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HISTORY
OF THE
CHAPARRAL/FAAR AIR DEFENSE SYSTEM

NATIONAL SECURITY INFORMATION

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HISTORY OF THE CHAPARRAL/FAAR AIR DEFENSE SYSTEM

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PREFACE

The CHAPARRAL guided missile system, the 20-mm. VULCAN gun, the Forward Area Alerting Radar, and the self-propelled HAWK missile system now in the active Army inventory represent the culmination of a long and perplexing search for an effective solution to the forward area low-altitude air defense problem. From the end of World War II until the mid-1950's, the Ordnance Corps sought to meet the low-altitude threat through the modernization of existing artillery guns. During that period, a number of possible solutions to the problem were investigated, but few of them reached the hardware stage and only one—the improved 40-mm. self-propelled gun (DUSTER)—was ever released to the Army supply system. Convinced that the achievement of a fully effective forward area air defense system would require a significant engineering breakthrough in fire control technology, the Chief of Ordnance set out to fulfill the requirement for an optimum weapon system through a series of evolutionary developments.

The Light Antiaircraft Development Program thus begun in 1952 consisted of three progressive phases: the improved RADUSTER system for interim use, followed by the advanced 37-mm. VIGILANTE system, and finally, the futuristic self-propelled MAULER guided missile system, which emerged in 1957-58 as the proposed ultimate solution to the low-altitude forward area air defense problem. Also placed in development in 1958 was the manportable, shoulder-launched REDEYE missile system to protect the foot soldier against attack by low-flying, strafing planes and close-support aircraft. One by one the three light antiaircraft weapons succumbed to the exceedingly complex problems posed by the stringent tactical and logistical requirements of forward area air defense—the RADUSTER in 1958; the VIGILANTE, in 1963; and the MAULER in November 1965. The REDEYE missile system finally reached the field in 1967 after narrowly escaping the same fate.

Although the technical feasibility of the single-vehicle MAULER concept was successfully demonstrated, the time and money required to solve certain problems and complete development of the tactical system caused it to lose out in competition with a combination of other air defense weapons that presumably would provide an earlier operational capability at less cost. To fill the void left by termination of the MAULER, the Department of the Army adopted a forward area air defense plan which provided for a number of self-propelled HAWK battalions and composite missile and gun battalions consisting of the CHAPARRAL and VULCAN, together with a Forward Area Alerting Radar to provide early warning and target identification information. The all-arms shoulder-launched REDEYE missile system was also procured for use in the forward area in conjunction with the Forward Area Alerting Radar.

This monograph traces the history of the CHAPARRAL and the Forward Area Alerting Radar from their inception in 1963-64 through early 1975. Histories of the MAULER and REDEYE have already been published. The history of the self-propelled HAWK will be covered in the volume with the basic HAWK system at a later date.

31 May 1977 Mary T. Cagle

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PART ONE

THE CHAPARRAL WEAPON SYSTEM

CHAPTER I

(U) ORIGIN OF THE PROJECT

Background

The need for the CHAPARRAL guided missile system now deployed in composite battalions with the VULCAN gun system grew out of technical problems and delays in the MAULER and REDEYE programs in mid-1963. Had there been no problems or delays in the MAULER and REDEYE, there would have been no CHAPARRAL, because these programs represented the proposed ultimate solution to the forward area low-altitude air defense problem. The manportable, shoulder-fired REDEYE missile system was to replace the outmoded .50-caliber machine gun, while the MAULER weapon system was to supplant the obsolete M42 DUSTER, a twin 40-mm. self-propelled gun. Both of these weapon systems were originally considered to be feasible and within the current state of the art. Their development, however, was marked by major technical problems, compromises in military characteristics, schedule slippages, and escalation in program costs. As a result of technical problems and delays encountered in 1962 and 1963, production release of the REDEYE system was deferred to 1964, and the MAULER development program was reoriented to one of feasibility validation.[1]

In view of the stretchout in the MAULER and REDEYE programs, the Assistant Secretary of the Army, R&D, in June 1963, directed that provision be made for an interim and/or backup system as an alternate solution to the forward area air defense problem. Among the "quick-fix" approaches suggested for consideration were adaptation of existing air-to-air missiles, such as the SIDEWINDER and FALCON, to the air defense role; a modification of the HAWK to a more mobile missile system to fulfill a portion of the MAULER mission; and a backup MAULER program with another contractor, based on reduced military requirements for an earlier availability date. The basic MAULER was a complete, self-contained air defense system with all radars, Identification, Friend or Foe (IFF) equipment, computers, launchers, and missiles mounted on a single tracked vehicle. The trade-offs considered for an earlier availability date included using two vehicles instead of one, increasing

[1]For a complete history of these missile systems, *see* Mary T. Cagle, *History of the MAULER Weapon System* (MICOM, 19 Dec 68), and *History of the REDEYE Weapon System* (MICOM, 23 May 74).

the radar cross-section of the target missile, giving up passive detection, and reducing the required altitude by 2,000 feet.[2]

After a cursory time and cost study, the Army Missile Command (MICOM) concluded that the suggested HAWK and FALCON-SIDEWINDER concepts offered a high probability of success within the prescribed 18-month timeframe, but that no benefit would accrue from a backup MAULER system with reduced capabilities. The Hughes Aircraft Company and Philco Corporation had already performed preliminary unfunded studies investigating the adaptability of the FALCON and SIDEWINDER missiles to the surface-to-air role. An additional 3-month study would be required, however, for the refinement of previously generated data and for further performance investigations of the individual systems versus certain representative threats. In the case of the modified HAWK system, a period of 6 months would be required for study and limited testing to establish technical feasibility.[3]

Advent of the CHAPARRAL Concept

In September 1963, MICOM awarded the Philco Corporation and Hughes Aircraft Company study contracts of $24,712 and $24,993, respectively, to define surface-to-air system concepts using the Navy's SIDEWINDER 1C missile and the Air Force's FALCON (GAR-2B) missile. These adaptations were to be considered either as parallel developments to the REDEYE and MAULER or as quick-fix weapons which could be fielded within 18 months. The Hughes Aircraft Company was also awarded a $38,291 contract for technical support on the FALCON and infrared search-track set equipments located at the Naval Ordnance Test Station. Philco proposed a system which combined the SIDEWINDER 1C missile, LAU-7 aircraft launcher, M45 quad .50-caliber machine gun mount, and the M113 armored personnel carrier. Hughes proposed a concept using the FALCON missile launched from its container mounted on a trainable turret, an Infrared Search Track Set (IRSTS), and the XM-546 vehicle which was being developed for the MAULER system.

Late in 1963, competitive tracking tests were conducted at the Naval Ordnance Test Station, using the two missile seekers and the IRSTS. Tracking tests were satisfactory for both the

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[2](1) Ltr, CG, AMC, to CG, MICOM, 5 Jun 63, subj: Fld Army AD. (2) MFR, Chf, AMC Dev Div, 4 Jun 63, subj: Interim & Back-Up Sys for MAULER & REDEYE. Both in Hist Div File (HDF).

[3]TT AMSMI-RFC-34, CG, MICOM, to CG, AMC, 7 Jun 63. HDF.

SIDEWINDER and FALCON; however, the IRSTS could not detect incoming targets at the required range for satisfactory system operation. In January 1964, MICOM recommended that no further work be done on the FALCON concept. Although the SIDEWINDER 1C appeared to be potentially adaptable to the surface-to-air role, the Command recommended that demonstration firing tests and cost effectiveness studies be conducted before making a final decision.

The fire unit of the proposed interim low altitude air defense system, which became known as the CHAPARRAL,* contained three major components: a tracked vehicle, a mount launcher, and heat seeking SIDEWINDER 1C missiles. It was to be assembled by bolting together existing off-the-shelf components which included the M113 tracked vehicle, the M45 machine gun mount with LAU-7 aircraft launchers replacing the machine guns, and four SIDEWINDER 1C missiles. Most of the missile components were proven production hardware, and some were combat tested with documentation and test equipment already available.[4] Major characteristics of the SIDEWINDER 1C missile, the modified M45 mount, and M113 vehicle are depicted in the accompanying illustrations.

About $200,000 was spent in FY 1964 to define system concepts based on the SIDEWINDER and FALCON missiles and to perform comparative seeker tracking tests of these missiles. Of this sum, $75,000 was spent on the SIDEWINDER (CHAPARRAL) studies.[5]

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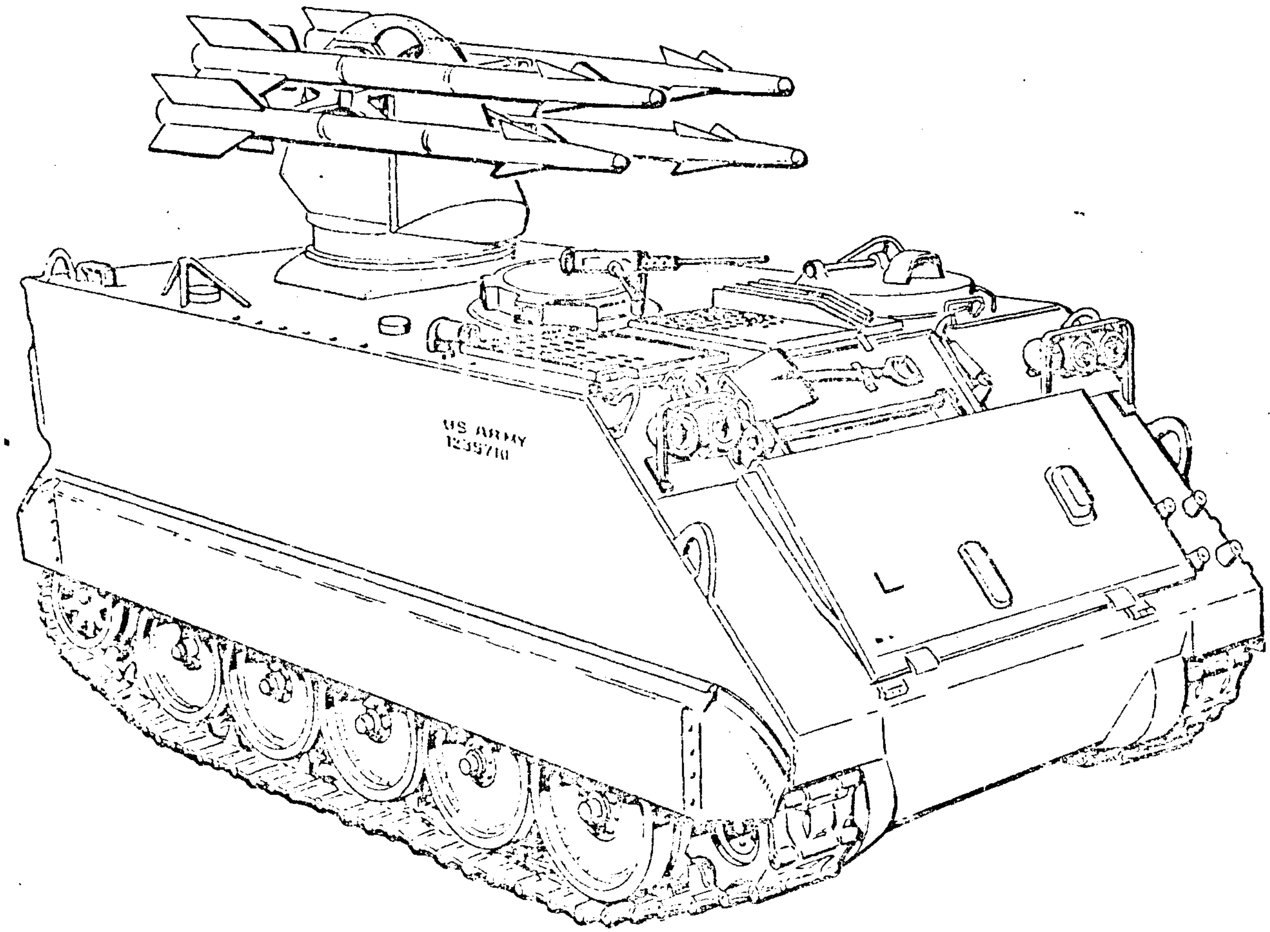
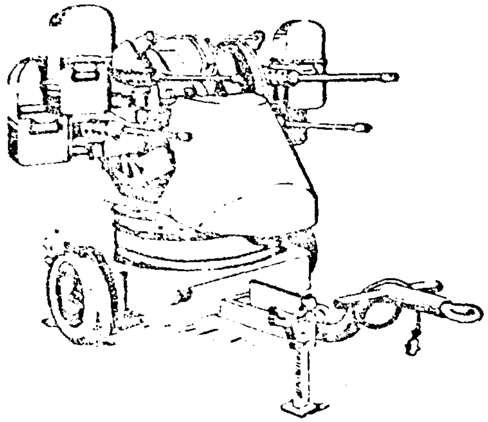
*The name CHAPARRAL is derived from *chaparro*, a Spanish term describing the dense thickets of shrubs and dwarf evergreen oak found in the southwestern United States. The Chaparral bird, also known as the Roadrunner, borrowed this name because he nests in these chaparral thickets. The designation aptly described the CHAPARRAL mission and deployment concept, as a large number of fire units would be deployed with each forward division and provide a dense, almost impenetrable concentration of air defense. Presn to NATO AC/225 Panel V, Ft Bliss, Tex, 12 Dec 67, by LTC Donald H. Steenburn. RHA Bx 14-8.

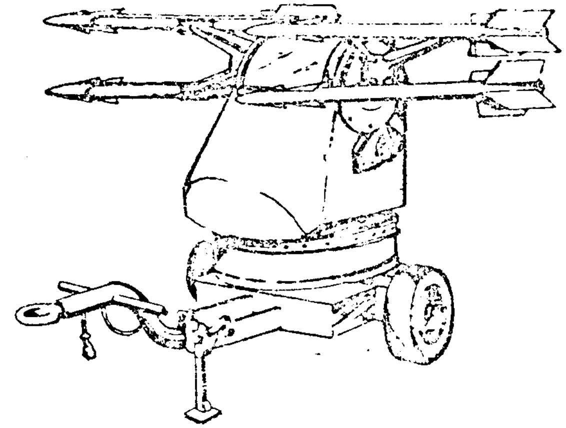
[4](1) Philco Rept, Tech Sys Definition Study for an Interim LA Def Sys, 6 Dec 63. Cited in Aeronutronic Pub C-3073, 15 Apr 65, subj: CHAP Prelim Design Rept. RSIC. (2) MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66. RHA Bx 14-7. (3) Rept, Presn to Ad Hoc Gp of the ASAP, 14 Mar 68. RHA Bx 14-8. (4) Ltr, DCG/ADS, MICOM, thru CG, AMC, to ASA(I&L), DA, 14 Jul 65, subj: Req for Apprl of D&F for the CHAP AD Sys, w incls. HDF.

[5]MICOM Rept, Prelim Tech Dev Plan - CHAP LA AD Sys, 14 Jan 65, p. I-5. RSIC.



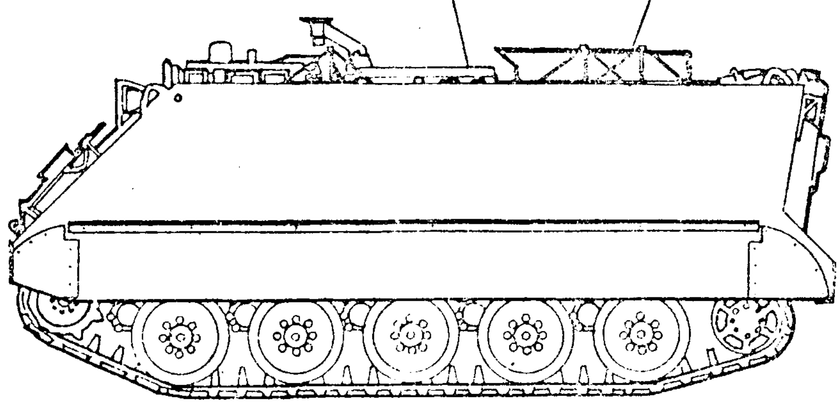
Artist's Conception of the Proposed CHAPARRAL System Aboard the M113 Vehicle





STANDARD	M45 SERIES MOUNT	SAM SYSTEM
61"	LENGTH (W/O ARMAMENT & AMMO)	66"
55 IN.	WIDTH (W/O ARMAMENT & AMMO)	64" (INC. LAUNCHERS)
56 IN.	HEIGHT (W/O ARMAMENT & AMMO)	58"
2,150 TO 3300 LB	WEIGHT OF MOUNT, COMBAT LOADED	2300 LB.
1 HP, 12 VDC MOTOR	POWER	1.5 HP 28V DC MOTOR
300 TO 2000 WATT	POWER CHARGER	USE VEHICLE
5 HR. TO UNLIMITED	DUTY CYCLE (5 MIN ON: 5 MIN OFF)	UNLIMITED
0-60 DEGREES PER SECOND	AZIMUTH SPEED	0-60 0/SEC
0-60 DEGREES PER SECOND	ELEVATION SPEED	0-60 0/SEC
	SIGHT	
M13 OR MK 9 MOD 1		M18 WITH REVISED RETICLE
	M20 TRAILER	
800 LB	WEIGHT	900 LB INCLUDING HOIST
114	LENGTH	114
83	WIDTH	83
23	HEIGHT	23

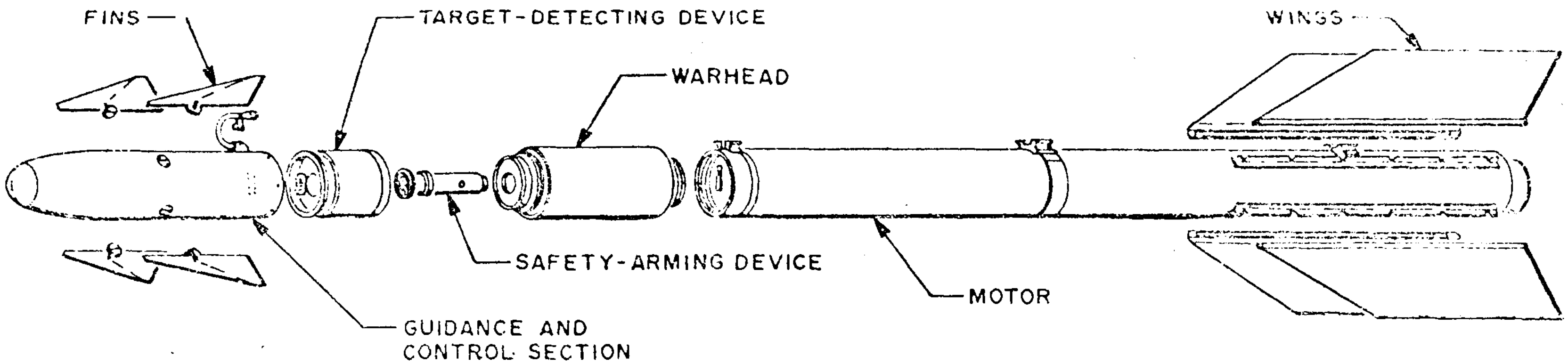
Characteristics of the Modified M45 Mount



	M113APC	M113, MODIFIED FOR SIDEWINDER SAM SYSTEM
LENGTH MAX OVERALL	191-1/2 IN.	191-1/2 IN.
REDUCIBLE TO	190 IN.	190 IN.
HEIGHT MAX OVERALL	86-1/2 IN.	86-1/2 IN.
REDUCIBLE TO	79-1/2 IN.	79-1/2 IN.
WIDTH MAX OVERALL	105-3/4 IN.	105-3/4 IN.
REDUCIBLE TO	100 IN.	100 IN.
GROUND CLEARANCE	16 IN.	16 IN.
FORDING DEPTH	UNLIMITED	UNLIMITED
WEIGHT		
COMBAT LOADED*	22,900	23,690
NET	20,160	N.A.
AIR DROP (+ 2%)	18,600	N.A.
CREW	1 DRIVER	2
PERSONNEL CAPACITY	12 MEN INCLUDING COMMANDER	N.A.
ARMAMENT	CAL .50 MACHINE GUN	CAL .50 MACHINE GUN 4 MISSILE LAUNCHERS
AMMUNITION	2000 RDS CAL .50	2000 RDS CAL .50 8 SIDEWINDER MISSILES
SPEED LAND FORWARD	40 MPH	40 MPH
REVERSE	6.6 MPH	6.6 MPH
WATER FORWARD	3.5 MPH	3.5 MPH
CRUISING RANGE	200 MI.	≈ 200 MI.
FUEL CAPACITY	80 GAL.	80 GAL.

* COMPLETE SYSTEM

Characteristics of the Modified M113 Vehicle



LENGTH	114 INCHES
BODY DIAMETER	5 INCHES
CONTROL CANARD CLEARANCE	16.4 INCHES
TAIL WING CLEARANCE	24.8 INCHES
WEIGHT: ON LAUNCHER	192 POUNDS
: ROCKET MOTOR BURNT	125 POUNDS
GYRO GIMBAL LIMIT	± 40 DEGREES
PNEUMATIC AND ELECTRICAL POWER; TIME OF	60 SECONDS
ROCKET MOTOR TOTAL IMPULSE	14,000 LB.-SEC.
MISSILE ACCELERATION, PEAK	25 G'S
MANEUVERING CAPABILITY (SEA LEVEL)	16.5 G'S

Exploded View of the SIDEWINDER 1C Missile

Program for Air Defense of the Field Army

In the wake of continuing slippages in the MAULER program, both as to availability and attainable characteristics, the Secretary of Defense, in September 1964, requested the Department of the Army (DA) to define a specific program for interim forward area air defense, to include an immediate buy of available weapons for deployment with forces in Europe. A study completed by the Office of the Assistant Chief of Staff for Force Development (OACSFOR), on 30 September 1964, emphasized the urgency of providing suitable air defense weapons for assignment to Europe by 1968. Among the systems considered by the study group were the self-propelled (SP) HAWK; REDEYE; Hispano-Suiza Triple 20-mm. gun; M61 VULCAN 20-mm. gun; M42 40-mm. gun (DUSTER); and the proposed CHAPARRAL.

One of the most promising options defined was a weapons mix of the CHAPARRAL with a companion gun system (Option IV). It was found that useful improvement in defense effectiveness could be attained by fielding five composite CHAPARRAL/gun battalions for fair weather, proliferated defense, and three battalions of SP HAWK for all weather defense. In addition, one CHAPARRAL/gun battalion and one SP HAWK battalion would be needed for use as a training base in the Continental United States (CONUS). As then envisioned, the composite air defense battalion would consist of four firing batteries. The primary weapon for two of these batteries would be the CHAPARRAL. The other two batteries would be equipped with an optimum gun system. Each battery would have 16 primary weapons. To provide early warning and identification, each CHAPARRAL firing platoon would be equipped with a continuous wave acquisition radar and an IFF system. The composite and SP HAWK battalions would be complemented by the shoulder-fired REDEYE missile which had been released for production earlier in 1964.

