amphibious Force credited ARDF data with providing the basis for targeting numerous B-52 strikes in the DMZ area. In fact, 50 percent of the total B-52 strikes executed are purported to be targeted through ARDF data.

(S) ARDF support is provided for all major operations. This close tactical support (CTS) is largely incidental since ARDF

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operations are conducted daily in most areas within 100 miles of the DMZ. When no major operations are being conducted in an area, the ARDF flights are referred to as continuity and development (C&D) flights.

(S) In some cases a study of ARDF files obtained within a given area has been the sole basis for conducting an operation. The planned area of operations has often been altered during the operation based on ARDF information. Tactical commanders rely heavily on ARDF data for planning troop maneuvers and fire support. Also, it is possible, to a large degree, for the commanders to measure the effectiveness of their actions through ARDF.

Effectiveness

(S) The following chronological brief presents some applications of ARDF to combat activities and the comments from the commanders relating to its effectiveness.

2 September 1966. The Commanding General, 1st Infantry Division (Airmobile) cited 7th Air Force activities for their outstanding air support to tactical forces during operation Paul Revere. Although ARDF was not specifically cited, it played a highly significant role in the operation.

29 September 1966. Major General Grover C. Brown, Director Intelligence, PACAF interrupted a briefing being presented Admiral Sharp and staff concerning the posture of enemy forces in the DMZ to laud ARDF. General Brown stated:

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"Without COMINT and the attendant support, we would be completely in the dark about the enemy situation in the DMZ."

31 October 1966. A message from the 1st Infantry Division stated, in part:

"On 28 October, the 1st Infantry Division sent two battalions into the Cam Xe Jungle, vicinity UR 8155, exclusively on the basis of intelligence provided by ARDF. The battalions made immediate contact. When the battlefield was policed, 70 bodies were found and evidence indicated numerous others had been carried away. Please pass to those responsible the compliments of the CG, 1st Infantry Division for a job well done. We need your continued support."

13 November 1966. A message from 1st Infantry Division in reference to a fix, of known significance, obtained by a Phyllis Ann aircraft stated, in part:

"Fix was received directly from the aircraft at 0917Z and passed to 1st Infantry Division G-2 at 0925Z. The G-2 immediately ordered 200-300 rounds of 155MM artillery on the fix location."

"The above incident is representative of the importance and reliance that the 1st Infantry Division places on COMINT material."

21 November 1966. A message from a U.S. Army 2nd Support Platoon in reference to a fix by a Phyllis Ann Aircraft stated, in part:

"Reference message received 21/0136Z and fix passed immediately to Regt S-2. Forward Air Control aircraft sent into the air approximately 21/0205Z to recon the area. Air strike requested in area by F.A.C. Convoy was notified of possible ambush. Four each UH1D gun ships sent to area due to approach of 11th Cavalry convoy along route 1. As convoy reached area of fix location, helicopters began recon by fire. Fire was returned by VC and fire-fight began--- Important point, this ARDF prevented serious ambush for which supported command is indebted to the COMINT community."

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"On 13 September 1966, the 773 ARDF fix of fire support base, which corresponded to a location in the fire plan as a likely enemy base, was fired into this area and resulted in destruction and fires. The brigade commander, 21st, feels the early CCINT (ARDF) planning saved the base from a possible mortar attack."

From 13 September 1966 through 11 February 1967, 773 ARDF fixes were obtained and passed to combat elements in support of Operations Thayer I and II, and Irving. At least two high strikes were targeted against a (target of known significance) from this information. Also, numerous fixes were fired on by artillery and naval gunfire. ARDF results were utilized extensively in the overall planning and execution of the operations.

January, CTS was provided for Operation Fairfax and Lanikai, joint RVN/Allied operations. ARDF results were not acted upon immediately, but rather were utilized to plan operations on a day-to-day basis.

January and February, CTS was provided for Operation Gadsen. The planning of the operation was accomplished through an area study of ARDF fix locations within the area of interest. Four hundred and eighty fixes were obtained in support of the operation; 255 were of immediate value to the combat elements. One B-52 strike was executed against (target of known significance) located by ARDF.

January, CTS was provided for operation Cedar Falls, an operation designed to destroy the enemy's secure base sanctuary in Binh Duong province from which he launched operations to the Saigon/Cholon area. The operation was planned through a study of ARDF of the area. ARDF guided the friendly forces directly to the enemy and continued locating his camps and staging areas throughout the operation. of the 574 ARDF fixes passed in support of the operation, 262 were of immediate

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