The Secretary of Defense approved Option IV of the ACSFOR study in Decision/Guidance Z-4-048, on 17 November 1964. The CHAPARRAL was to be a quick fix, interim weapon system which would be deployed to Europe only, and remain in the field some 2 to 4 years until the MAULER became available. Its development would be based on a bolt-together concept with off-the-shelf hardware and minimum changes to meet an early battalion activation date of July 1967 and deployment to Europe in January 1968.

Along with approval of Option IV of the ACSFOR study, the Defense Department directed MICOM to start a technical development plan for CHAPARRAL and to initiate, with the Army Test & Evaluation Command, an Engineering Design/Military Potential Test (ED/MPT) program. The objective of this phase was to verify performance of the CHAPARRAL missile as part of the weapon system tracking and firing loop. Also, certain hardware, technical, and safety considerations would be evaluated to insure that the adaptation of existing hardware could be accomplished to allow production of a workable system in the timeframe scheduled. Concurrently with the ED/MPT phase, three competitive gun systems would undergo evaluation and one would be selected for use with the CHAPARRAL in the composite battalion.[6]

Preliminary Technical Development Plan

The Army Missile Command completed the preliminary technical development plan for the CHAPARRAL on 14 January 1965. In the absence of a Qualitative Materiel Requirement (QMR), this plan was limited to a description of the development, engineering, and industrial effort which would be responsive to the program defined in the ACSFOR study of September 1964.

The program outlined in the preliminary plan did not follow a normal development cycle for two reasons. First, the system concept relied upon the adaptability of certain major items of military equipment that had already been developed; and second, the limited time available before the established deployment date (1 January 1968) did not allow any extensive redesign or major modifications before a release for production. Accordingly, the immediate goal of the development program was to realize the greatest performance of the various components through minor modifications only, and within the available time.

Principles of System Performance and Operation

Basically conceived as an interim fair weather air defense weapon for use with the division, the CHAPARRAL was expected to be capable of engaging the following target types during daylight hours and with good visibility:

1. Helicopters under any aspect, at speeds up to 120 knots

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[6](1) *Ibid.* (2) ACSFOR Rept, 30 Sep 64, subj: Program for AD - Fld Army. Cited and summarized in CDC Study M-6098, Aug 65, subj: TAMIRAD, Vol. I, p. C-8, and MICOM Rept, Prelim Tech Dev Plan - CHAP LA AD Sys, 14 Jan 65, p. I-1. RSIC. (3) CHAP Program Sum, Dec 69. RHA Bx 14-8. (4) MICOM Rept, Fwd Area AD (CHAP) IPR, 29-30 Aug 66, p. I-2. RHA Bx 14-7. (5) SECDEF Decision/Guidance Z-4-048, 17 Nov 64, subj: Fwd Area AD Wpns. CMO Files.

and at altitudes from 100 to 5,000 feet.

2. Low performance reconnaissance (reciprocating engine) aircraft at speeds from 80 to 220 knots and at altitudes from 100 to 5,000 feet, regardless of aspect.

3. Jet aircraft (single or multiple engine) on their receding leg (tail chase) at speeds from 150 to 550 knots and at altitudes from 100 to 10,000 feet.

In a typical sequence of operation, the acquisition or early warning operator would provide fire distribution information via radio to the mount operator. Upon receipt of directional and estimated range information on suspected targets, the mount operator would slew the mount to the appropriate sector and commence optical track of the target using a modified M-18 reflex sight. An audible tone in the operator's headset would indicate sufficient signal-to-noise to allow the missile to lock on the target before launch. Upon receipt of this signal and completion of target identification, the mount operator would uncage the gyro, superelevate to about 10°, and fire. The missile would establish a proportional navigation course to the point of intercept, at which time the fuze mechanism would detonate a 25-pound continuous rod warhead. In the event of a miss, the missile would self-destruct about 25 seconds after launch.

The CHAPARRAL fire unit would be fully passive in operation. Fire unit personnel would consist of a mount operator, a driver/radio operator, and two ammunition handler/observers. Planned deployment called for 32 fire units (the equivalent of 1 battalion) in the division area. Each CHAPARRAL battalion would consist of 2 batteries, each battery containing 16 fire units. Each fire unit would have a basic load of 12 missiles. These weapons would be organic to a composite battalion which would also contain two batteries of automatic weapons (20- or 40-mm. guns).

Among the risk factors identified in the technical development plan were two involving the human link. The ability of the observer and mount operator to detect and acquire an incoming 550-knot target at a range of 3 kilometers by visual means only remained to be demonstrated. The employment of a forward area search or early warning radar, as set out in the approved ACSFOR study, would ease the burden of the observer and mount operator, and greatly reduce the risk involved. However, the problem of visual target acquisition by the launch operator could not be entirely eliminated, since this was a prerequisite to successful launch.

The other risk factor involved the problem of target identification. A target detected by either the observer or mount operator would have to be positively identified as either friend or foe, and the operator would have to decide when and at which aircraft to fire the missile within prescribed rules of engagement. Moreover, there was the possibility that an aircraft might not be positively identified as hostile until the launcher or some nearby target was taken under fire. In this case, the launcher would have no self-defense capability against jet-type targets. Thus, the value of the CHAPARRAL system would be seriously degraded without a positive means of target identification.

The plan was to develop and field a suitable early warning or acquisition radar and IFF device within the same timeframe as the CHAPARRAL system. The Forward Area Acquisition Radar, later redesignated as the Forward Area Alerting Radar (FAAR), was to be compatible with the CHAPARRAL/gun battalion and deployed at the battery or platoon level.

Program Schedule

The preliminary technical development plan for the CHAPARRAL was composed of an engineering development phase and an industrial phase, the schedules for which were necessarily compressed to meet the early service availability date. As shown in Charts 1 and 2, the R&D program would begin in January 1965 and continue through June 1967, and the industrial program would commence with advance production engineering in May 1965 and continue through June 1968. Personnel training would begin with initial production deliveries in January 1967, followed by activation of the first unit in July and deployment of the six CHAPARRAL battalions during the period January to September 1968.

The planned duration of the initial engineering development effort was 8 months (January - August 1965), at which time the design of the basic (interim) CHAPARRAL would be completed. Included in this initial effort was an abbreviated program definition phase, system engineering studies, and an integrated ED/MPT program to validate the system performance data collected in earlier analyses and tests conducted at the Naval Ordnance Test Station. Assuming favorable results of these tests and a decision to field the system, an Engineering Test/Service Test (ET/ST) program would begin in October 1965 and continue into 1966. From August 1965 through June 1967, the R&D effort would focus on long leadtime modifications to increase system performance and reliability; e.g., a new seeker to permit head-on engagement and a smokeless rocket motor.

CHART 1. CHAPARRAL PROGRAM SCHEDULE

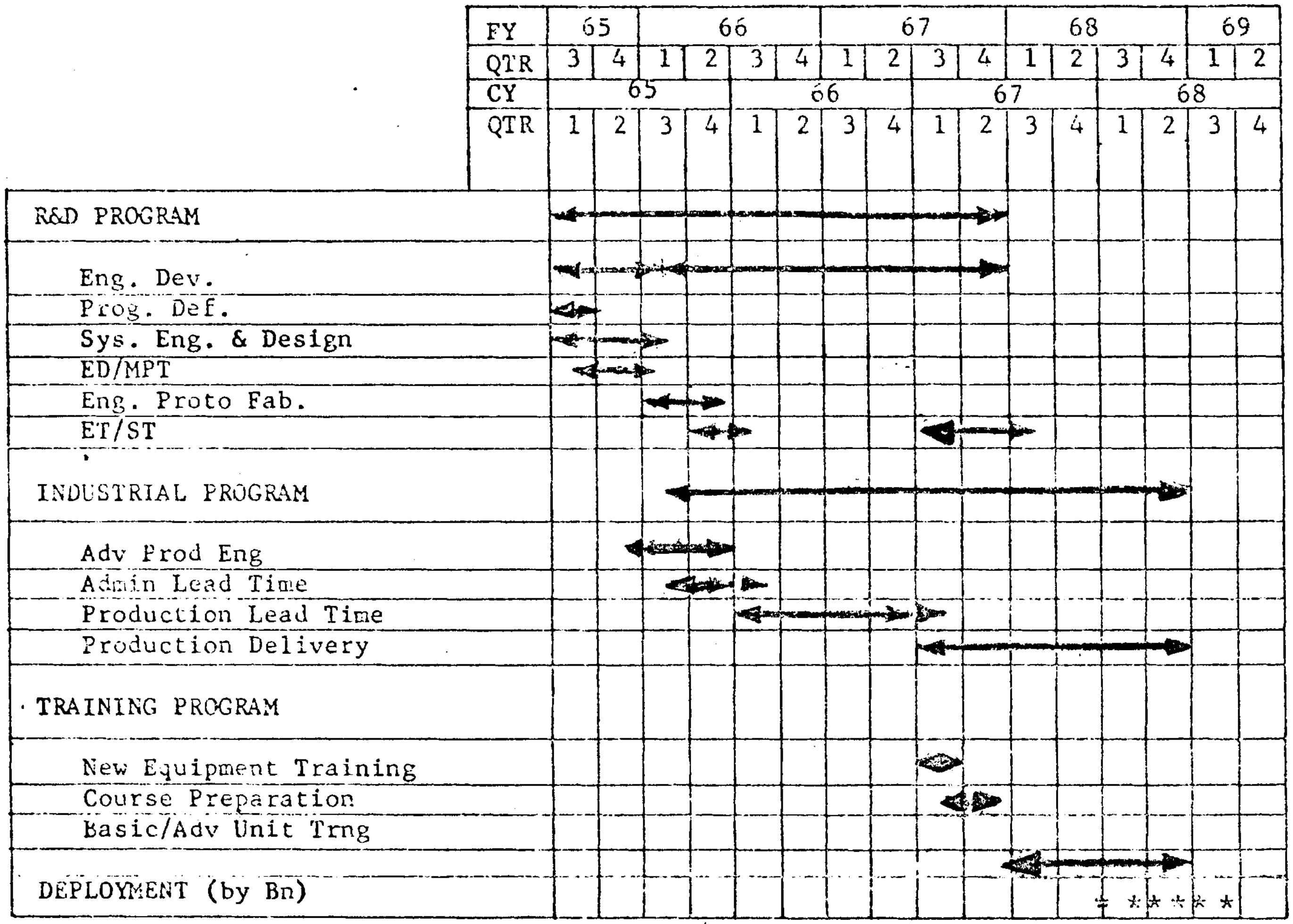

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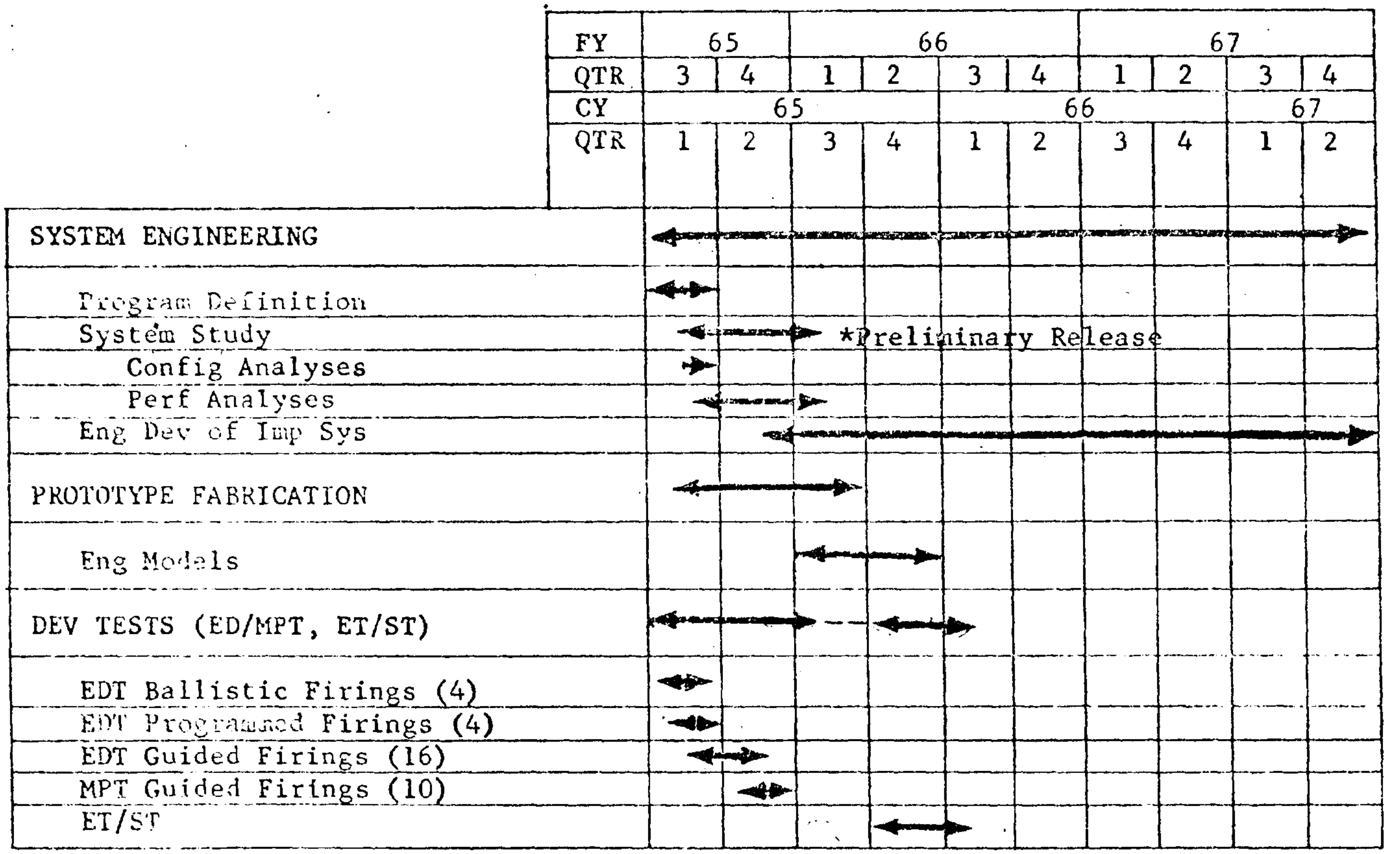
CHART 2. ENGINEERING DEVELOPMENT SCHEDULE



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The system engineering studies to be conducted concurrently with the ED/MPT would include configuration analyses to determine an optimum weapon/prime mover combination; analyses of the human engineering problems and effects of the man/machine interface; investigation of countermeasure and counter-countermeasure devices and techniques; definitization of the maintenance package, procedures, and equipment; and determination of training requirements, to include preliminary design of a suitable training device for field use.

Two sets of R&D prototype equipment were required for use in the ED/MPT program: one for non-firing, acquisition, tracking, and environmental tests, and one for flight test firings. These prototypes were to resemble as closely as possible the ultimate fire unit configuration; however, with the limited time available it was expected that many design changes would be required as a result of the ED/MPT. These design changes would then be incorporated into a minimum of four engineering prototypes which would be subjected to ET/ST in FY 1966.

The total industrial program would last for about 5 years; however, the quantities to meet established requirements would be procured over a period of 2 fiscal years, with Advance Production Engineering (APE) being initiated in May 1965. A total of 5,033 missiles were planned for procurement. Of these, 223 would be used for training, leaving 4,810 for tactical use. In addition, 1,040 LAU-7 launchers and 260 M113 vehicles were planned for procurement. This initial production plan was based on training and equipping six battalions with the interim CHAPARRAL system.

Because of the compressed time phasing of the R&D and industrial programs, it was considered essential that the industrial engineering services contract be awarded to the R&D prime contractor, who would be responsible for insuring system integrity and compatibility during the industrial phase. Effort under the contract would include product and production engineering of all equipment to be produced, plus the maintenance of liaison with Navy contractors, Government agencies, and other contractors producing system equipment. Existing Army and Navy contractor facilities would be used.

Program Cost Estimate

Exclusive of funds required for the FAAR program, it was estimated that $17.5 million in RDTE* funds would be required

*Research, Development, Test, and Evaluation.

during the 1965-67 period to complete engineering development and conduct necessary tests of the CHAPARRAL. The estimated PEMA* funds required for the planned procurement was $77,901,000 during the 1965-69 period. This brought the total estimated program cost to $95,401,000 for the 1965-69 period.[7]

TABLE 1
ORIGINAL CHAPARRAL PROGRAM COST ESTIMATE
January 1965
(Thousands of Dollars)

SOURCE	FY 65	FY 66	FY 67	FY 68	FY 69	TOTAL
RDTE	5,000	9,500	3,000	0	0	17,500
PEMA	300	38,952	36,343	1,433	873	77,901
Total	5,300	48,452	39,343	1,433	873	95,401

SOURCE: MICOM Rept, Prelim Tech Dev Plan - CHAP LA AD Sys, 14 Jan 65. RSIC.

Mindful of the urgent need for the weapon system and the schedule delays caused by funding deficiencies in other missile programs, MICOM emphasized that the validity of the schedules presented was contingent upon the availability of the required RDTE and PEMA funds during July and September, respectively, of each fiscal year. "Insufficient funds and/or untimely funding availability," it warned, "will certainly cause a slip in the system operational readiness date." Moreover, the decision to field the system would have to be made by 1 September 1965, and FY 1966 RDTE money would have to be released in advance of that date in order to allow procurement of the prototypes for ET/ST and to meet New Equipment Training (NET) requirements at the Air Defense Center and the Ordnance Guided Missile School. "Failure to release FY 66 monies until after the decision is made would preclude timely availability of this equipment; thereby delaying initiation of the ET/ST and NET Programs."[8]

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*Procurement of Equipment and Missiles, Army.

[7]MICOM Rept, Prelim Tech Dev Plan - CHAP LA AD Sys, 14 Jan 65. RSIC.

[8]*Ibid.*, p. I-8.

Implementation of the Program

The FY 1965 phase of the engineering development effort began with award of the initial R&D contract to the Philco Corporation in February 1965, and was completed essentially on schedule with delivery of the first prototype system in August 1965. But that was as far as the original program plan remained valid. As a result of major changes in military requirements, program decision delays, inadequate and untimely funding support, technical and production difficulties, and problems associated with the complex management structure, initial deployment of the CHAPARRAL system was delayed 22 months (from January 1968 to November 1969) and the RDTE cost increased from the original estimate of $17.5 million for the 1965-67 period to $62,481,000 for the 1965-74 period. Because of similar problems in the FAAR program, early warning and IFF equipment, which was to have been developed and fielded within the same timeframe as the CHAPARRAL, was not available for deployment until December 1972.

The development, production, and deployment of the CHAPARRAL system will be dealt with in appropriate detail following an account of the project management structure and problems related thereto. The FAAR program was a major subtask requiring management on a separate "system" basis. It will be covered in Part Two of this study.

CHAPTER II

(U) PROJECT MANAGEMENT STRUCTURE

The management structure imposed by the Army Materiel Command (AMC), over objections of MICOM, was an unusually complex and unwieldy one fraught with managerial red tape and overt duplication of effort. Instead of having separate project managers for the CHAPARRAL and VULCAN* systems located at MICOM and the Army Weapons Command (WECOM), respectively, the Commanding General of AMC insisted that the mission of the forward area air defense program could best be met by a single project manager reporting directly to him and located in the Washington area. The AMC project manager accomplished his CHAPARRAL/VULCAN missions through assistant project managers located at MICOM and WECOM.

Despite several attempts by MICOM to have overall management responsibility for the CHAPARRAL and VULCAN systems assigned to the source of their technical base, the project management structure remained unchanged for more than 7 years. Throughout that period, the prosecution of the CHAPARRAL/FAAR program was hampered by piecemeal funding, serious manpower deficiencies, and a general lack of support at higher Army levels. The reason was that the original system was placed in development to provide an interim capability only, pending availability of the MAULER system, and the general tendency was to get it in the field as expeditiously and inexpensively as possible. The trouble was that the system ceased to be an "interim" weapon the first year of development, when the bolt-together concept was invalidated, the MAULER program was terminated, and the environmental and service life requirements for the CHAPARRAL were expanded for world-wide deployment. This necessarily increased RDTE costs above the original estimate, and the dilatory piecemeal funding itself added both to the cost and time requirements.

In retrospect, one of the biggest mistakes from a management viewpoint was the decision to place the two diverse weapon systems under a single project manager in Washington, with the work being done by assistant project managers located miles away at the commodity commands. The unrealistic management levels thus imposed

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*The M61 VULCAN automatic gun system was selected as the CHAPARRAL's companion for the composite battalions.

were as non-productive as they were costly and frustrating. They essentially amounted to a manager managing a manager, for the assistant project manager was delegated the directive authority and mission responsibilities assigned in the AMC Project Manager's charter. The result was extensive duplication in job areas, but not in work, because the Project Manager could not possibly carry out the mandate of his charter at a distance of more than 725 miles. While the Project Manager's office staff averaged in the 30's during the crucial years of the program, the CHAPARRAL Management Office at MICOM lacked the number and caliber of personnel needed for the actual accomplishment of the mission. As will be noted later, there was a conflict over civilian grade structures at the two management levels, and, at one time, MICOM had to detail qualified engineering personnel to the CHAPARRAL office in order to fill critical gaps.

Aside from the multifarious problems stemming from the fragmented management structure, MICOM's task was further complicated by the joint Army-Navy management-procurement concept for the CHAPARRAL missile. Since the Navy's SIDEWINDER and the CHAPARRAL missile shared about 95 percent commonality of components, and the Army lacked the specialized knowledge essential for the immediate performance of technical functions relating to procurement, the joint management-procurement concept appeared to be advantageous both from a cost and time standpoint. The advantages derived from this arrangement, however, were largely nullified by a variety of problems and conflicts which led to delays in CHAPARRAL delivery and activation schedules.

The summary which follows traces the basic management structure as it evolved at MICOM during the 1965-74 period. The contractual structure and problems associated with funding deficiences and the Army-Navy relationship will be treated in later chapters.

Early Management Organization

During the evaluation phase of the Interim Air Defense Systems (IADS) Project, in FY 1965, the IADS Project Manager, located in Washington, was responsible for the management and coordination of various systems to aid AMC in arriving at an interim solution to the forward area air defense problem. Within MICOM, the responsibility for execution of the early CHAPARRAL/FAAR functions was vested in the Air Defense Systems Branch, Development Division, R&D Directorate, with the Deputy Commanding General for Air Defense Systems (DCG/ADS) providing general direction and control. LTC William Smith, chief of the Air Defense

Systems Branch, was the responsible project officer.[1]

On 1 April 1965, shortly after initiation of the CHAPARRAL engineering design tests, AMC organized a Project IADS Field Office at MICOM with an authorized strength of two civilians. The new field office reported directly to the IADS Project Manager at AMC and was attached to MICOM for administrative, training, and logistical support. Its primary mission was to coordinate and control all actions and activities related to the CHAPARRAL missile system. A similar field office was established at Rock Island Arsenal, Illinois, and attached to WECOM, to coordinate and control activities related to the evaluation of automatic weapons of various calibers.[2]

By mid-summer of 1965, the evaluation of available automatic weapons was completed and the M61A1 VULCAN gun was selected for deployment with the CHAPARRAL in the composite battalions. LTC John T. Peterson, the IADS Project Manager at AMC, assumed project management responsibility for the CHAPARRAL and VULCAN systems effective 1 August 1965.[3]

The CHAPARRAL Commodity Office

On 2 August 1965, near the end of the ED/MPT program, the CHAPARRAL Commodity Office was organized at MICOM under jurisdiction of the DCG/ADS. LTC William Smith was assigned as the CHAPARRAL Commodity Manager. Personnel performing CHAPARRAL management functions in the R&D Directorate were concurrently transferred to the new office. They were physically located near the MAULER Project Manager to receive direct assistance, guidance, and support from his office, which was then phasing out of existence.[4] With the termination of the MAULER Project Office some 3 months later, the CHAPARRAL and SAM-D* offices absorbed key

*Surface-to-Air Missile - Development.

[1](1) Hist Rept, CMO, 1 Jan 65 - 30 Jun 66. (2) MFR, MAULER PMSO, 2 Oct 64, subj: Fwd Area AD Wpn Sys. (3) Ltr, CG, MICOM, to CG, AMC, 14 Oct 65, subj: Req for Dsgn of a CHAP Proj Ofc. All in HDF. (4) MICOM Rept, Prelim Tech Dev Plan - CHAP LA AD Sys, 14 Jan 65, pp. V-2 & Annex A. RSIC.

[2]AMC GO 34, 8 Jun 65.

[3]Hist Rept, CMO, 1 Jan 65 - 30 Jun 66, p. 2. HDF.

[4](1) MICOM GO 69, 9 Aug 65. (2) SS AMSMI-WM-85-65, Mgt Science & Data Sys Ofc, 5 Aug 65, subj: Estb of CHAP Cmdty Ofc. HDF.

members of the project staff, thereby maintaining the integrity and experience of the team.[5] The majority of the MAULER personnel went to the SAM-D Project Office.[6] The CHAPARRAL Commodity Office had a total of 11 personnel spaces (4 military and 7 civilian).[7]

Although there was an AMC project manager for interim air defense systems, of which CHAPARRAL was one, the responsibilities and authorities of the CHAPARRAL Commodity Office, within MICOM, were very similar to those of a project office. Even so, it was limited in its flexibility, responsiveness, and scope of operation. With the completion of the military potential tests and with the decision to proceed with development and production anticipated very shortly, the Commanding General of MICOM concluded that the combined AMC project office removed from the detailed supervision of the program was no longer the most reasonable and efficient method of managing the weapon system. He therefore recommended, in October 1965, that a project manager be designated with full authority and with a project management organization that could be completely responsive to the requirements of the expanded CHAPARRAL program. By way of justification, he pointed out that the development and production programs would have to be compressed in order to field the weapon system in the required timeframe, and that the complexity of the compressed program would require extremely close supervision and direction from a single focal point. The initial program, outlined in Secretary of Defense Decision/Guidance Z-4-048 of November 1964, more than met the requirements for vertical project management. Moreover, the complexity of the system was such that its management would involve not only MICOM, but also the other commodity commands, as well as the Combat Developments Command and agencies of the Department of the Navy.[8]

Instead of having two project managers (one for the CHAPARRAL/FAAR at MICOM and one for the VULCAN at WECOM) coordinated by AMC staff action, as MICOM suggested, the Commanding General of AMC decided to continue the centralized coordination and control of the programs by a single project manager reporting directly to him and located in the Washington area. He indicated, however, that

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[5]Mary T. Cagle, *History of the MAULER Weapon System* (MICOM, 19 Dec 68), p. 247.

[6]Intvw, M. T. Cagle w Adrian O. Watson, 25 Jan 74.

[7]MICOM Pers Sta Repts, Aug-Nov 65. Drte for Pers Tng & Force Dev (D/PT&FD), Force Dev Div Files.

[8]Ltr, CG, MICOM, to CG, AMC, 14 Oct 65, subj: Req for Dsgn of a CHAP Proj Ofc. HDF.

he would be willing to consider the delegation of AMC directive authority to the CHAPARRAL office as a primary participating organization in support of the IADS Project Manager.[9]

The CHAPARRAL Management Office

Under the "assistant project manager" concept thus instituted, the CHAPARRAL Commodity Office was redesignated as the CHAPARRAL Management Office, effective 29 November 1965, with LTC William Smith as chief.[10] A subsequent change to the AMC IADS Project Charter delegated the office full line authority to exercise integrated management of weapon system responsibilities, including the pursuit of activities covering research, development, procurement, production, distribution, logistical support, personnel training, operational testing, and deployment. Within MICOM, the CHAPARRAL Management Office was considered as a project office and its functions were vertically managed. Although responsible to the Commanding General of MICOM, through the DCG/ADS, the Assistant Project Manager (APM) for CHAPARRAL was responsive to the AMC Project Manager, IADS, and operated under his guidance and control.[11] The organization consisted of a Program Management Office and four divisions: System Engineering, Procurement & Production, Product Assurance & Test, and System Support.[12]

Until mid-January 1966, the office's authorized personnel strength remained unchanged (4 military, 7 civilian). Its assigned strength increased from 21 (4 military, 17 civilian) on 30 November 1965, to 29 (4 military, 25 civilian) on 15 January 1966. At the end of January, its authorized strength had been increased to 30 (5 military, 25 civilian), and it had an assigned strength of 31 (4 military, 27 civilian).[13]

Since direct support from the assistant project managers at MICOM and WECOM invalidated the need for independent field offices,

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[9] Ltr, CG, AMC, to CG, MICOM, 10 Nov 65, subj: Req for Dsgn of a CHAP Proj Ofc. HDF.

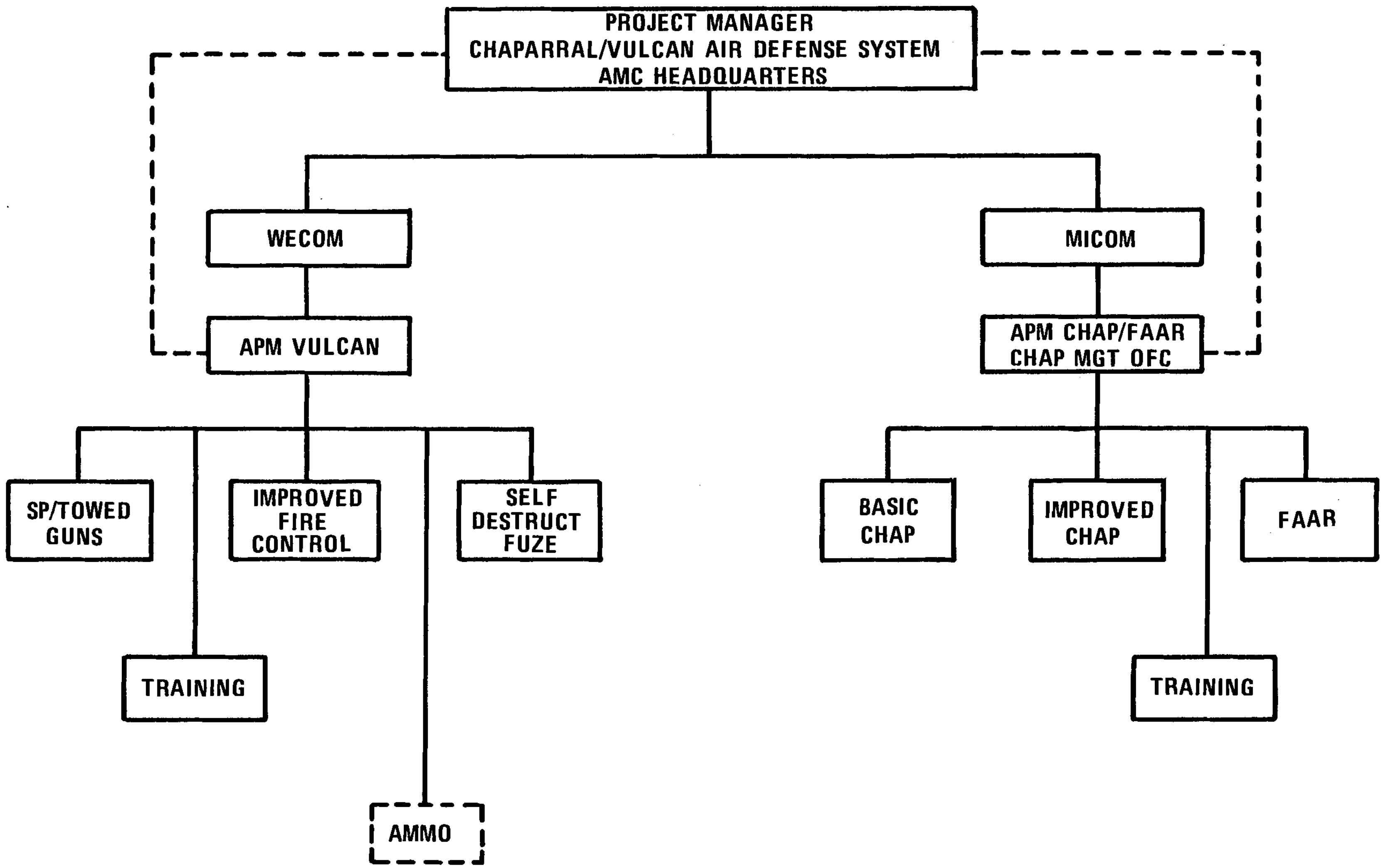
[10] MICOM GO 101, 1 Dec 65.

[11] (1) MICOM GO 5, 13 Jan 66. (2) 1st Ind, CG, MICOM, to CG, AMC, 29 Nov 65, on Ltr, CG, AMC, to CG, MICOM, 10 Nov 65, subj: Req for Dsgn of a CHAP Proj Ofc. HDF.

[12] MICOM Org & Mgt Manual, Sec 160, 15 Dec 65. HDF.

[13] MICOM Pers Sta Repts, 30 Nov 65 - 31 Jan 66. D/PT&FD, Force Dev Div Files.

CHART 3
CHAPARRAL/VULCAN ORGANIZATION & WORK STRUCTURE
29 NOVEMBER 1965 – 3 JANUARY 1971



AMC discontinued the IADS Field Offices at Redstone Arsenal and Rock Island Arsenal effective 15 January 1966.[14] Shortly thereafter, on 24 January 1966, the Project Manager, Interim Air Defense Systems, AMC, was redesignated Project Manager, VULCAN/CHAPARRAL Air Defense System, and the project charter was approved.[15] The CHAPARRAL ceased to be known as an interim system in December 1965, when the Department of Defense approved the expanded program.[16]

During the period 15 February to 15 June 1966, the CHAPARRAL Management Office (CMO) continued to operate under the Table of Distribution (TD) authorizing 30 spaces (5 military, 25 civilian), while its assigned strength increased from 31 to 48 (2 military, 46 civilian). Late in June 1966, the office was allocated 15 additional civilian spaces, bringing the authorization to 45 (5 military, 40 civilian). On 30 June, there were 51 personnel assigned (4 military, 47 civilian).[17]

LTC William Smith continued to serve as chief of CMO until 7 June 1966. Mr. Marvin B. Snipes filled in as acting chief until the assignment of LTC Donald H. Steenburn on 13 September 1966.[18]

Upon his arrival, Colonel Steenburn found the CMO staff working an enormous amount of overtime because of inadequate technical and professional personnel to carry out the rapidly expanding CHAPARRAL and FAAR missions. A survey in August 1966 showed that the CMO overtime rate far exceeded that of the 10 other project organizations. The office's authorized strength had just been increased from 45 to 55 (5 military, 50 civilian) spaces from within MICOM resources; however, 10 additional civilian spaces were urgently needed from AMC for use in system engineering and field support areas. Pending approval of these spaces and the revised Table of Distribution & Allowances (TDA), arrangements were made for detailing knowledgeable personnel to key positions

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[14]AMC GO 6, 10 Feb 66.

[15](1) AMC GO 15, 21 Mar 66. (2) To avoid possible confusion with the initial VC (Viet Cong), the name VULCAN/CHAPARRAL (V/C) was later changed to CHAPARRAL/VULCAN (C/V). DA Msg 850501, 8 Feb 68. Quoted in MICOM DB #31, 13 Feb 68.

[16](1) SECDEF Decision A-5-069, 6 Dec 65. RHA Bx 14-8. (2) AMCTCM 3970, 16 Dec 65. RSIC.

[17]MICOM Pers Sta Repts, 15 Feb 66 - 30 Jun 66. D/PT&FD, Force Dev Div Files.

[18]MICOM GO 83, 14 Jul 66; MICOM GO 113, 5 Oct 66.

for a period of 6 to 9 months. At the end of August 1966, the office had an assigned staff of 1 officer and 48 civilians.[19]

In October 1966, MICOM submitted to AMC a revised TDA reflecting the new composition of required skills within the 50 civilian spaces already provided and the 10 additional spaces requested. Included in the latter were eight spaces for aerospace, electronic, and general engineers in grades GS-12 to 14.[20]

The AMC Director of Personnel & Training reviewed the TDA on 13 October, but reached no decision. Instead, the CMO was required to furnish additional justification and information on the CHAPARRAL organization and the proposed staffing pattern. The questions raised by AMC indicated a lack of understanding of the interlocking complexities of the CHAPARRAL/FAAR program and the kind of performance involved in carrying out the mission. This action by AMC caused additional delays in the hiring of critically needed engineering personnel and added to the risks already involved in the program. At that time, the status of the total program was being reviewed to determine the extent of risks being assumed under the existing deployment schedule and whether or not such risks were reasonably acceptable. In a presentation to the MICOM Review Board on 25 October 1966, CMO personnel emphasized that the lack of personnel involved significant risks and that proper management of the program could not be assured without an adequate engineering staff.[21]

By the end of 1966, the manpower shortage was rapidly becoming one of the most critical situations facing the CHAPARRAL office. In November 1966, AMC again demanded additional justification of the TDA. This information went to AMC in late November, and the TDA was forwarded to DA for review and approval in early December.[22] Meanwhile, the civilian staff dropped from 48 on 31 August, to 44 on 31 December 1966.[23]

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[19](1) DF, DCG/ADS to Mpr Div, Pers & Tng Ofc, 11 Aug 66, subj: CHAP Mpr Rqrmts, w incls. HDF. (2) MICOM Pers Sta Rept, 31 Aug 66. D/PT&FD, Force Dev Div Files.

[20]Ltr, CG, MICOM, to CG, AMC, 10 Oct 66, subj: Mpr Rqrmts - CHAP, w incl, TDA M1-3009-00, 30 Sep 66. HDF.

[21](1) Hist Rept, CMO, FY 67. (2) MICOM Rept, CHAP Program Review as Presented to MICOM Review Bd, 25 Oct 66, pp. 8, 10. CMO Files.

[22]Hist Rept, CMO, FY 67. HDF.

[23]MICOM Pers Sta Rept, 31 Dec 66. HDF.

In mid-January 1967, CMO received a TD authorizing the 50 civilian spaces and personnel actions up to and including GS-13's. The higher grade positions and the 10 additional spaces requested were still pending DA approval; however, with authority then in MICOM, about 80 percent of the personnel actions could be promptly processed.[24] By the end of June 1967, 5 people had been hired, bringing the total civilian strength to 49.[25]

The 10 civilian spaces requested were never approved by DA, and reductions in MICOM's manpower resources made it increasingly difficult to satisfy personnel requirements of the CHAPARRAL/FAAR and other high priority programs. Fluctuations in the office's manpower resources during the period July 1967 through December 1969 are depicted below.[26]

	OFFICERS		CIVILIANS		TOTAL	
Date	Auth	Act	Auth	Act	Auth	Act
1 Jul 67	5	2	57	49	62	51
30 Sep 67	5	6	50	48	55	54
31 Dec 67	5	5	49	48	54	53
15 Apr 68	5	5	54	54	59	59
30 Jun 68	5	3	60	48	64	51
30 Sep 68	5	4	59	51	64	55
31 Dec 68	5	5	51	53	56	58
30 Apr 69	5	5	54	54	59	59
31 Jul 69	5	5	58	57	63	62
31 Oct 69	5	4	55	55	60	59
31 Dec 69	5	4	53	54	58	58

In April 1969, some 7 months before initial deployment of the CHAPARRAL, the organization of the CHAPARRAL/FAAR and VULCAN projects came under close scrutiny by both MICOM and the AMC Review Board. In addition to staff studies of nine project managed systems requested by AMC, the Commanding General of MICOM directed that a separate study be prepared on the CHAPARRAL/VULCAN organizational structure, pointing out the overt duplication of management and recommending that project management of the two systems be returned to the source of their technical base. The Assistant Project Manager at WECOM indicated that he also planned to request

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[24]Hist Rept, CMO, FY 67. HDF.

[25]MICOM Pers Sta Rept, 30 Jun 67. HDF.

[26]MICOM Mpr Sta Repts, Jul 67 - Dec 69. D/PT&FD, Force Dev Div Files.

project status for the VULCAN.[27]

In the appeal for establishment of separate management offices for the CHAPARRAL and VULCAN at the commodity command level, the Commanding General of MICOM emphasized that the scope of the CHAPARRAL/FAAR program was of such size and complexity that it required a management office of its own and that this had been true since its inception. He wrote:

> I firmly believe that managers of expensive, large programs must be located and assigned where the functional expertise can be made available to them in fulfilling their responsibilities. Negotiations, pricing and contract administration, as well as comptroller activities, legal advice, breakout, documentation, field support, maintenance, etc., all require functional expertise from personnel who have skill and experience in the daily activities of dealing with contractors and the field. This kind of support is not available in AMC HQ and the personnel which staff the project manager offices in Washington are generally program, administrative-review type personnel and not personnel with a hard, practical and technical experience in materiel business.
>
> It is my recommendation that first consideration be given to the abolishment of the CHAPARRAL/VULCAN Project Office in Washington and the creation of a product-managed office for CHAPARRAL and one for VULCAN at each respective commodity command. . . . The two are already working together effectively and interfaces are well established so as to assure a common approach in those few areas where such is needed.
>
> If it is determined that the field requirements are so essential as to require a single product office, then it is my recommendation that the product manager be located at either the Weapons Command or the Missile Command and that the other command involved be authorized a commodity office to carry out its part of the assigned responsibilities.[28]

In a fact sheet sent to the Commanding General of AMC, on 7 April 1969, the Project Manager, CHAPARRAL/VULCAN Air Defense

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[27]DF, CMO to DCG/ADS, 9 Apr 69, subj: Review of Proj Mgt. HDF.

[28]TT AMSMI-WM-4-1-69, CG, MICOM, to CG, AMC, 10 Apr 69, subj: Org & Loc for Mgt of the CHAP/VULCAN AD Sys. HDF.

System (CVADS), had recommended that his organization continue to operate as in the past.[29] However, in light of a subsequent AMC decision to relocate system managers from the Washington area to the major subordinate commands, where possible, MICOM felt that more favorable consideration would be given to its proposal to establish product management for the CHAPARRAL/FAAR. Accordingly, the MICOM recommendation of 10 April 1969 was assembled in the form of a formal proposal, complete with organization, charter, job descriptions, modified TDA, and justifications. The proposal was submitted to AMC in mid-August 1969,[30] but it turned out to be another exercise in futility.

Some 4 months later, on 9 December 1969, LTC Monte J. Hatchett took over as chief of the CHAPARRAL Management Office,[31] succeeding LTC Donald H. Steenburn, who had occupied the post since September 1966. Colonel Hatchett guided the program through deployment and type classification of the CHAPARRAL system and through solutions to many of the technical and contractual problems which plagued the FAAR system. Primarily as a result of serious problems in the FAAR program, the office's authorized personnel strength increased from 58 on 31 December 1969 to a peak of 74 (8 officers, 66 civilians) on 30 June 1970. During the same period, the actual strength climbed from 58 to 67 (5 officers, 62 civilians). On 31 December 1970, the office had an assigned staff of 66 (4 officers, 62 civilians), against an authorized strength of 74.[32]

Despite the overall gain in personnel, the office was still severely understaffed for the efficient execution of the CHAPARRAL and FAAR programs, which were two completely different systems requiring separate engineering, test, maintenance and support, configuration management, and other managerial reporting tasks. Yet, in December 1970, AMC decided to reduce the grade structure of the CMO TD on the grounds that the Project Manager at AMC had overall program management responsibility and, therefore, the same grades for like positions at MICOM would not be authorized.

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[29] Fact Sheet, PM, CVADS, 7 Apr 69, subj: Org Loc of the PM, CVADS. Quoted in TT AMC-53596, PM, CVADS, to CG, MICOM, 8 Apr 69, subj: Req for CG, MICOM Cmts & Recmn. HDF.

[30] SS AMSMI-WM-93-69, 8 Aug 69, subj: Req for Dsgn of a CHAP/FAAR Prod Ofc, & incl thereto, Ltr, CG, MICOM, to CG, AMC, 15 Aug 69, same subj. HDF.

[31] MICOM SO 265, 11 Dec 69.

[32] MICOM Mpr Sta Repts, Dec 69 - Dec 70. D/PT&FD, Force Dev Div Files.

The Commanding General of MICOM argued that the CHAPARRAL Management Office was required to operate in a manner identical to other project management organizations within MICOM, and that the individuals adversely affected were performing essentially identical tasks as employees assigned to those organizations. The downgrading actions, he said, were essentially a management rather than a salary and wage problem, which stemmed from a management decision to projectize at AMC instead of MICOM. However, the end result reflected potential salary and wage downgrading actions involving key supervisory personnel and experienced journeymen who would be lost to the program. Since the grade structure requested in the TD was within the guidelines of existing civilian personnel regulations, he urged that it be approved without exception.[33]

The grade structure was allowed to remain intact, but the CHAPARRAL Management Office underwent an organizational realignment, in January 1971, which led to a downward trend in personnel staffing.

The CHAPARRAL Special Items Management Office

The CHAPARRAL Management Office was redesignated the CHAPARRAL Special Items Management Office (SIMO) effective 4 January 1971, as part of the new standard commodity command organizational structure. Within MICOM, the office continued to operate in the same manner as a project office, and as "assistant project manager" to the CVADS Project Manager at AMC.[34] LTC Monte J. Hatchett stayed on as chief of the new office until 15 July 1971, when LTC Fredrick H. Niedermeyer replaced him.[35]

During FY 1971, CHAPARRAL/VULCAN project management underwent several reviews to determine if continuation of intensive management was warranted. In September 1970, the DA Chief of Staff approved an AMC recommendation that project management of CVADS be discontinued in FY 1972. After a detailed review of the program, AMC Headquarters decided to continue project management through 31 December 1971, with the stipulation that the decision would be

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[33] DF, DCG/ADS to CG, MICOM, 28 Dec 70, subj: CMO Staffing Problems, & incl thereto, Ltr, CG, MICOM, to CG, AMC, 29 Dec 70, subj: CHAP TD Grade Struc. HDF.

[34] (1) MICOM GO 21, 1 Mar 71. (2) MICOM Hist Sum, FY 71, pp. 1-2.

[35] MICOM GO 99, 15 Jul 71.

reviewed again in January 1972.[36] This action, however, was strongly opposed by the Army Air Defense Center and the U. S. Fourth Army, both of which insisted that the program had not progressed far enough to justify relaxation of the emphasis on centralized management.[37]

In March 1971, the CVADS Project Manager was advised that the project office would continue at least through June 1972. At the end of June 1971, the APM WECOM office had been terminated, and the APM MICOM office was tentatively planned for phase out by 30 June 1972.[38] The staff of the CHAPARRAL SIMO declined from 65 (3 officers, 62 civilians) in January 1971, to 8 (3 officers, 5 civilians) on 15 June 1972.[39]

The Air Defense Special Items Management Office

For all intents and purposes, the APM MICOM office ceased to exist on 26 June 1972, when the CHAPARRAL Special Items Management Office was discontinued. At that time, overall weapon system management functions associated with the CHAPARRAL and FAAR were transferred to the Air Defense Special Items Management Office (ADSIMO). The responsibility for providing in-depth functional support to ADSIMO for these systems was assumed by the Directorates for Research, Development, Engineering & Missile Systems Laboratory; Procurement & Production; Product Assurance; Maintenance; and Materiel Management.[40]

On 26 December 1972, the Secretary of the Army approved the termination of the CVADS Project Office effective 30 June 1973.[41] In mid-January 1973, the AMC Commander assigned MICOM the responsibility for continued intensive management of the CHAPARRAL and FAAR systems, as well as the lead command

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[36] Ltr, CG, AMC, to CG, MICOM, 7 May 71, subj: Mpr Mgt Survey - CHAP Mgt Ofc, MICOM. HDF.

[37] Ltr, CG, USAADCENFB, thru CG, 4th USA, Ft Sam Houston, Tex, & CG, CONARC, to CG, AMC, 4 Feb 71, subj: Future of C/V PM Ofc, w 1st Ind, CG, 4th USA, to CG, CONARC, 12 Feb 71. HDF.

[38] AMC Hist Sum, FY 71, p. 84.

[39] MICOM Pers Sta Repts, Jan 71 - Jun 72. PT&FD, Force Dev Div Files.

[40] MICOM GO 34, 8 Mar 72.

[41] SA Memo, 26 Dec 72, subj: Termn of Proj Mgt for Manned Aerial Veh for Survl (MAVS) & CVADS. Cited in AMC GO 87, 1 May 73.

responsibility for insuring proper interface of FAAR with the VULCAN and CHAPARRAL.[42] The Office of the CVADS Project Manager was officially terminated on 31 March 1973,[43] soon after overseas deployment and type classification of the FAAR system.

The Special Systems Management Office

In late August 1973, AMC approved the concept for a MICOM Special Systems Management Office, which was to embrace the weapon system management functions assigned to ADSIMO and the Land Combat Special Items Management Office (LCSIMO). On 16 September 1973, ADSIMO and LCSIMO were discontinued and their assigned functions were transferred to the new Special Systems Management Office (SSMO). COL Hal C. Bennett, Jr., chief of the former LCSIMO, was appointed chief of the new office.[44]

The SSMO was a small office which performed overall intensive management of its assigned systems/items. It differed from the project manager organizations, in that it had virtually no "doing" functions, these being performed as a routine mission by the appropriate MICOM staff element or functional directorate. The SSMO's job was basically one of budgeting, program planning, system evaluation (review and analysis), and assuring that the MICOM mission elements did the rest.[45]

The CHAPARRAL/FAAR Division of SSMO was headed by LTC Robert W. Gruen. As of 29 August 1974, it had an assigned personnel staff of 19 (4 officers, 15 civilians), against an authorized strength of 20 (2 officers, 18 civilians). Four of the authorized civilian spaces were supplemental (temporary), as were three of the assigned personnel.[46]

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[42] Ltr, Cdr, AMC, to Cdr, MICOM, 16 Jan 73, [re: CVADS & FAAR Mgt], atchd as incl to DF, Cdr, MICOM, to Distr, 5 Feb 73, subj: Spt to ADSIMO Relative to CVADS Trns. HDF.

[43] AMC GO 87, 1 May 73.

[44] (1) MICOM GO 149, 12 Sep 73. (2) DF, Act Dep Cdr, MICOM, to Distr, 13 Nov 73, subj: Guidance Relative to the New SSMO. HDF.

[45] *Ibid.*

[46] Info provided by Ms. Vonda Beard, CHAP/FAAR Div, SSMO.

The CHAPARRAL/FAAR Management Office (Provisional)

The acceleration of activity and interest in the CHAPARRAL led to a proposal, in September 1974, for the establishment of a CHAPARRAL/FAAR Product Office at MICOM. Aside from a major product improvement program and plans for new production, there was an increased foreign interest in buying the CHAPARRAL. As a result, the Commander of MICOM created the CHAPARRAL/FAAR Management Office (Provisional) effective 24 September 1974, and appealed to higher headquarters for authority to establish a product office.

The mission of the office was to coordinate all planning and assume direction and control of the work and associated system resources in all phases of development, procurement, production, distribution, and logistic support involved in providing CHAPARRAL/FAAR systems to the intended operational destination. The system manager reported directly to the Commander of MICOM and received full assistance and support from MICOM staff elements and functional directorates. LTC Robert W. Gruen, who had served as chief of the CHAPARRAL/FAAR Division of SSMO, was named as manager of the new office.[47]

The provisional office was staffed primarily from elements within MICOM.[48] As of 21 April 1975, it had an assigned strength of 40 (6 officers, 34 civilians), against an authorized strength of 53 (7 officers, 46 civilians).[49]

Authorization for establishment of the proposed CHAPARRAL/FAAR Product Office was yet to be received. Also being held in abeyance were FY 1975 PEMA funds for production of the improved MIM-72C missile and FY 1975 RDTE funds for the follow-on product improvement program.[50]

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[47] (1) MICOM GO 192, 25 Sep 74. (2) The [Redstone] *Rocket*, 9 Oct 74.

[48] *Ibid.*

[49] Info provided by Ms. Gloria Abee, CHAP/FAAR Mgt Ofc (Prov).

[50] *See* below, pp. 120-21.

CHAPTER III

(U) ENGINEERING DESIGN AND DEVELOPMENT

The CHAPARRAL engineering design and development program was begun in January 1965 to fulfill requirements set forth in the ACSFOR study of September 1964 and approved by the Secretary of Defense on 17 November 1964. The primary objectives of the program were to determine the technical feasibility of the system concept, to validate system performance, and to determine military potential of the system as an interim forward area air defense weapon for deployment in Europe. As originally conceived and described earlier in this study, the CHAPARRAL was to be a quick-fix, interim weapon system which would remain in the field some 2 to 4 years until the MAULER became available.

Specifically, the system would be a rather unsophisticated assemblage of slightly modified, off-the-shelf hardware consisting of the M113 armored personnel carrier with minor structural modifications to support a mount on its roof; the M45 quad-50 machine gun mount, modified to support and fire four missiles and provide environmental protection to the gunner; Navy LAU-7A launch rails installed on the M45 mount; and SIDEWINDER 1C missiles slightly modified to accommodate firing from the ground at zero initial velocity. Modifications to existing hardware would be held to an absolute minimum, in order to meet an early battalion activation date of July 1967 and an initial operational availability date of January 1968. The original RDTE program cost estimate of $17.5 million for the FY 1965-67 period was based on this bolt-together concept. It was believed that $5 million in FY 1965 funds would suffice for engineering design and development work, and that subsequent effort in FY 1966-67 could be restricted to the ET/ST program.[1]

Implementation of the Program

The Army Missile Command procured services and equipment for the engineering design and development effort from three primary

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[1](1) Hist Rept, CMO, 1 Jan 65 - 30 Jun 66, p. 1. HDF. (2) Prog Rept on Fwd Area AD, PM, IADS, Aug 65, pp. 3, B-20. CMO Files. (3) MICOM Rept, CHAP Program Review, 25 Oct 66, p. 6. File same.

sources. The Aeronutronic Division of the Philco-Ford Corporation designed, developed, and fabricated the CHAPARRAL ground support equipment under contract with MICOM. The Naval Ordnance Test Station (NOTS) provided range facilities and technical support for the test program, and the Navy Bureau of Weapons* supplied missile hardware under Military Interdepartmental Purchase Requests (MIPR's) from MICOM. Other agencies participating in the program included the Army Mobility Command, the Army Combat Developments Command (CDC), the Army Electronics Command, the Army Test & Evaluation Command (TECOM), the White Sands Missile Range (WSMR), and the Human Engineering Laboratories.[2]

Interim FY 1965 RDTE program authority for CHAPARRAL, received at MICOM on 15 January 1965, amounted to $4,315,000. Of this sum, $1,650,000 was committed to the Procurement & Production Directorate for the R&D contract with Philco-Ford; $413,900 went to the Naval Air Systems Command (Bureau of Weapons) for missile hardware; and $599,310 was sent to NOTS for initiation of the test program. The remainder was distributed among TECOM, WSMR, Army Air Defense Board, Human Engineering Laboratories, and MICOM for in-house support of the program. The actual RDTE expenditure for FY 1965 was $5,160,000, including $25,000 for support of the AMC Project Manager Field Office at MICOM.

A 30-day letter order contract (DA-01-021-AMC-11907) for $500,000 was awarded to the Philco-Ford Corporation, Aeronutronic Division, on 12 February 1965, for immediate initiation of work on the interim CHAPARRAL system. Negotiation of the R&D contract was completed on 11 March 1965, and Aeronutronic got a notice of award on 15 March. The contract price was $1,811,509 plus a target fee of $181,151, with a plus-or-minus 4 percent incentive fee swing.[3]

Engineering Design Changes

Very early in the system engineering studies, it became

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*After a 1966 reorganization, the Naval Air Systems Command (NASC) performed this function.

[2](1) MICOM Rept, Prelim Tech Dev Plan - CHAP LA AD Sys, 14 Jan 65, p. I-7. RSIC. (2) Hist Rept, CMO, 1 Jan 65 - 30 Jun 66, p. 1. HDF. (3) MICOM Hist Sum, FY 65, p. 148.

[3](1) *Ibid.*, pp. 148-49. (2) C&DP Rept, CHAP Cost & Tech Info Rept (COSTECH) 70-19, Aug 70, p. 47. CMO Files. (3) The final value of the FY 1965 R&D contract was $2,856,207. MICOM Contr Listings, 1 Jul 72. HDF.

apparent that the original bolt-together concept was not entirely valid. The extent of modifications exceeded expectations and some CHAPARRAL peculiar equipment had to be developed. As a result, the prototype system delivered in August 1965 bore little resemblance to the one originally proposed.

In the Vehicle

One of the first changes concerned the M113 vehicle, which failed to meet several CHAPARRAL requirements. Though in the Army inventory and in substantial numbers, the M113 was still in short supply in relation to CHAPARRAL requirements. Its silhouette was too high and, with the mount installed, substantial and time-consuming disassembly would be necessary for transportation within the confines of the Berne Tunnel* and Phase II airlift dimensions. Moreover, the vehicle was too small to accommodate the crew, and it was overloaded. The user required eight spare missiles (in addition to the four on the launch rails) and these could not be carried completely assembled inside the vehicle because the vehicle body was too short. Another drawback was the height of the mount and launchers relative to the ground or the vehicle bed, which would make loading missiles onto the launch rails difficult, at best, and probably require the development of a hoisting/loading device.

After a survey of six vehicles of the M113 family, MICOM selected the M548 full-tracked cargo carrier as the one best meeting the technical and availability requirements. While eliminating the technical problems inherent in the M113 personnel carrier, this vehicle also possessed some weaknesses, requiring extensive modification. Firing tests using a simulated M548 cargo compartment revealed that interaction between the missile back blast and the vehicle sides and rear imposed unsatisfactory forces on the launch rails and vehicle sides. This was solved by removing the sides and rear panel, providing a clear deck. Also, protection against the motor blast was provided for the crew compartment, engine, and other vulnerable areas. The swim capability lost as a result of the changes could be restored by the design of a swim kit.[4] The modified XM-548E1 vehicle was later designated as the XM-730.

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*Tunnel for rail traffic through the Alps which separate northern and southern Europe.

[4](1) MICOM Rept, CHAP Program Review, 25 Oct 66, pp. 6-7. (2) Rept of CHAP Review Gp, 16 Nov 66, pp. II-1, II-8. (3) Prog Rept on Fwd Area AD, PM, IADS, Aug 65, pp. 3, B-5. All in CMO Files.

In the Mount

Though considered to be available in adequate numbers, the World War II M45 machine gun mounts in inventory were in various states of repair, and even those judged to be in Class A condition were found to be completely incompatible with CHAPARRAL requirements. The M45 could not be properly sealed to protect the gunner from blast effects; it did not provide sufficient space for the gunner and necessary control panels; its electromechanical drive system did not possess the required dynamic response; and the drive motor for the turret was underpowered. In addition, the M45 could not be adapted to production line techniques because of the loose tolerances allowed in the World War II manufacture of these units.

Technical incompatibility of the M45 unit was overcome by the design of a new mount of similar exterior dimensions fitting on the same base configuration but using efficient structure and materials to provide adequate interior space and the required load-bearing capability. Specifically, the electromechanical drive was replaced with an electro-hydraulic system; the operator's compartment was sealed and pressurized against entry of exhaust gases; provision was made for raising and lowering the mount to meet transportation requirements; a control console was added; the machine gun support arms were redesigned to provide proper support for the launch rails and adequate boresighting facilities; additional stiffening structural members were added; and the mount was assembled to a pallet which carried the basic load of missiles and all auxiliary equipment.[5]

In the Launch Rails

The LAU-7A launch rails, which had been designed for launching the SIDEWINDER 1C missile in the air-to-air role, also proved to be unacceptable for the CHAPARRAL. Each launch rail required a separate power and cryogenic air supply for each missile, which was technically and financially undesirable. The former resulted in lower efficiency and therefore higher prime power requirements, while the latter (requiring replenishment of a self-contained air bottle) was incompatible with operations of extended duration. These factors, coupled with changes in design of the missile lugs

[5](1) *Ibid.*, pp. B-4, B-5. (2) MICOM Rept, CHAP Program Review, 25 Oct 66, p. 7. (3) Rept of CHAP Review Gp, 16 Nov 66, pp. II-2, II-10. All in CMO Files.

to reduce aerodynamic drag, precluded further use of the LAU-7A launch rail. Consequently, a new, simplified launch rail was designed and provisions were made for a single missile power supply for all four missiles, along with a continuous source of cryogenic air.[6]

In the Missile

The modified AIM-9D missile, later designated as the XMIM-72A, was a SIDEWINDER 1C air-to-air missile modified for low altitude surface-to-air performance against jet aircraft targets. The SIDEWINDER 1A missile, with a radar guidance system, was developed in the early 1950's and became operational in 1956. The SIDEWINDER 1C, an improved version of the 1A with an infrared guidance system, became operational in 1964. Significant improvements in the 1C model included increased rocket motor performance, maneuverability, seeker sensitivity, and look-angle capability; an improved fuze; and a more effective warhead.

In January 1965, MICOM authorized the Navy to conduct engineering design studies and tests in support of the CHAPARRAL missile evaluation. In February, NOTS published the definition of the predicted performance of the CHAPARRAL missile and the design changes required to convert the SIDEWINDER 1C to the CHAPARRAL surface-to-air configuration.

In the air-to-air role, the SIDEWINDER was fired with an initial velocity equal to that of the launching aircraft. As such, drag was not too much of a problem. However, when the missile was used in the surface-to-air role and launched with zero initial velocity, drag was quite a factor. To reduce drag, the lugs (or hangers) were redesigned, two of the rolleron wings were replaced with thin wings, and all fairings were streamlined. Among other design changes were these: the firing circuitry was changed; motor performance was increased; and guide vanes were removed. In the Guidance Control Group, a soft enablement circuit was added to allow sufficient velocity to be attained before initiating aerodynamic control, and the intercept arm circuitry (not required with the CHAPARRAL Mark 15 target detecting device) was removed.[7]

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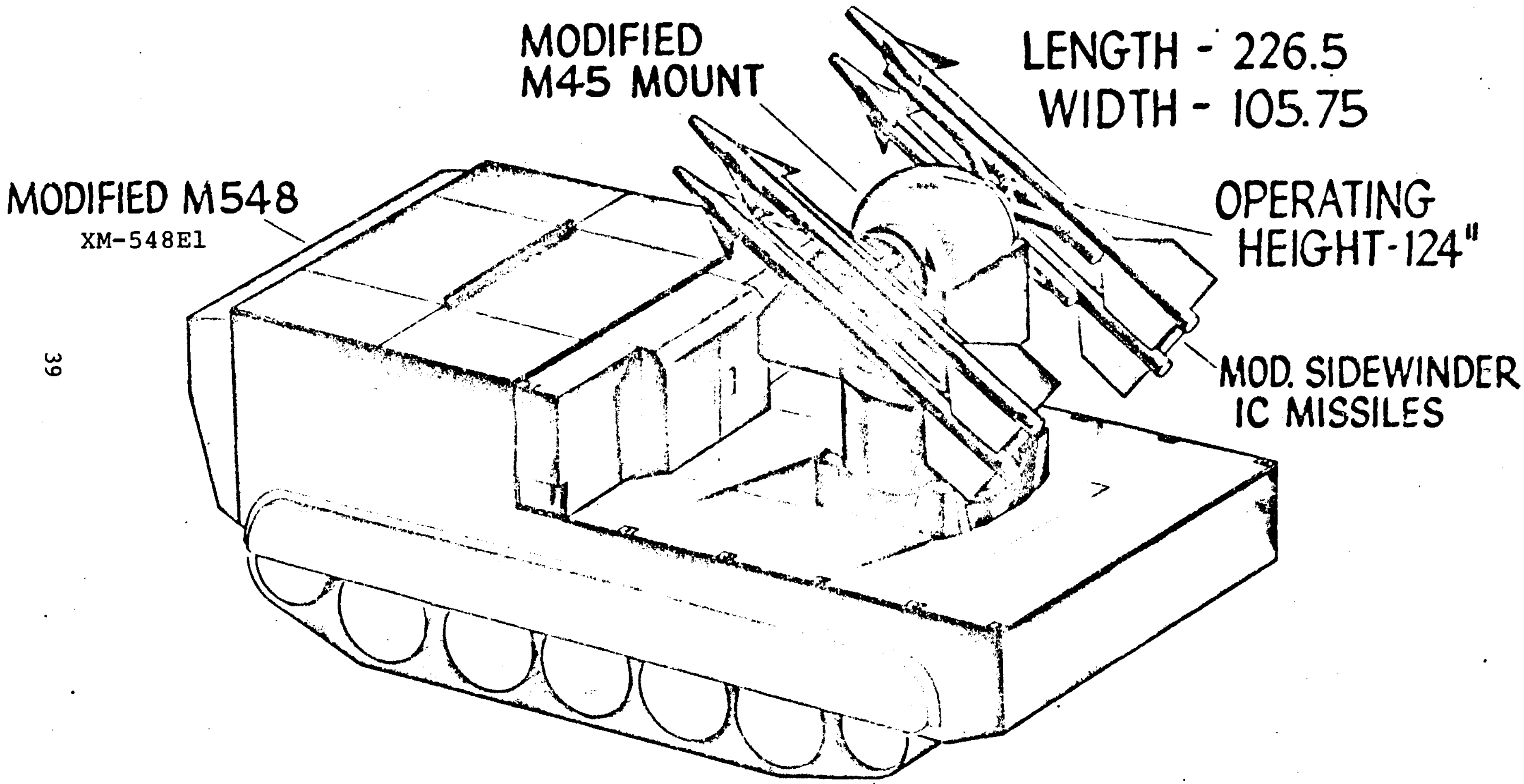
[6] (1) *Ibid.*, p. II-1. (2) MICOM Rept, CHAP Program Review, 25 Oct 66, pp. 7-8. CMO Files.

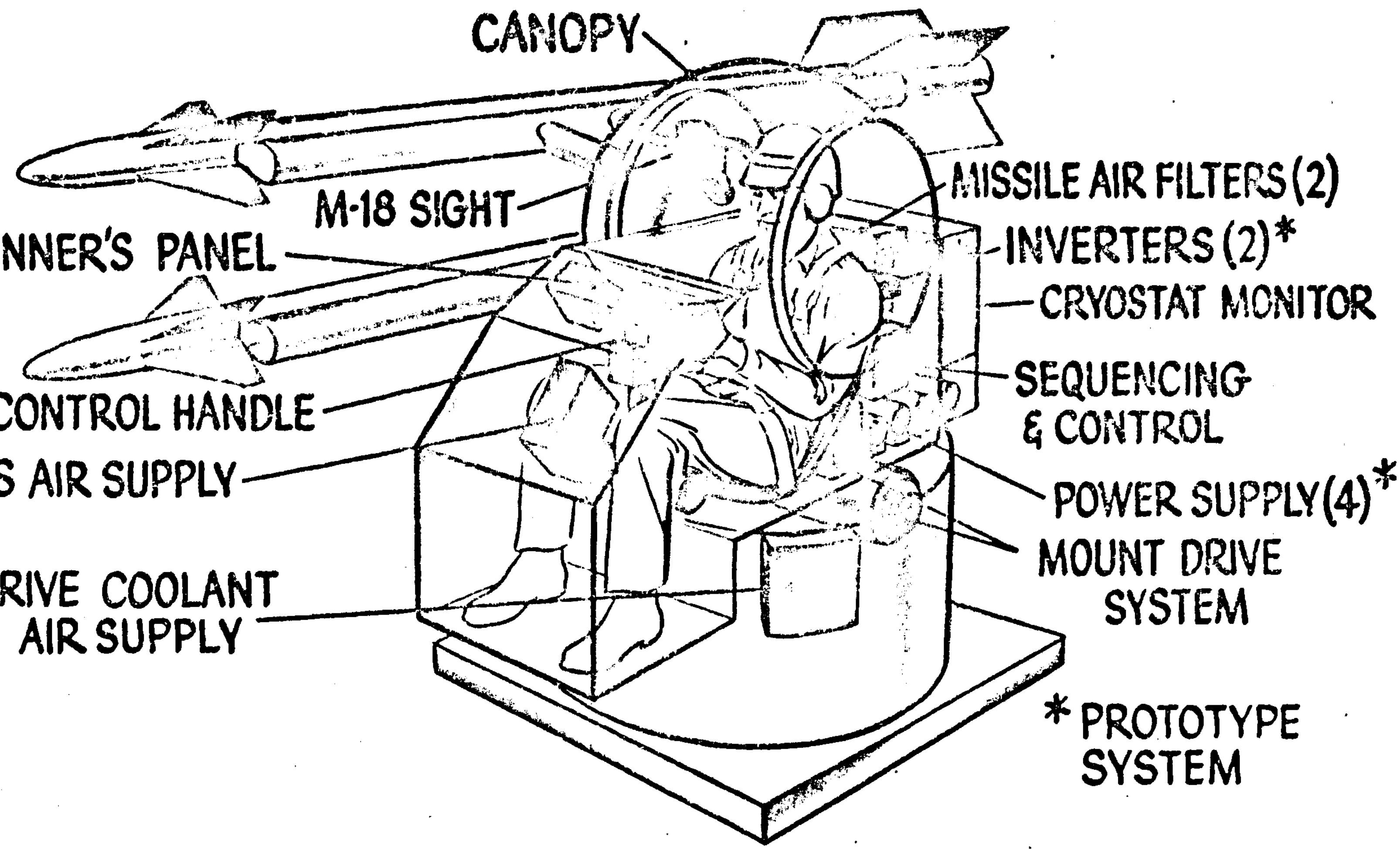
[7] (1) *Ibid.*, pp. 8-9. (2) Rept of CHAP Review Gp, 16 Nov 66, pp. II-2, II-12. (3) Prog Rept on Fwd Area AD, PM, IADS, Aug 65, p. B-9. All in CMO Files.

CHAPARRAL SYSTEM

ON THE MODIFIED M548 (XM-548E1) VEHICLE



MOUNT
GENERAL ARRANGEMENT



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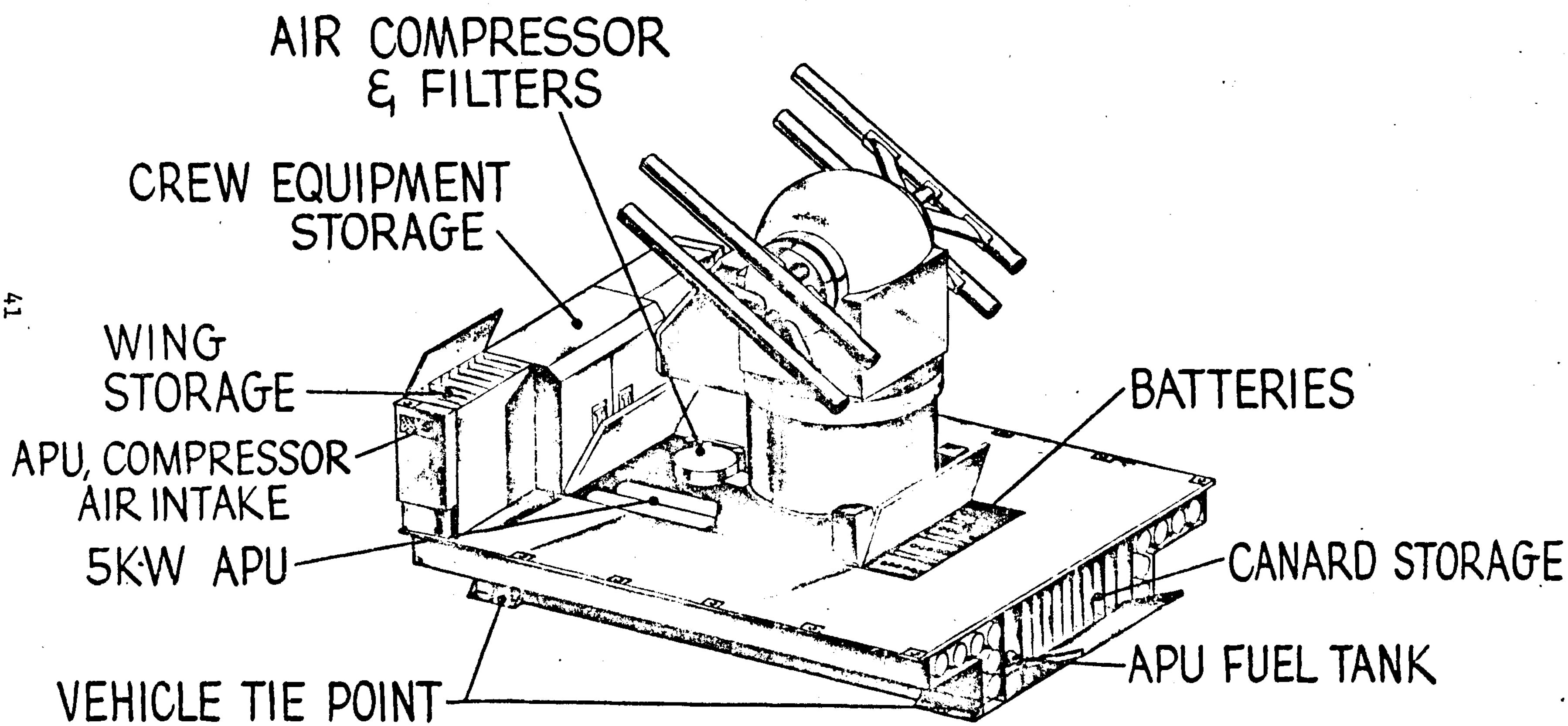
MISSILE LAUNCH & CONTROL SUBSYSTEM



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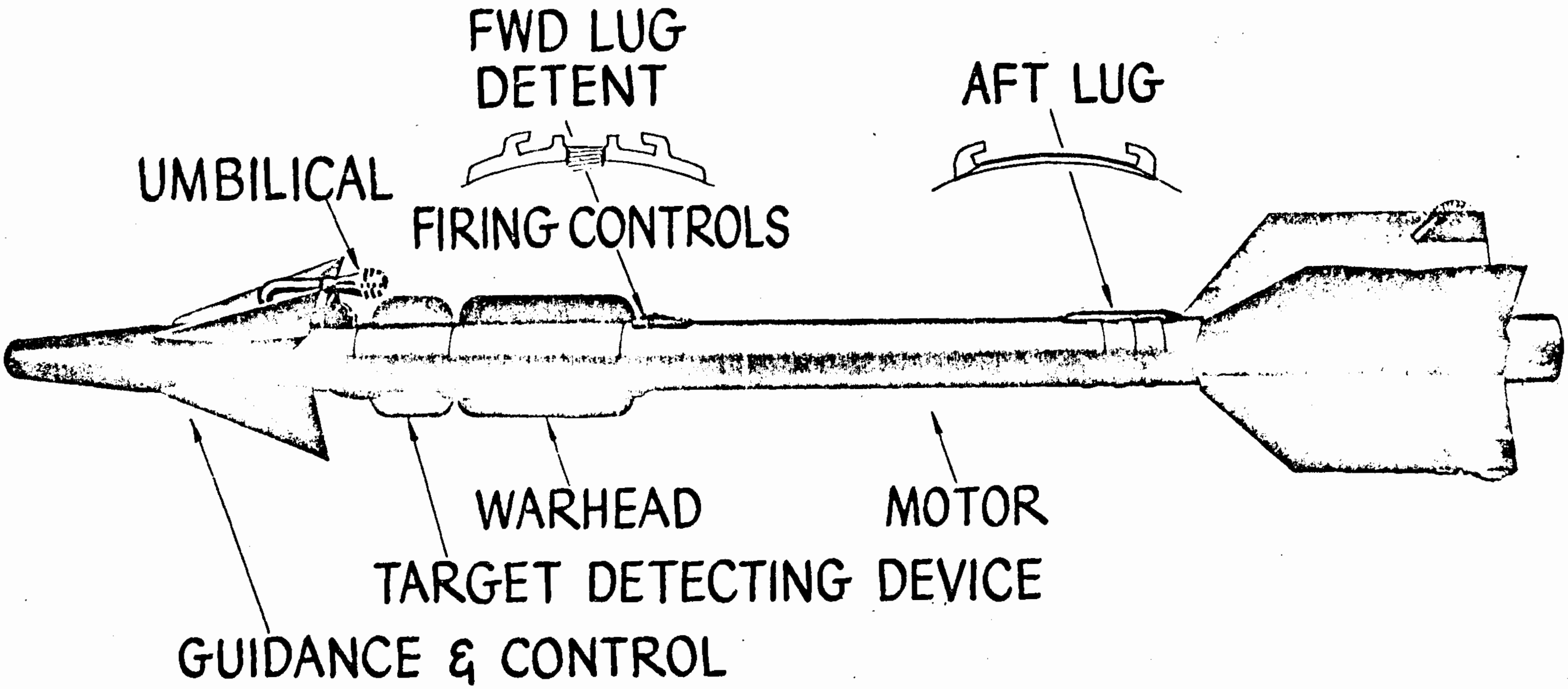
CHAPARRAL MISSILE



Engineering Design/Military Potential Test Program

The above design changes were made in the course of the ED/MPT program, which included 11 ballistic and 11 guided firings during the period 5 March through 27 July 1965. Under the original test plan, the engineering design test program by MICOM was to produce a vehicle-mounted prototype system, which would then be subjected to military potential tests by TECOM. However, as noted above, it became apparent early in the engineering design program that the M113 tracked vehicle would not fulfill the CHAPARRAL technical requirements. This, together with the limited time allowed for the test program, led to a decision, in February 1965, to conduct combined ED/MPT's on the Navy-developed demonstration mount consisting of four LAU-7A launchers attached to a modified machine gun mount, which was transported to the various test sites on an M-20 trailer. Engineering design studies of the modified XM-548E1 tracked vehicle for the tactical prototype system were conducted concurrently with the ED/MPT program. Three guided CHAPARRAL rounds were reserved for firing from the complete prototype system at a later date. All testing, including non-firing tests, was performed with participation by the U. S. Army Air Defense Board, the Aeronutronic Division of Philco, and NOTS.

The objectives of the 11 engineering design (ballistic) firings, which began on 5 March, were to obtain missile drag data for use in establishing optimum fairing configurations; to determine roll stability of the missile with two rolleron-equipped wings; to qualify the mount for manned firings; and to measure the exhaust blast effects in and around the mount during missile firings. The non-firing tests were conducted to evaluate simulated system performance under representative tactical conditions, to define operating procedures, and to investigate the man/machine relationship as a contribution to total system performance. The primary objectives of the 11 guided military potential tests were to evaluate missile performance and to determine the capability of the CHAPARRAL to fulfill the requirements of an interim air defense system.

The guided firings were conducted against targets at altitudes from 15 to 1,701 meters, at intercept ranges from 762 to 6,887 meters, and at speeds of 0 to 454 knots. In the absence of drone tactical-type aircraft, various types of target drones were used. Since these targets had thermal outputs considerably lower than those to be expected from tactical aircraft, they were augmented by thermite pots mounted at various locations on the drone. All of the target drones were of the fixed-wing (Q-2C) type except two, which were stationary H-19 helicopters mounted atop a 50-foot tower. The firings from a manned mount began on 31 March and continued through 21 June 1965.

Four of the 11 firings were tactically successful. Four of the others guided to within an acceptable miss distance (17 feet), but were tactically unsuccessful. Fuze failures occurred on three of these and on the fourth, the target (a stationary H-19 helicopter with engine running) required infrared augmentation for the missile seeker to lock on against the desert background. The remaining three firings were unsuccessful: one warhead detonated prematurely and two missiles failed to guide to the target.

The unreliability of the Mark 15 Target Detecting Device (TDD) was considered to be the most serious deficiency in the CHAPARRAL missile. The TDD battery failed on two flights, spurious fuze functions occurred on two, and possibly three flights, and no fuze function occurred on one flight which achieved an acceptable miss distance. Deficiencies in the TDD would have to be corrected before the modified AIM-9D missile could be considered as having sufficient military potential for use in a surface-to-air role. Among other potential problem areas were these:

1. The rocket motor exhaust plume tended to pinpoint the fire unit location and obscure other targets. The time required for dissipation of the smoke cloud depended upon atmospheric conditions.

2. Sun glare on the transparent dome covering the mount operator's compartment could reduce the system's effectiveness under certain conditions.

3. The missile seeker's susceptibility to background radiation could obscure target radiation. Operator training could help to eliminate a portion of this problem, but not all of it.

4. There was a serious quality assurance problem in the manufacture of missile components, particularly the guidance and control unit. A total of 31 major and 387 minor deficiencies were corrected during preparation and checkout of the 11 guided rounds.[8]

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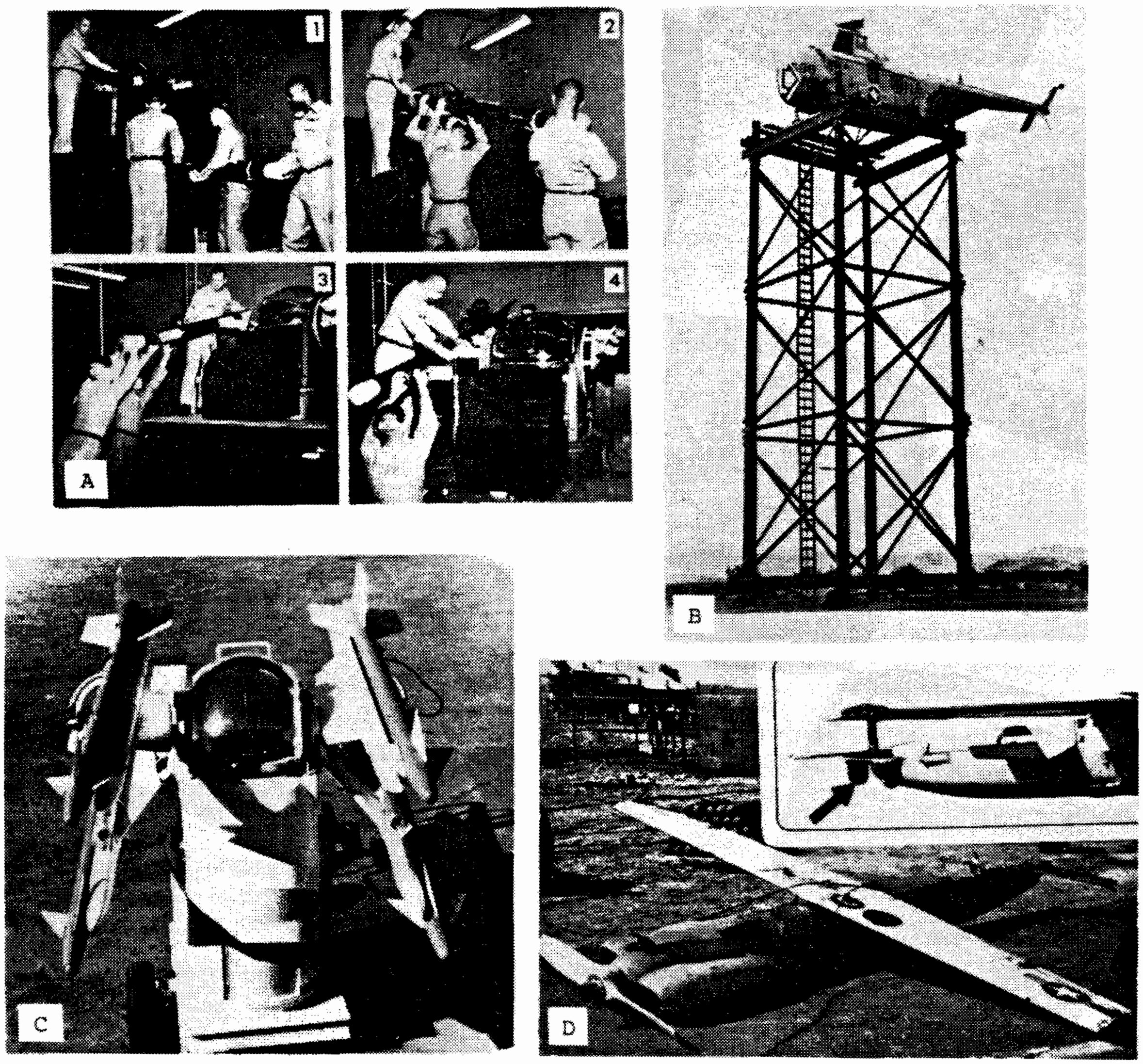
[8](1) *Ibid.* (2) TECOM Rept, 5 Aug 65, subj: Final Rept of MPT of the CHAP/M-45 Fwd Area AD Msl Sys - USATECOM Proj No. 3-5-9240-03 (GM-0265). RSIC.



(U) SCENES FROM THE CHAPARRAL MILITARY POTENTIAL TEST PROGRAM

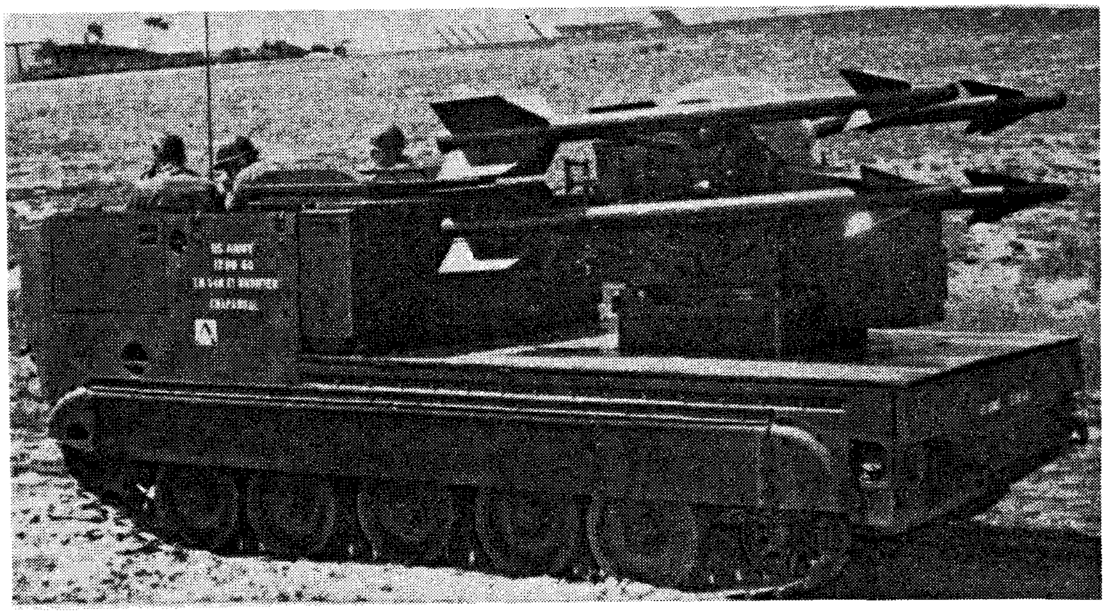
A. Loading Procedure - 4-man crew using contractor mockup: (1) withdrawing missile; (2) aligning lugs with rail; (3) sliding missile on; (4) attaching wings and umbilical.

B. H-19 Helicopter mounted on 50-foot tower - Target for Missile PIR-811 fired on 15 June 1965. Arrow shows location of infrared augmentation.

C. External view of NOTS M45 Mount on M-20 Trailer. Note sun glare on dome.

D. KD2R5 Target Drone after hit by Missile PIR-806 on 4 May 1965. Test was adjudged unsuccessful because of premature fuze function which would have detonated the warhead before intercept. The hit occurred at point of the thermite pot shown in insert.

Although test firings were yet to be conducted from the complete (XM-548E1) prototype system, an analysis of the 11 military potential tests indicated that the CHAPARRAL weapon system could successfully engage and destroy low flying helicopters and jet aircraft under conditions to be expected in the forward area of a combat situation. It also showed that the system had a good tail-chase and side-aspect capability and some head-on capability. The latter capability, however, was not well defined, as it depended upon many parameters not readily controlled for test purposes.



CHAPARRAL Prototype System Delivered 11 August 1965
(Redstone Arsenal Photo, 13 September 1965)

Aeronutronic delivered the XM-548E1 prototype system on 11 August 1965, completing the FY 1965 R&D effort. In a report issued on 13 August 1965, the Army Missile Command concluded that it would be technically feasible, with low to moderate risk, to field the interim CHAPARRAL system within the established time-frame,* but only with the approval and timely release of $10,102,000 in additional FY 1966 RDTE funds. It was therefore recommended that the CHAPARRAL weapon system be fielded as an interim forward area air defense system, and that the required

*i.e., activation of the first CHAPARRAL battalion by 1 July 1967 and initial deployment to Europe by January 1968.

RDTE and PEMA funds be programmed and approved.[9]

Between August and October 1965, three guided missiles were fired from the prototype system against Q-2C targets, increasing the number of military potential tests to 14. One of these hit the target and the other two had wide miss distances.[10]

Meanwhile, MICOM sent NOTS an MIPR for $1.1 million for procurement of 102 additional R&D missiles and associated test equipment. These items were needed to validate the engineering design, to perform ET/ST's, and to conduct new equipment training.[11]

Escalation in Program Costs

Very early in FY 1966, it became apparent that the complexity of the CHAPARRAL system and the original cost projection had been underestimated. As stated before, the original RDTE program cost estimate of $17.5 million for the FY 1965-67 period had been based upon the bolt-together concept. In July 1965, before delivery and test of the prototype system, the RDTE funding requirement for FY 1966 was $6,950,000, about $2.5 million less than the original estimate of $9.5 million. This approved funding program was still predicated on the "quick-fix" system concept; i.e., the integration of off-the-shelf components with minimum modifications to provide an early operational capability. It was believed that the $5.16 million in FY 1965 funds would suffice for engineering design and development work, and that the FY 1966 effort could be restricted to the ET/ST program. By mid-August 1965, however, the estimated RDTE cost of the FY 1966 effort had increased from $6,950,000 to $17,052,000, nearly as much as the original projection for the entire 1965-67 period.

This increase of $10,102,000 was attributed to four primary factors: the "quick-fix" system proved to be technically infeasible; the original estimates were optimistic and incomplete; system components and equipment had to be modified far beyond

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[9] (1) Hist Rept, CMO, 1 Jan 65 - 30 Jun 66, p. 3. HDF. (2) Prog Rept on Fwd Area AD, PM, IADS, Aug 65, pp. B-25 - B-26. CMO Files.

[10] NWC Rept, Aug 67, subj: CHAP Program Review, p. 22. CMO Files.

[11] (1) Ltr, CG, MICOM, to Cdr, NOTS, 7 Jun 65, subj: Proc of Mat for the CHAP Program. HDF. (2) NOTS Rept TP 4001, Apr 66, subj: NOTS 1965 Tech Hist. RSIC.

original expectations in order to bring them together in a workable system with acceptable performance and reliability; and new containers and test equipment—not originally considered necessary—had to be developed. Also contributing to the added cost were the results of two guided CHAPARRAL firings and tracking, road, and environmental tests of the prototype firing unit, which led to additional changes in the Engineering Model Fire Unit (EMFU) configuration, including significant mount and pallet redesign.

Of the $10,102,000 increase in FY 1966 RDTE costs, $1,568,000 was for additional hardware, targets, and support not included in the July 1965 estimate for the ET/ST program. The remaining $8,534,000 was required for the following engineering design and development tasks not previously programmed: development tests of the prototype system before fabrication of the ET/ST prototypes; design of containers and system peculiar test equipment; development of the reduced-time self-destruct capability; qualification testing of the missile modifications developed in FY 1965; new equipment training; documentation; continuing system studies; and development of a back-up fuze. The latter task involved adaptation of the MAULER fuze to the CHAPARRAL as an alternate solution, in the event that the Mark 15 fuze (target detecting device) proved to be unacceptable. A comparison of the basic and revised RDTE funding program for FY 1966 follows.[12]

	BASIC (Jul 65)	REVISED
Hardware, Range Support & Engrg Services..	$ 4.300	$ 6.156
Dev & Fab of 4 ET/ST Prototypes..........	2.400	2.112
Operational Effectiveness Test............	.250	.250
Engineering Design & Development..........	0	8.534*
	$ 6.950	$17.052

*Including $2.160 million for MAULER fuze adaptation by the Harry Diamond Laboratories.

The $10,102,000 increase in FY 1966 costs, together with $25,000 authorized in May 1965 for support of the AMC Project Manager Field Office at MICOM, raised the total RDTE cost estimate

[12](1) Prog Rept on Fwd Area AD, PM, IADS, Aug 65, pp. B-19 - B-23. CMO Files. (2) Hist Rept, CMO, 1 Jan 65 - 30 Jun 66, p. 3. HDF. (3) Ltr, CG, MICOM, to CG, AMC, 29 Jul 65, subj: Sbm of Program Plans. Cited in Ltr, AMC PM, IADS, to CG, MICOM, 10 Feb 66, subj: Review of CHAP Program & Funding. RHA Bx 14-8.

from $17,500,000 to $27,627,000.[13]

The total PEMA cost estimate was also increased over the original projection of $77.9 million, which had been based upon the bolt-together concept using the M113 vehicle and a surplus M45 gun mount equipped with LAU-7A launch rails. The total projected PEMA program in July 1965 was $72,886,437, about $5 million less than the original estimate of January 1965. This was increased, in August 1965, to $98,051,911.

The preliminary plan for procurement of 5,033 missiles was increased to 6,234, in July 1965, then reduced to 5,444, for a net increase of 411. The quantity of fire units was increased from 260 to 269 (192 tactical and 77 non-tactical) to satisfy training requirements. Both the July and August estimates were based on use of the XM-548 vehicle. The fire unit vehicles were to be provided at no cost to the program; however, the cost of required modifications was included in the estimate. The increased cost of the fire unit stemmed from the new palletized mount which was a self-contained unit capable of being fired from the XM-548E1 vehicle or being removed from the vehicle and used as a ground unit. Another reason for the rise in PEMA costs was the addition of auxiliary equipment not previously programmed, such as the air compressor, primary power unit, communications equipment, and exhaust system for the turret. Shown below is a comparison of the basic and revised PEMA funding programs for FY 1966-68, both predicated on the Interim Field Army Air Defense System (IFAADS) program to support the activation of six battalions.

	BASIC (Jul 65)	REVISED
Missiles (Quantity)...........	(6,234)	(5,444)
Total Cost..................	$59,111,835	$51,498,875
Fire Units (Quantity).........	(260)	(269)
Total Cost..................	11,850,294	27,219,696
Spare Parts & SHUCRP*.........	---	15,277,640
Test Equipment................	1,924,308	4,055,700
	$72,886,437	$98,051,911

*Select High Unit Cost Repair Parts.

The revised PEMA funding requirement for FY 1966 totaled $29,274,121. Aside from spare parts, SHUCRP, and test equipment, the FY 1966 plan called for the procurement and production of

[13] C&DP Rept, CHAP COSTECH Rept 70-19, Aug 70, p. 49. CMO Files.

1,300 missiles and 59 fire units.[14]

Limited Production (LP) Classification

On 29 September 1965, following completion of the ED/MPT program and delivery of the first prototype fire unit, the Office, Chief of Research & Development (OCRD) granted approval for LP classification of the CHAPARRAL missile and associated test sets. This was followed, on 12 November 1965, by LP classification of the CHAPARRAL fire unit (launch and control pallet mounted on the XM-548E1 vehicle) and associated test sets.

The items approved for limited production in FY 1966 included 1,300 missiles; 59 carrier-mounted fire units; 164 missile trainers; 13 guided missile test sets; 59 missile assembly tool sets; 12 organizational maintenance test sets; and 12 support maintenance test sets. Production deliveries were to begin in March 1967. The delivery of 32 fire units, each with a complement of 12 missiles, was required by 30 June 1967 for activation in July of the first battalion, with activation of a battalion every other month thereafter until a total of six were activated.[15]

Changes in Program Requirements

An expansion of program objectives in December 1965 led to further changes in the design of major components and another increase in program costs. The results of field army air defense studies conducted in 1965 disclosed certain fairly constant weaknesses in existing deployments and system capabilities, and were essentially unanimous in their recommendations for the redirection of tactical army air defense programs for materiel, doctrine, and organization. The Theatre Air Base Vulnerability (TABV) study of August 1965 generated a requirement for a towed version of the CHAPARRAL for defense of certain air bases. At about the same time, the Tactical Mid-Range Air Defense (TAMIRAD) study by CDC also revealed a need for a towed CHAPARRAL system for world-wide deployment with Army airborne and air mobile divisions. The latter report and the recommendations submitted by the Secretaries of the Army and Air Force, in early October 1965,

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[14] Prog Rept on Fwd Area AD, PM, IADS, Aug 65, pp. B-23 thru B-25 & G-1. CMO Files.

[15] (1) AMCTCM 4040, 20 Jan 66, w incls. (2) AMCTCM 4355, 27 Apr 66, w incls. Both in RSIC.

addressed the critical mid-range void in air defense capability resulting from the decision to terminate the MAULER project. The recommended program consisted of three additive options, the first of which would alleviate the most critical defects in existing air defense capability through a force increase of 15 CHAPARRAL/VULCAN battalions, 12 HAWK batteries, and related supporting units.

The results of growth potential studies and military potential tests conducted in the first phase of the CHAPARRAL program had shown that, for a somewhat higher cost, many improvements could be made in the original quick-fix concept, which would result in a much more effective and longer-life system and still meet the deployment availability date of January 1968. Early in December 1965, following final termination of the MAULER program in November, the Secretary of Defense approved the TAMIRAD program, which called for the equivalent of 21 composite CHAPARRAL/VULCAN battalions for world-wide deployment, instead of the original requirement for 6 composite battalions for deployment to Europe only.

At the same time, the Secretary of Defense approved the $10,102,000 in FY 1966 emergency RDTE funding, which was needed to assure deployment availability of the basic CHAPARRAL by January 1968, along with $1,800,000 in additional FY 1966 funds for development work relating to the new requirements. Of the latter, $500,000 was for development of the trailer or towed version of the CHAPARRAL and $1,300,000 was for redesign work necessary to assure compatibility of the system with world-wide environmental conditions.[16]

To fill the gap in forward area air defense until the CHAPARRAL/VULCAN units became available, the Secretary of Defense, in October 1965, had approved the activation of 27 M42 40-mm. (DUSTER) gun batteries and 6 M55 50-caliber machine gun batteries as temporary forces through the end of FY 1967. In the decision guidance of December 1965, these units were extended as permanent forces to permit phase-in of the CHAPARRAL/VULCAN equipment. The CHAPARRAL missile and VULCAN gun systems would complement each other in the daytime, fair weather role, by combining the quick reaction and extremely low altitude capability of the VULCAN with the longer range capability of the CHAPARRAL. Together, they

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[16](1) CDC Study M-6098, Aug 65, subj: TAMIRAD, Vol. I, pp. 33-34. RSIC. (2) Ltr, OCRD, DA, to CG, AMC, 23 Sep 65, subj: TAMIRAD. RHA Bx 14-8. (3) DF, CHAP Cmdty Mgr to R&D Drte, 12 Oct 65, subj: TAMIRAD, w incl. File same. (4) Program Ch, SECDEF Decn A-5-069, 6 Dec 65, subj: Tac AD Program. File same.

would complement the all weather, low and medium altitude air defense role of the self-propelled HAWK. The manportable, shoulder-fired REDEYE missile would also be procured for use in the forward area.[17]

[17](1) *Ibid.* (2) Mary T. Cagle, *History of the MAULER Weapon System* (MICOM, 19 Dec 68), pp. 255, 259-60.

CHAPTER IV

(U) EVOLUTION OF THE TACTICAL WEAPON SYSTEM (U)

(U) The M42 DUSTER and M55 machine gun batteries were destined to fill the gap in forward area air defense for a much longer period than expected. Funding and technical problems, a lack of timely program guidance and decisions, and design changes resulting from the revised program objectives led to several revisions in the CHAPARRAL schedule and an ultimate slippage of 22 months in the operational availability date.

Revision of the Program Schedule

(U) As a result of the revised program objectives approved by the Secretary of Defense in early December 1965, the original CHAPARRAL fire unit, which was to have remained in the field from 2 to 4 years, was changed to a more complicated unit which would fully meet world-wide environmental conditions and have an estimated service life of some 10 years. As stated earlier, the Secretary of Defense approved $10,102,000 in emergency FY 1966 RDTE funds plus $1,800,000 for work relating to the new system requirements. This was based on the original schedule calling for activation of the first battalion by July 1967 and initial system deployment in January 1968. However, it failed to take into account the leadtime specified in the preliminary technical development plan of January 1965. In this plan, MICOM emphasized that the validity of the schedule was contingent upon a decision to field the system by 1 September 1965 and release of FY 1966 RDTE money before that date.[1]

(U) Because of the 3-month delay in the DOD decision, the contractual action planned for October 1965 could not be completed before January 1966. Since any further compression of the development and procurement schedule would impose unacceptable risks, MG William B. Bunker, the Deputy Commanding General of AMC, proposed that the target date for delivery of the first battalion equipment be moved back from 1 July 1967 to 1 October 1967. This would permit deployment of the first battalion early in CY 1968, but not in January 1968 as previously planned. The revised

[1] *See* above, p. 17.

schedule, however, was based upon the assumption that the emergency FY 1966 RDTE funds, which had been approved on 6 December 1965, would be forthcoming without further delay.[2]

FY 1966 Development Program

(U) Meanwhile, the development program at Aeronutronic was hampered by serious funding deficiencies. In August 1965, contract funds were depleted, but Aeronutronic continued work with company funds. As an interim measure, a contract for about $500,000 enabled the contractor to continue work from mid-August to mid-November 1965, at which time funds again ran out. During this interim period, further testing of the prototype fire unit led to additional changes in the Engineering Model Fire Unit (EMFU) configuration, which included significant mount and pallet redesign. From mid-November 1965 to mid-January 1966, Aeronutronic continued the effort with company funds. At the time of the contract award for FY 1966 effort, in January 1966, this work was recognized as pre-contract costs amounting to about $900,000.

(U) The FY 1966 R&D contract (DA-01-021-AMC-14097*), awarded on 19 January for $8,792,000, included the design changes engendered by tests of the prototype and the fabrication of four EMFU's, one set of engineering model subassemblies, and associated test equipment for use in the ET/ST program. It was incrementally funded with an initial amount of $5,200,000, because the emergency FY 1966 funds still had not been received. The last increment of the emergency funds was released to MICOM on 8 February 1966. This additional money was not sufficient to carry the effort to completion, and the FY 1966 contract was based on a cutoff date of 30 September 1966 for all work except fabrication of the four EMFU's and test equipment.[3] (Subsequent modifications of the contract extended the period of performance through March 1968 and increased the total value to $19,108,642.[4]) The missile development effort at NOTS was continued in FY 1966 under an MIPR for $1.7 million,

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*Later renumbered DA-01-021-66-C-0061.

[2]Ltr, DCG, AMC, to ACSFOR, DA, 30 Dec 65, subj: Tac AD Program. RHA Bx 14-8.

[3](1) Hist Rept, CMO, 1 Jan 65 - 30 Jun 66. HDF. (2) MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66. RHA Bx 14-7.

[4](1) Ofc Memo, C. W. Small to H. J. Burton, Philco-Ford, 27 Feb 74, subj: Maj CHAP Contrs. HDF. (2) Final contract value furnished by DCASD, Anaheim Ofc, 8 Oct 74.

bringing the total expended in this phase of the program to slightly less than $5 million.[5]

(U) Approval of the TAMIRAD program necessitated an immediate change in design to cope with world-wide environmental requirements and to provide a towed/ground emplacement capability. In March 1966, MICOM issued a change order to Aeronutronic's R&D contract for this added work on the fire unit, and directed NOTS to make essential design changes in the missile. By that time, the design of the fire unit and missile had progressed to the point that extensive redesign and additional testing and qualification were mandatory. Many completed and in-process designs had to be withheld from release for hardware fabrication until their integrity could be evaluated under the imposed environmental conditions.

(U) The impact was felt particularly in the electronic area, where it was necessary to redesign numerous circuits, substitute some components and add others, and provide the required temperature compensation networks. In the mechanical area, it was necessary to reevaluate tolerances, seals, lubricants, etc., and to study, identify, and install added components such as air conditioners. Also, the requirement for off-vehicle operation (on a trailer or ground emplacement device) required some structural changes, as well as the complete design and qualification of additional hardware.[6]

(U) To prevent excessive delays in delivery of the four EMFU's required for ET/ST, new equipment training, and maintenance evaluation, MICOM decided to redesign only the electronic packages and to provide modification kits for other essential changes in the four units. This affected the R&D schedule, since redesign of fire unit hardware entailed 6 additional weeks. To provide the towed version of CHAPARRAL, Aeronutronic began the design and fabrication of a fifth EMFU, which was to include the changes necessary to meet world-wide requirements without the use of modification kits. Since the design of the associated test equipment, which was dependent on fire unit design, had not reached the point where redesign would be necessary, the CHAPARRAL Manager decided to incorporate the design for extended environmental requirements in all five sets of equipment without the use of modification kits.[7]

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[5]MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66. RHA Bx 14-7.

[6](1) *Ibid.* (2) MICOM Rept, CHAP Program Review, 25 Oct 66, p. 13. CMO Files. (3) Hist Rept, CMO, 1 Jan 65 - 30 Jun 66. HDF.

[7]*Ibid.*

(U) The towed or trailer version of the CHAPARRAL fire unit was developed but never released for production. The integration support structure, together with the mount, provided a palletized version of the fire unit which could operate autonomously when removed from the tracked vehicle. The launch and control pallet was mounted on a simple trailer consisting of a frame, four wheels, and tow bar. The ground emplacement jacks folded down and allowed for leveling of the pallet. This trailer mode used the basic CHAPARRAL system. The pallet weighed 11,000 pounds, but could be stripped down to about 9,000 pounds by removing missiles, fuel, and on-vehicle equipment.[8]

(U) The refined RDTE estimate of August 1965, together with the new system requirements added in December 1965, increased the total RDTE cost estimate from $17.5 million to $30,167,000, and the FY 1966 program from $6,950,000 to $18,852,000. Included in the latter was $1.8 million for redesign effort related to the additional system requirements. Another $1.8 million was programmed for that purpose in FY 1967. In a review of the CHAPARRAL program and funding, on 10 February 1966, LTC John T. Peterson, the AMC IADS Project Manager, emphasized that the immediate task involved the development and procurement of a "relatively simple system of limited capability" designed to fill a serious gap, on a tight development and deployment schedule. "We have been given to understand," he said, "that appreciable program slippage as well as additional overruns are not favorably regarded at DA and OSD and may result in review and possible cancellation of the CHAPARRAL program."[9]

(U) Not only was there a substantial increase in the RDTE program cost, but also a 15-month slippage in the schedule. The actual RDTE expenditure for FY 1966 was $19,486,000 instead of $18,852,000. In July 1966, the RDTE cost estimate was increased by $23,086,000, from $30,167,000 to $53,253,000. Of this increase, $3,900,000 was for development of training devices and the remainder was for previously unprogrammed effort on the missile and ground support equipment. Aside from the cost of the fifth EMFU mentioned earlier, the added effort on the ground equipment included design changes in the engineering model configuration, the scope of which exceeded expectations. The SIDEWINDER missile did not prove to be as reliable as originally anticipated, nor did

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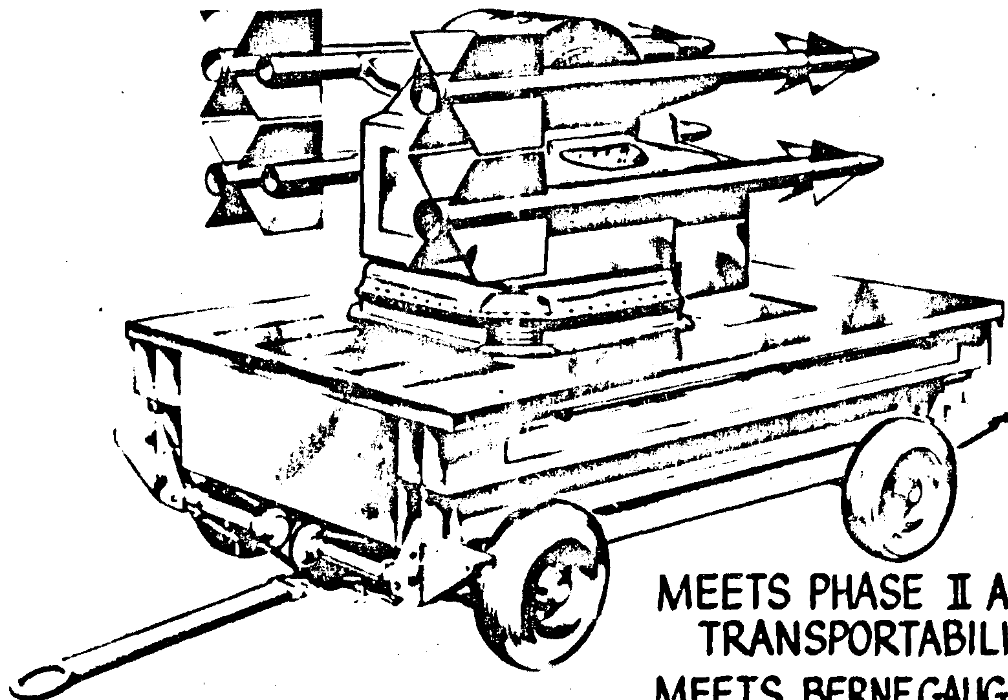
[8]Rept of CHAP Review Gp, 16 Nov 66, pp. II-2, II-3, II-9, II-15. CMO Files.

[9]Ltr, IADS PM, AMC, to CG, MICOM, 10 Feb 66, subj: Review of CHAP Program & Funding. RHA Bx 14-8.

CHAPARRAL LAUNCH & CONTROL MODE
TRAILER MODE

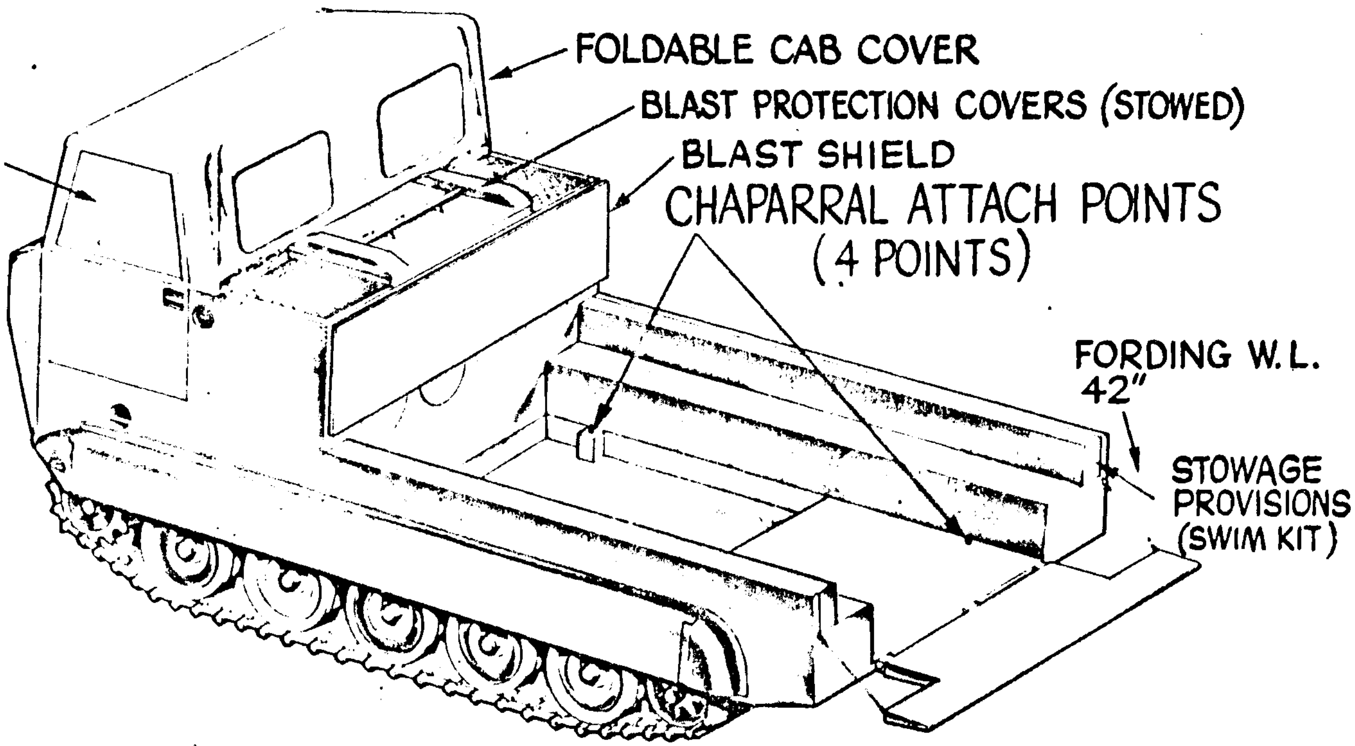


MEETS PHASE II AIR TRANSPORTABILITY

MEETS BERNE GAUGE CRITERIA

57

XM-730 CHAPARRAL VEHICLE



its documentation meet Army standards. This required a more comprehensive quality assurance program and increased levels of testing to insure reliability, as well as additional documentation for procurement.[10] A 15-month slippage in the schedule and another program cost increase occurred late in CY 1966 and will be discussed later.

(U) The overall CHAPARRAL program schedule as of July 1966 called for continuing design and development through 1969, with the bulk of the design for production occurring in CY 1966 and the ET/ST program mostly in CY 1967. Under the compressed schedule, the design and development period overlapped the production leadtime and deliveries, and an early release to production was given, so that ET/ST's would still be going on after production equipment reached the field.[11]

Initiation of the Industrial Program

(U) Funds for initial procurement of production hardware were approved early in FY 1966, but their release was withheld pending final approval of the LP classification. As stated earlier, type classification for limited production of the missile was approved on 29 September 1965 and for ground equipment on 12 November 1965.[12]

Missile Procurement

(U) From the inception of the program, the Army planned to procure missile components and associated test equipment from the Navy. The CHAPARRAL missile was a modification of the Navy's SIDEWINDER 1C missile, for which production facilities and contractors were already established. Since the two missiles shared about 95 percent commonality of components, and the Army lacked the specialized knowledge essential for the performance of technical functions relating to CHAPARRAL procurement, the joint management-procurement concept appeared to be advantageous both from a cost and time standpoint.

(U) CHAPARRAL missile components were procured by MIPR to

[10] C&DP Rept, CHAP COSTECH Rept 70-19, Aug 70, pp. 47, 49-50. CMO Files.

[11] MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66, pp. I-3, I-4. RHA Bx 14-7.

[12] *See* above, p. 50.

the Naval Air Systems Command (earlier, to the Navy's Bureau of Weapons), Washington, D. C., and assembled into "full-up" rounds at the Red River Army Depot. The procurement and technical management responsibilities for the missile were widely dispersed throughout the Navy. Several components were manufactured in-house and the others were procured competitively through three Navy procurement offices. The primary technical management element was the Naval Weapons Center at China Lake, California. Among other technical management and support agencies were the Naval Weapons Laboratory at Dahlgren, Virginia; the Naval Ammunition Depot, Crane, Indiana; Naval Ordnance Stations at Louisville, Kentucky, and Indianapolis, Indiana; and the Fleet Missile System Analysis & Evaluation Group at Corona, California.[13]

(U) The procurement of production hardware was initiated on 17 October 1965, when MICOM sent the Navy an MIPR in the amount of $12.7 million for 1,300 missiles. A revision of the MIPR, in February 1966, reduced the FY 1966 quantity to 720* and the dollars to $7.6 million. In March 1966, the Army completed the review of missile documentation and released it to the Navy in support of the procurement package. With this step completed, the Navy issued the Request for Quotation in June 1966, and awarded the General Electric Company a contract for the Guidance & Control Group (GCG) on 1 July. Major components of the missile, aside from the GCG, were the rocket motor, warhead, safety and arming device, target detecting device, wing assembly, cast wings, and fin assembly. The Navy would deliver all components to the Red River Army Depot, where they would be assembled into complete missiles, thence into shipping and storage containers procured by MICOM. In addition to tactical missiles, the Navy received orders for 135 XM-30 trainers, which were dummy missiles used for training.[14]

Ground Support Equipment

(U) The initial FY 1966 buy of ground equipment consisted of

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*The FY 1966 buy of missiles was later increased to 840. CVADS PMP Prog Rept, 4th Qtr, FY 69. RHA Bx 14-7.

[13](1) DF, Cmt #1, Chf, CMO, to P&P Drte, *et al.*, 16 Jun 69, subj: Proc of the CHAP Msl. (2) DF, Cmt #2, P&P Drte, to Chf, CMO, 24 Jun 69, subj: same, w incl: Study of CHAP Msl Proc Resp, *circa* Sep 67. Both in HDF.

[14](1) MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66, pp. XIV-2, XIV-3, XIV-4. RHA Bx 14-7. (2) Rept of CHAP Review Gp, 16 Nov 66, pp. V-9, V-10. CMO Files.

39 fire unit pallets (launch and control units) for mounting on the XM-730 vehicle (modified XM-548E1), 25 guided missile equipment sets, and Government-furnished air compressors for the first buy of Organizational Maintenance Shop Sets (OMSS's) in FY 1967. The air compressors had to be purchased a year ahead of the OMSS because of the difference in leadtime (18 months for the air compressors versus 7 months for the shop sets). The XM-730 vehicles were furnished by WECOM at no cost to the CHAPARRAL program.

(U) The FY 1966 engineering services contract with the Aeronutronic Division of Philco-Ford (DA-01-021-AMC-14107) was awarded on 15 April 1966 for $1.7 million. A subsequent modification of this contract, dated 29 April 1966, provided for special test equipment and increased the value to $2.9 million.* This was followed, on 31 May 1966, by the award of a $6,451,383 production contract (DA-01-021-AMC-14206)** for the first buy of 39 fire units.

(U) In support of the industrial program, Philco-Ford leased a plant at Anaheim, California, for production of the launch and control pallet, and MICOM awarded Aeronutronic a $100,000 facilities contract (DA-01-021-AMC-14745) in April 1966. In addition, 115 items of production equipment valued at $800,000 were provided from Government reserves, along with $69,941 worth of tooling. To supplement the Government-furnished items, the contractor acquired 59 pieces of equipment with corporate funds. The Anaheim production facility had a total of 128,000 square feet of floor area, 40,000 square feet of which was air conditioned. Aeronutronic occupied the plant in June 1966. By October, most of the equipment was installed and operational, and the facility was being used for fabrication of engineering materials required under the R&D contract. This allowed almost complete proofing of the facility and training of manufacturing personnel before actual start-up of the production program.

(U) The fire unit pallets produced at the Anaheim plant would be shipped to a mounting and checkout facility at Fort Bliss for mating with the XM-730 vehicle, which would be delivered from the Food Machinery Corporation at Charleston, West Virginia. After completion of the mounting operation, the system would undergo a

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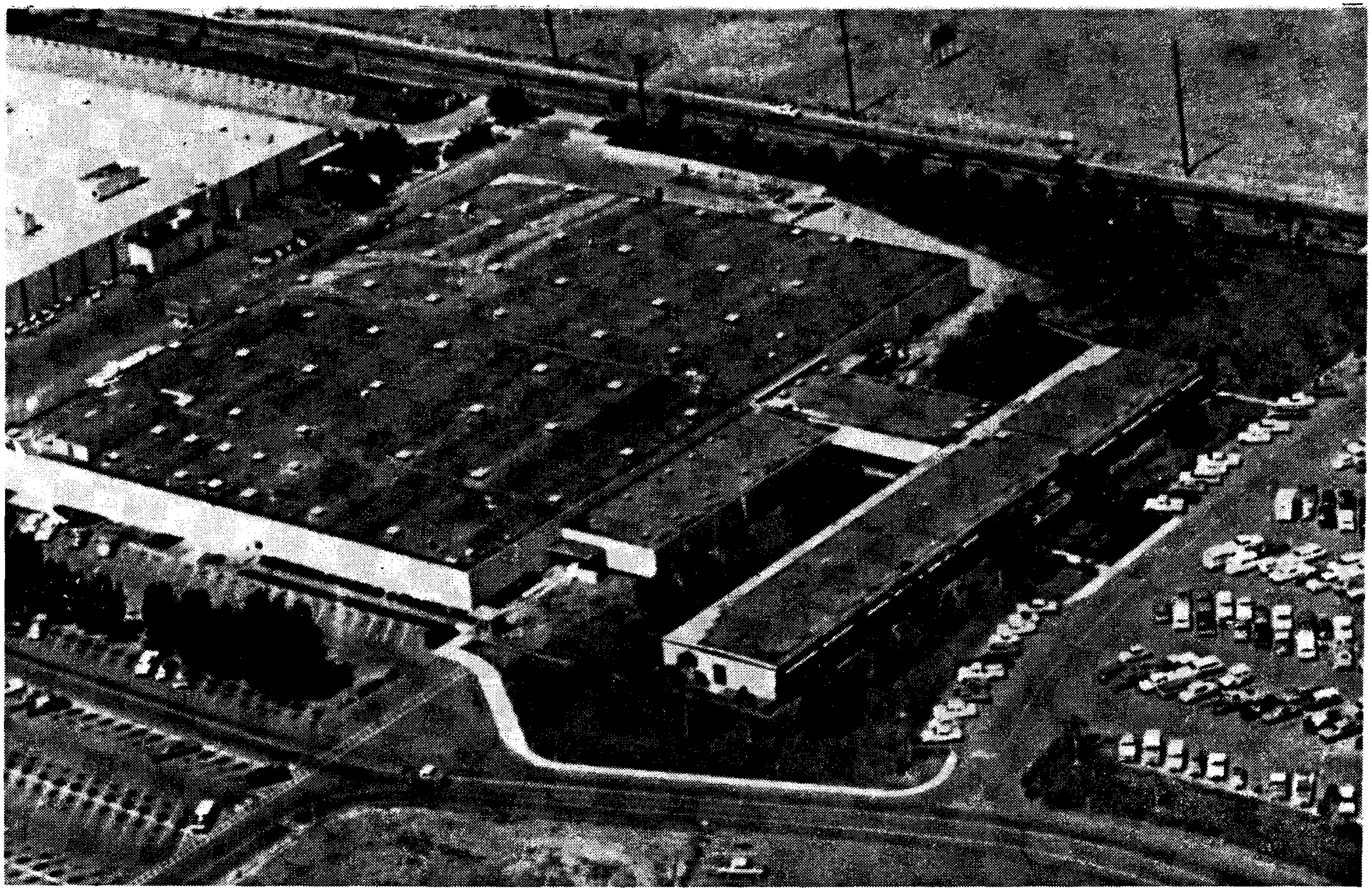
*The final value of the FY 1966 engineering services contract was $3,112,648. MICOM Contr Listings, Jul 72. HDF.

**Contract AMC-14206 was later renumbered DA-01-021-66-C-0062. Its final value was $13,826,065. Information furnished by DCASD, Anaheim Office, 7 Oct 74.



Anaheim Manufacturing Plant - Aeronutronic Division, Philco-Ford checkout before release to the user. The first fire unit pallet, to be completed in February 1967, would be retained at the Anaheim plant for use in the checkout of manufacturing processes, tooling, test equipment, and production changes. The delivery of complete pallets to Fort Bliss was scheduled to begin in June 1967.[15]

Revision of the Army Materiel Plan

(U) The revised Army Materiel Plan (AMP) of May 1966 reflected the increase in procurement quantity to support 21 instead of 6 CHAPARRAL battalions. The number of missiles planned for procurement was increased from 5,444 to 16,824 and the number of fire units from 269 to 859 (680 self-propelled and 179 towed). Excluding FAAR equipment, the estimated PEMA cost for the revised program was $265,162,000.[16] Table 2 shows the quantities and estimated costs of major items by fiscal year.

Review and Revision of the Program Schedule

(U) In the summer and fall of 1966, the CHAPARRAL program was beset with serious managerial and technical difficulties which led to deferment of the second hardware buy, a 15-month slippage in the unit activation schedule, and another increase in the estimated RDTE funds required to complete development. A CHAPARRAL In-Process Review (IPR) was held at Redstone Arsenal on 29 and 30 August 1966. Partly as a result of this IPR and partly because of a subsequent CHAPARRAL Management Office analysis, the Deputy Commanding General of AMC, in late September 1966, temporarily suspended FY 1967 PEMA commitments and directed MICOM to conduct an evaluation of the program to determine the risks involved in adhering to the existing deployment schedule and whether or not such risks were reasonably acceptable.

(U) Several conditions prompted the technical review. Problems associated with the production of CHAPARRAL GCG's indicated that the contractor needed to develop further manufacturing techniques and that better quality control procedures would have to be implemented. Also, the GCG contractor had encountered considerable difficulty in obtaining qualified parts from vendors.

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[15] (1) Rept of CHAP Review Gp, 16 Nov 66, pp. V-1, V-2. CMO Files. (2) MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66, pp. XIV-1 thru XIV-10. RHA Bx 14-7.

[16] *Ibid.*, pp. XIV-2, XIV-9, XIV-10.

TABLE 2—(U) CHAPARRAL Major Item Procurement Plan - 17 May 1966

	FY 1966	FY 1967	FY 1968	FY 1969	FY 1970	FY 1971	TOTALS
MISSILE							
Quantity	720a/	3576	4238	4197	4093	0	16,824
Cost	8,631,000	34,267,000	36,412,000	34,371,000	32,265,000	993,000	146,939,000
FIRE UNIT							
Quantityb/	39/0	220/20	219/21	202/138	0		680/179b/
Cost	10,861,000	34,462,000	25,059,000	32,278,000	1,322,000		103,982,000c/
SMSS							
Quantity		15	12	8	0		35
Cost		2,398,000	1,376,000	835,000	135,000		4,744,000
OMSS							
Quantity	0	33	25	19	10	0	87
Cost	122,000d/	3,110,000	1,836,000	1,145,000	591,000	101,000	6,905,000
MSL TRAINER							
Quantity	135	0	66	56			257
Cost	901,000	65,000	434,000	356,000			1,756,000
GM EQUIP SET							
Quantity	25	24	24	18			91
Cost	200,000	224,000	240,000	172,000			836,000
TOTAL PEMA	20,715,000e/	74,526,000	65,357,000	69,157,000	34,313,000	1,094,000	265,162,000

a/ Later increased to 840.

b/ Self Propelled/Towed. (The towed unit was later dropped from the procurement plan.

c/ Based on total program costs, less cost of the XM-730 vehicle.

d/ For purchase of air compressors, which had a longer leadtime than the shop set.

e/ The actual PEMA expenditure for FY 1966 was $26,029,663. The increase was attributed to the procurement of 120 additional missiles and cost overruns on the fire unit contract because of the scope of changes related to the world-wide environment and towed capability.

SOURCE: AMP, May 66, & MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66. RHA Bx 14-7.

Because of late delivery of GCG's for R&D missiles, the CHAPARRAL had not been tested or qualified for the required environment, and firm figures on predicted missile reliability were not available.

(U) Secondly, technical changes engendered by incorporation of the world-wide environment and the towed version requirements caused a retrofit and configuration control problem of considerable magnitude. Moreover, the ET/ST program was scheduled for completion after delivery of a considerable number of fire units and missiles. (Normally, ET/ST programs are conducted before release to production and feed engineering changes into the system design for production follow-on.) Since the R&D and production programs were highly compressed, ET/ST's would be conducted concurrently with first production. This could have resulted in a costly and time-consuming retrofit action.[17]

(U) As it happened, MICOM had already acted and the evaluation had been under way since 21 September. On 17 October 1966, letter orders were issued formally creating a CHAPARRAL Program Review Group. The group was chaired by BG Clarence C. Harvey, Jr., DCG/ADS, and consisted of key personnel from MICOM staff and directorate elements. COL Robert C. Daly, the AMC CHAPARRAL/VULCAN Project Manager, was also a member.[18] On 25 October, the MICOM Review Group received a technical briefing on the current and potential problem areas and the risks involved in maintaining the existing deployment schedule.

(U) Delays in R&D hardware deliveries resulted in an even more compressed schedule than originally anticipated and made the risks involved totally unacceptable. Delivery of the 102 R&D missiles, which was to have been completed by September 1966, was slipped to August 1967. Delivery of the five EMFU's, originally planned for the August-November 1966 period, was rescheduled to begin in December 1966 and continue into March 1967. With these schedule adjustments, subsystem and system tests of the fire units and qualification tests of the missile would not be completed until mid-1967. Changes resulting from the various tests could have been phased into the early production; however, these tests would

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[17](1) TT AMC-41988, CG, AMC, to CG, MICOM, 22 Sep 66, subj: CHAP PEMA Actions. (2) Ltr, DCG, AMC, to CG, MICOM, 28 Sep 66, subj: Review of CHAP Program. (3) Hist Rept, CMO, FY 67, p. 1. All in HDF.

[18](1) *Ibid.*, p. 2. (2) MICOM LO 1397-66, 17 Oct 66, subj: CHAP Program Review Gp, as amended by MICOM LO 1439-66, 26 Oct 66. Atchd as App B to Rept of CHAP Review Gp, 16 Nov 66. CMO Files.

not significantly affect the first 119 production fire units. The ET/ST agencies were scheduled to complete temperate tests in March 1968 and arctic/tropic tests in March 1969. Thus, 179 fire units would be fabricated before completion of the temperate tests, as a result of which, changes required on the first 119 to 179 units would be much higher than originally planned.

(U) The delay in receipt of vendor components presented a problem in both the R&D and production programs, and indications were that vendor deliveries would get worse instead of better. The primary reasons for this were: the relatively low priority assigned to the CHAPARRAL by the Navy; the saturation of vendor manufacturing facilities with DX-rated orders for Southeast Asia; inadequate quality control; and raw material shortages. Attempts to justify a DX priority rating for the CHAPARRAL had been unsuccessful.

(U) Among other conditions hindering the execution and control of the program were problems stemming from the unwieldy project management structure and the lack of an adequate engineering staff in the CHAPARRAL Management Office, both of which have already been discussed.* Coordination and support problems in the Army/Navy relationship also had a significant impact on the program. Under the joint management-procurement concept, the Army was completely dependent upon the Navy for decisions and advice on all technical matters involving the CHAPARRAL missile, and had no control over the selection of contractors, the contract scope of work, or contract administration. In addition to technical problems and schedule delays being encountered in production of the missile GCG, the briefing team noted a number of irregularities in the Navy's handling of the program. There had been instances in which invitations for bid issued by the Navy reflected delivery schedules which were not compatible with the Army MIPR. Attempts to obtain detailed production information (such as lists of components or sub-components, current procurement or production status, name of contractor, and copies of contracts) had met with only partial success. An agreement to assure Army control of certain engineering changes had been in effect for a year, but there was no evidence that the procedure was being followed. In the procurement of air compressors, the Navy rejected the Army's justification for sole source and entered into a contract with a new source based on a performance specification which resulted in the delivery of an item with neither documentation nor support.

(U) The briefing team concluded that the risks associated with

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**See* above, pp. 25-30.

the existing program schedule were unacceptable and recommended that the activation date be slipped by 6 months. While this slippage would not eliminate all risks and problems, it would place the program on a schedule with risks compatible with original guidance.[19]

(U) After further study of the problems and risks involved, the MICOM CHAPARRAL Review Group decided that a slippage of at least 12 months would be necessary. The findings and recommendations of the review group were presented to LTG William B. Bunker of AMC, on 18 November 1966. General Bunker essentially adopted the group's recommendations in a letter to ACSFOR, on 15 December 1966. In support of the proposed 1-year slippage in the CHAPARRAL/VULCAN activation schedule, he explained that continuation of the original industrial program would produce from 250 to 300 fire units before completion of significant system testing, possibly leading to extensive engineering changes and retrofit. Further, in the absence of adequate reliability data, the probability of meeting reliability and availability requirements was relatively low, while overall risks (moderate to medium in the original program) were now unacceptable unless further production was delayed until some system testing was done. The requirements for system testing, logistic and maintenance support, a satisfactory training base, and missile and ammunition development demanded that current buys be stretched out to retain a production base and provide early training equipment. Further buys would depend upon qualification of the equipment for ET/ST and upon production maturity. First large-scale procurement for both systems would await a June 1967 review, with contracting planned for August 1967. This would delay equipment availability for initial activation by 1 year. The alternative to delaying the procurement contracts, which were to have been placed during the second quarter of FY 1967, was to continue procurement without the benefit of engineering design and system tests. This course of action appeared too risky. The delays in testing increased RDTE and PEMA requirements above current programs, however.

(U) General Bunker concluded that revision of the procurement schedule would re-establish more favorable phasing between the development testing and industrial programs, and would substantially increase the chances of fielding a successful and fully supported system. A revised schedule, he thought, would materially reduce program risks by providing time for producibility-engineering of

[19](1) Hist Rept, CMO, FY 67, pp. 2-3. HDF. (2) MICOM Rept, CHAP Program Review as Presented to MICOM Review Bd, 25 Oct 66. CMO Files.

the CHAPARRAL GCG; adequate systems testing before quantity procurement; sufficient equipment to CONARC in time for a complete and normal training cycle; normal maintenance and repair parts support of tactical units; and time for the solution of technical development and production priority problems. He therefore recommended that the CHAPARRAL/VULCAN activation program be postponed for 1 year, from October 1967 to October 1968.[20]

(U) The Army Chief of Staff approved AMC's recommendations, but extended the activation schedule by 15 months, from October 1967 to January 1969.[21] As a result of the schedule changes, the estimated funds required to complete development were increased, in December 1966, from $53,253,000 to $59,941,000. These supplemental RDTE funds were needed for additional testing and design changes to correct maintainability problems to reduce risks in the program, and to cover an overrun in the development contract for the fire unit and weapon system test equipment. The RDTE expenditure for FY 1967 was $17,125,000, bringing the actual cost of the program to $41,771,000 for the FY 1965-67 period.[22]

Coordinated Test Program

(U) Despite continued problems and delays in the production and delivery of missile hardware and in meeting certain qualitative materiel requirements, the revised program schedule was met. The CHAPARRAL Coordinated Test Program (CTP) was established late in August 1967 and ratified during the prototype system IPR conducted by the CVADS Project Manager at Fort Bliss on 1-2 November 1967. The first two EMFU's were delivered to the Army in the first quarter of CY 1967, the next two in the second quarter, and the last one early in the third quarter. Delivery of the first production fire units began in October 1967, followed by the first production missiles in the first quarter of CY 1968. These engineering and production units underwent a wide variety of tests as shown in Chart 4.[23]

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[20] Ltr, DCG, AMC, to ACSFOR, DA, 15 Dec 66, subj: Revision of VULCAN/CHAP Program. Quoted in Hist Rept, CMO, FY 67, pp. 3-4. HDF. (2) *Also see* Rept of CHAP Review Gp, 16 Nov 66. CMO Files.

[21] Hist Rept, CMO, FY 67, p. 6. HDF.

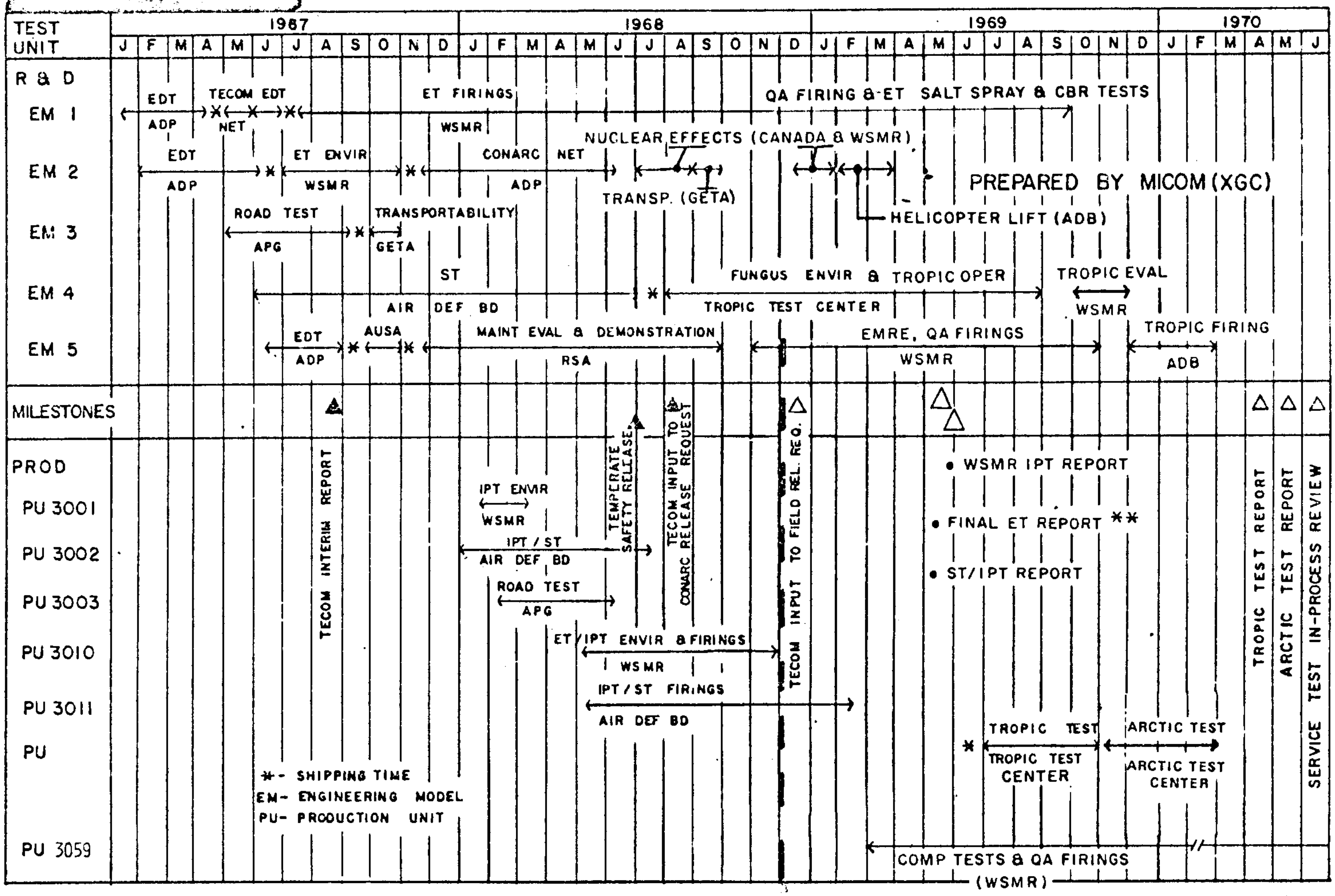
[22] C&DP Rept, CHAP COSTECH Rept 70-19, Aug 70, pp. 47, 49-50. CMO Files.

[23] (1) Hist Rept, CMO, FY 68. HDF. (2) CHAP PMP Prog Rept, 4th Qtr, FY 69. RHA Bx 14-7.

CHART 4

(U) CHAPARRAL CTP SCHEDULE

1 DEC 1968



** CBR, FUNGUS & SALT SPRAY SUSCEPTABILITY ET REPORTS TO BE PUBLISHED AS SUPPLEMENTS

Description of Materiel

(U) The major elements of the CHAPARRAL weapon system consisted of the XMIM-72A missile; the XM-48 (carrier-mounted) fire unit; weapon system test equipment, which included the AN/TSM-95 Organizational Maintenance Shop Set (OMSS) and the AN/TSM-96 Support Maintenance Shop Set (SMSS); and the XM-570 (missile) shipping and storage container.

(~~C~~ U) XMIM-72A Missile. The XMIM-72A was a supersonic, passive homing missile using infrared (IR) sensing, torque-balance aerodynamic control, and proportional-navigation guidance. The airframe was an in-line cruciform with four movable canard control surfaces at the front end and four fixed wings at the rear. The missile was 114.5 inches long by 5 inches in diameter and weighed about 190 pounds. It was composed of five major sections: the Guidance and Control Group (GCG), fuze, warhead, rocket motor, and wing assembly.

(~~C~~ U) The GCG consisted of a seeker head, electronics assembly, and pneumatic control servo system. Through the canards, it provided steering in both pitch and yaw planes in response to signals generated by the IR seeker head, which had a 2.75° field of view. To obtain high sensitivity, the photodetector cell was cooled by supplying high-pressure air to the missile cryostat before missile launch. Without canards, the GCG was about 24.3 inches long and 5 inches in diameter and weighed 31 pounds. With canards attached, it had an overall span of about 16.4 inches and weighed 35 pounds.

(~~C~~ U) The Mark 322 Mod 0 fuze, located aft of the GCG and forward of the warhead, consisted of the Mark 15 Mod 3 Target Detecting Device (TDD) and a Safety & Arming (S&A) device. The TDD, a pulsed doppler proximity device, was 6.75 inches long by 5 inches in diameter and weighed about 9.5 pounds. The 1.4-pound S&A device was 7.1 inches long and 1.5 inches in diameter. To compensate for the difference in size between tactical targets and the smaller drone targets used in the Engineering Test (ET) firing program, the more sensitive Mark 44 Mod 0 fuze was used. This fuze differed from the Mark 322 Mod 0, in that it had no S&A device and used the Mark 15 Mod 0 TDD with extra-sensitive amplifiers. In addition, a small hole was drilled in the base of the TDD to accommodate the telemetry cable.

(~~C~~ U) The continuous rod warhead, located between the fuze and motor, was 13.6 inches long by 5 inches in diameter and weighed about 25 pounds, including 6.5 pounds of high explosive. The warhead was replaced by the telemetry package for the missile firing program at WSMR.

(U) The Mark 50 Mod 0 rocket motor and tail wing assembly provided the total thrust and aerodynamic stability of the missile. The wing assembly, attached to the aft of the motor, contained four fixed wings, two of which included rollerons. It had a span of about 25 inches and weighed 19.1 pounds. The Naval Weapons Center, China Lake, California, developed the Mark 50 Mod 0 rocket motor during the 1965-69 period, under three MIPR's issued by MICOM. Except for certain modifications necessary to adapt the propulsion system to the surface-to-air firing environment, the Mark 50 motor was identical to the Mark 36 Mod 5 motor used in the SIDEWINDER 1C missile. Major parameters and characteristics of the Mark 50 Mod 0 were as follows:

Dimensions:	
Length, overall	72.46 in.
Diameter	5.014 in.
Diameter at aft end	5.165 in.
Weight:	
Before Firing	96.7 lbs.
After Firing	35.2 lbs.
Motor Case	AISI 4130 Steel; 0.060-in. Wall Thickness
Propellant	N-29 Ammonium Perchlorate, Solid, 6-Point Star
Igniter	Mk 264 Mod 1
Performance (70°F. at Sea Level):	
Thrust (Nominal)	2,740 lbs.
Duration (Burning Time)	4.7 sec.
Specific Impulse	230 lb-sec/lb.
Total Impulse (Nominal)	14,250 lb-sec.
Temperatures (Firing & Storage)	-65 to +165°F.
Storage Limit	Indefinite

The rocket motor, with igniter installed, was shipped in the Mark 37 Mod 0 shipping container, which was 77.5 inches long, about 8 inches wide, and 6.75 inches deep. The container had a loaded weight of 130 pounds and an empty weight of 30 pounds.

(U) XMIM-72B Missile. The XMIM-72B missile was the same as the XMIM-72A described above, except that it used the Mark 24 passive infrared fuze and was intended primarily for use against training targets.

(U) XM-48 Fire Unit. The XM-48 fire unit consisted of two major elements: the XM-54 launching station and the XM-730 tracked vehicle. The fire unit provided space for 12 missiles; a crew of 5 personnel; vehicle fuel and fuel for the main power unit of the launching station for a minimum of 18 hours of operation; crew equipment; and other equipment needed for combat operations.

(U) The XM-54 launching station was constructed as a self-contained unit which could be removed from the vehicle and, with the addition of simple mounting fixtures, operated autonomously on the ground, railroad flat cars, flat bed trucks or trailers, and landing craft. It consisted of two major items: the launcher turret base and the launcher turret.

(U) The lightweight, unarmored XM-730 vehicle was an M548 cargo carrier modified to carry the launching station in the cargo area and to permit launching of the missiles. The vehicle was air transportable but not air droppable, and was limited to fording streams and lakes to a maximum depth of 30 inches without special equipment to make it amphibious. It could be operated over cross-country terrain and improved highways, and was capable of speeds up to 38 mph on highways. The cab of the carrier accommodated a driver and a crew of four. The vehicle was 240 inches long, 105.5 inches wide, and 116.5 inches high (to top of the cargo cover). It had a gross weight of 27,400 pounds in its combat configuration with the launching station installed. The reliability of the vehicle was degraded by any weight in excess of 24,500 pounds; however, the M548 had successfully passed the 4,000-mile endurance test at a gross weight of 28,240 pounds.

(U) Weapon System Test Equipment. The AN/TSM-95 OMSS and AN/TSM-96 SMSS were mounted in helihuts and transported by standard Army vehicles. The primary function of the OMSS was to provide a missile testing capability in the field and to carry a test set providing fault isolation capability for maintenance of CHAPARRAL fire units. The SMSS (originally known as the Field Maintenance Test Set—FMTS) had the primary function of providing a test and repair capability for replaceable electrical assemblies removed from a fire unit and for the maintenance of test sets.

(U) The Organizational Maintenance Shop Set (OMSS) provided a protected work space for conducting missile GCG tests using the AN/DSM-79 guided missile test set, which was used by both organizational and support personnel. It also contained the necessary air compressor and power generating equipment to supply the AN/DSM-79 test set and provided storage for the Launch & Control Test Set (LCTS), boresight test fixture, missile assembly stand, missile tool kit, common tools and test equipment, and spare assemblies and manuals. The LCTS consisted of a missile simulator which generated simulated missile signals for processing by appropriate fire unit circuitry. The boresight alignment test fixture consisted of a variable power optical sighting device used in aligning the fire unit launch rails to the gunner's sight. The OMSS was issued as a Table of Organization & Equipment (TOE) line item with the LCTS and boresight tester as part of the shop set. The AN/DSM-79 test set and common tools and test equipment were issued as separate TOE line items.

(U) The Support Maintenance Shop Set (SMSS) provided a protected work space for the maintenance of electrical assemblies removed from the CHAPARRAL fire unit. The primary equipment in this air-conditioned shelter was the subassembly test set which provided the capability for fault isolation and checkout of the weapon system electrical subassemblies (except the missile GCG). The shop set also provided storage for replacement parts and other maintenance equipment. Fault isolation and repair were accomplished to a replaceable circuit board or major replaceable assembly if circuit boards were not used.

(U) Missile Container. The XM-570 missile shipping and storage container used rigid, closed-cell polyurethane plastic foam for structural strength and shock mounts for shock mitigation. It was 18 inches wide, 19 inches high, and 125 inches long, with a volume of 24.4 cubic feet and a loaded weight of 280 pounds. The missile wings and canards were housed in each end of the container.[24]

Flight Test Results

(U) In addition to the full gamut of transportability, roadability, environmental, and maintenance testing shown in Chart 4, 117 CHAPARRAL guided missiles were fired in the various flight test phases between March 1965 and April 1969. Included in these were the 14 military potential tests conducted in 1965 and 10 Engineering Design Tests (EDT) during the period July 1966 to April 1967. In July 1968, two additional EDT rounds were fired at NWC against maneuvering targets, making a total of 26 MPT/EDT firings. The first four EDT rounds were fired from the prototype fire unit delivered in August 1965; the remaining six rounds were fired from

[24](1) TECOM Rept, Mar 69, subj: ET of CHAP Wpn Sys - Vol. I Final Rept, pp. 3-15. CMO Files. (2) NWC Tech Note 40071-07-70, Jun 70, subj: Description & Dev of the CHAP Mk 50 Mod 0 Rkt Mtr, pp. 1-3, 5-6, 8, 13, 16. CMO Files. (3) MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66, pp. VIII-1 - VIII-5. RHA Bx 14-7.

one of the EMFU's. Thirty-six Engineering Test (ET) rounds were fired from an EMFU at WSMR between 28 July 1967 and 20 August 1968. The Air Defense Board fired 40 rounds in the combined Service Test/ Initial Production Test (ST/IPT) program during the 1967-69 period. Also included in the flight test program were three IPT's at WSMR and 12 special Engineering Analysis (EA) firings, in November 1968, to evaluate corrective fixes for a missile dispersion problem encountered in earlier tests.

(~~C~~ U) As shown below, 14 of the 117 flight tests were invalid because of personnel errors, target malfunctions, misfires, etc. Of the 103 valid tests, 40 were failures and 63, or 61 percent, were successful.[25]

Test Phase	No Test	Suc.	Unsuc.[a/]	Total	Reliability[b/]
MPT/EDT......	4	16	6	26	73%
ET...........	4	20	12	36	63%
ST/IPT.......	4	15	21	40	42%
IPT (WSMR)...	0	2	1	3	67%
EA (WSMR-NWC)	2	10	0	12	100%
Totals.......	14	63	40	117	61%

[a/] All miss distances greater than 23 feet considered failures.

[b/] Percent of valid tests successful.

Tropic Storage Tests

(U) Tropic tests of the CHAPARRAL missile were conducted at the U. S. Army Tropic Test Center, Panama Canal Zone, and at WSMR from August 1968 to 17 February 1970. Six missiles in their containers were placed in open storage at the Fort Gulick test area for 12 months and then shipped to WSMR for microbiological examination and flight test. The microbiological examination revealed no microbial growth on the missiles; however, the paint on the storage containers had blistered and moisture had penetrated the forward end cover, causing pitting-type corrosion on the rolleron assembly. Two of the six missiles were rejected for

[25] (1) MICOM Rept, BOB/DOD/DA/AMC PEMA FY 70 Pre-Apportionment Orientation, CHAP & FAAR, 28 Apr 69. RHA Bx 14-8. (2) TECOM Rept, Apr 69, subj: ET of CHAP Wpn Sys - Msl Firing Synopses. CMO Files. (3) NWC Rept, CHAP Program Review, Aug 67, pp. 22, 24, 26. File same. (4) TECOM Rept, Mar 69, subj: ET of CHAP Wpn Sys - Vol. I Final Rept. File same.

flight test because parameters of their GCG sections were out of tolerance, but there was no evidence that the failures were the result of storage in the tropic environment.

(U) In January and February 1970, the other four missiles were fired from one of the EMFU's against the MQM-34D target drone with a butane-fueled IR source. The first firing was scored as "no test" owing to a malfunction of the IR source. The other three firings were completely successful, with miss distances of 2.45, 6.43, and 11.64 feet, respectively.[26]

Follow-On Development and Production

(U) During the 1967-68 period, all phases of the CHAPARRAL program were geared to support activation of the first training battery in January 1969 and the first tactical unit in May. Both of these milestones were met, and the first battalion was deployed to Europe in November 1969. By the end of FY 1970, the test cycle for the basic CHAPARRAL system had been completed, including EDT, ET/ST, and IPT. Aside from completion of the simulator/evaluator program discussed below, the remaining effort consisted primarily of analyzing data from all tests, assessing system reliability and meantime between failure, and improving system effectiveness.[27]

AN/TSQ-T3 Monitoring Set

(U) The simulator/evaluator training device (later identified as the AN/TSQ-T3 monitoring set) was one of the last items to be placed in development. The Aeronutronic Division of Philco-Ford began development of the set in mid-1969 under Contract DA-AH01-69-C-1571. The ET/ST program was conducted during the period August 1970 to February 1971, and the development acceptance IPR was held 27-28 April 1971. In June 1971, MICOM awarded Hydro-systems, Inc., a production contract (DA-AH01-71-C-1359) for 118 sets, but only 116 were delivered.[28]

(U) The AN/TSQ-T3 provided a means for monitoring the gunner's

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[26] TECOM Rept, Apr 70, subj: ET of CHAP Wpn Sys [Tropic Test] - Addendum to Final Rept. CMO Files.

[27] CHAP/FAAR Bfg for GEN Guthrie, 28 May 70. RHA Bx 14-8.

[28] (1) MICOM Contr Listing, 1 Jul 72. HDF. (2) Intvw, M. T. Cagle w Ms. O. Walters, Item Mgr, D/Mat Mgt, 4 Dec 74. (3) AMCTCM 8588, Mtg No. 8-71. RSIC.

tracking accuracy and anomalies and reactions thereto. The set operated from the fire unit power to facilitate field usage, was quick and easy to install, imposed no restrictions on fire unit movement, and required no modification of the fire unit. It consisted of an instructor control indicator assembly, a cable set group, and an XM-30 training missile, mounted on a launch rail and incorporating a tactical missile guidance section. The XM-30 dummy missile, developed and produced by the Navy, contained inert components and simulated the tactical missile in size, shape, weight, and center of gravity. For the handling mode, a dummy front end replaced the tactical guidance section used in the tracking mode.[29] The original program also included the development of a CHAPARRAL mount simulator for use with the REDEYE Moving Target Simulator; however, this requirement was cancelled.

RDTE Cost Summary

(U) Between January 1967 and May 1970, the estimated RDTE cost for completion of the basic CHAPARRAL development effort was reduced by $575,000,* from $59,941,000 to $59,366,000. The revised cost estimate represented an overall increase of 239.2 percent over the original estimate of $17,500,000 for the FY 1965-67 period.[30]

(U) Including the CHAPARRAL product improvement effort, which will be discussed later, the actual RDTE cost of the program totaled $62,481,000 for the FY 1965-74 period (*see* Table 3). This

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*In January 1968 the RDTE cost estimate was increased by $627,000 to cover costs of operating the Project Manager's Office at AMC HQ for FY 1967-71. A refinement of the estimate in January 1969 added $2,228,000 to the program cost ($1,125,000 in added costs resulting from deferral of training device development and procurement of test hardware and targets for arctic/tropic tests from FY 1968 to 1969, and $1,103,000 for operation of the Project Manager's Office. The latter included cost increases for FY 1969-71 plus FY 1972 requirements). A refinement of the estimate in October 1969 reduced the cost by $297,000. This was followed, in May 1970, by a further reduction of $3,133,000 ($2,125,000 from deletion of the mount simulator development effort, $981,000 from adjustments in program authority for FY 1970-71, and $27,000 from other adjustments in prior-year programs).

[29](1) *Ibid.* (2) CHAP Pocket Guide, pp. 8, 28. HDF.

[30](1) C&DP Rept, CHAP COSTECH Rept 70-19, Aug 70, pp. 47, 49-51. CMO Files. (2) *Also see* above, p. 68.

TABLE 3—(U) Actual RDTE Costs - FY 1965-74
($ in millions)

Fiscal Year	Annual	Cumulative
1965	5.160	5.160
1966	19.486	24.646
1967	17.125	41.771
1968	7.251	49.022
1969	5.456	54.478
1970	2.492	56.970
1971	.605	57.575
1972	1.193	58.768
1973	.375	59.143
1974	3.338	62.481

SOURCE: For FY 1965-69: C&DP Rept, CHAP COSTECH Rept 70-19, Aug 70, p. 47. For FY 1970-74: Mrs. Mary L. DeYoung, Budget Div, Compt.

represented an increase of 257 percent over the original estimate. Most of the RDTE obligations after 1971 were for new initiative and prototype effort in the product improvement program. The major R&D contracts with the Aeronutronic Division of Philco-Ford are listed in Table 4.

Production Summary

(U) As stated earlier in this chapter, the CHAPARRAL missile and fire unit were classified as LP type in September and November 1965, and initial procurement quantities were authorized. The first buy of 840 missiles and 39 fire units was placed under contract in FY 1966. Major PEMA commitments for FY 1967 were frozen, in September 1966, because of difficulties encountered in the production of acceptable GCG sections and a resultant delay in first missile deliveries. This delay, coupled with risks involved in the compressed schedule, led to a 1-year stretchout in fire unit production and a 15-month extension in the CHAPARRAL activation schedule (from October 1967 to January 1969).[31] After AMC froze major FY 1967 procurement actions, only a few exceptions were made at MICOM's request.[32] Among these were contracts with

[31] *See* above, pp. 59-68.

[32] Hist Rept, CMO, FY 67, p. 6. HDF.

TABLE 4—(U) Major R&D Contracts with Aeronutronic Division of Philco-Ford

Contract Number	Date	Commodity or Service	Period of Perf	Total Value
DA-01-021-AMC-11907	Feb 65	FY 65 R&D - CHAP Ground Equipment	02/65 - 08/66	$ 2,856,207
DA-01-021-66-C-0061	Jan 66	FY 66 R&D	01/66 - 03/68	19,108,642*
DA-AH01-67-C-0038	Aug 66	CHAPARRAL Study	unk	157,267
DA-AH01-67-C-0217	Sep 66	CHAPARRAL Improvement Study	unk	443,878
DA-AH01-68-C-0725	Jan 68	FY 68 R&D	10/67 - 01/69	3,264,941
DA-AH01-69-C-0542	Oct 68	FY 69 R&D	10/68 - 11/69	1,641,207
DA-AH01-69-C-1571	Apr 69	Simulator/Evaluator Development	04/69 - 04/71	1,878,778
DA-AH01-70-C-0311	Oct 69	FY 70 R&D	10/69 - 04/71	1,286,769
DA-AH01-71-C-0271	Nov 70	FY 71 R&D	10/70 - 12/71	372,822
DA-AH01-72-C-0762	Apr 72	CHAP Improvement Program	04/72 - 12/74	1,661,980**
DA-AH01-73-C-0193	Nov 72	R&D - Target Acquisition Aids	11/72 - 08/74	5,046,280***
			TOTAL:	$37,718,771

*Final contract value furnished by DCASD-Anaheim Ofc, 8 Oct 74.

**Initial value of contract was $1,053,321. Subsequent modifications in FY 1973-74 increased the value to $1,661,980. Per Bob Lipscomb, CMO, 21 Nov 74.

***Contract value furnished by Bob Lipscomb, CMO, 21 Nov 74.

SOURCE: Except as otherwise noted, contract data compiled from MICOM Contract Listings and Memo G031-74-56, C. W. Small to H. J. Burton, Philco-Ford, 27 Feb 74, subj: Maj CHAP Contrs. HDF.

the Aeronutronic Division of Philco-Ford for new equipment training, FY 1967 engineering services, and the first buy of weapon system test equipment.[33]

(U) On 8 July 1967, upon completion of the configuration audit review, the documentation release was made to assure follow-on production and to establish configuration control. This was followed by the full production release on 15 August 1967. The second hardware buy, in FY 1968 with FY 1967 funds, included 1,280 CHAPARRAL missiles and 113 fire units. A letter order for the latter was signed with Aeronutronic in October 1967 and definitized in March 1968. Other Aeronutronic contracts included one for FY 1968 engineering services, one for the second buy of weapon system test equipment, one for technical publications, and one for repair parts/components (FY 1969 spare parts Basic Ordering Agreement—BOA).[34]

(~~C~~U) Since testing had not been completed, procurements in FY 1969 and subsequent years were made under extensions of the LP classification authority.[35] Because of funding shortages and a reduction in the number of CHAPARRAL battalions, the procurement of major items fell considerably below the May 1966 Army Materiel Plan shown in Table 2. For example, the procurement of Army missiles was reduced from 16,824 to 9,600, and self-propelled fire units from 680 to 448. These and other major item procurements are listed in Table 5.

(U) Including equipment modifications and a small customer order, the actual PEMA outlay totaled $307,456,866 for the FY 1966-74 period (*see* Table 6). Major production contracts with the Aeronutronic Division of Philco-Ford are listed in Table 7. Most of the contracts after FY 1971 were concerned with the CHAPARRAL product improvement program.

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[33] *See* Table 7.

[34] (1) Hist Rept, CMO, FY 68. HDF. (2) *Also see* Table 7.

[35] *See* AMCTCM's 5904, recorded 9 Apr 68; 6505, recorded 18 Dec 68; 6786, recorded 21 Apr 69; 7252, recorded 25 Nov 69; and 7313, recorded 17 Dec 69. RSIC.

TABLE 5—(U) CHAPARRAL Major Item Procurement (U)

Item	Proc Period	Quantity
Missiles: Army.............	FY 1966-71	9,600
Customer.........	FY 1974	20
Missile Trainer, XM-30......	FY 1966-71	537
Fire Unit, XM-48, SP........	FY 1966-70	448*
Guided Missile Equip Sets...	FY 1966	25
OMSS, AN/TSM-95.............	FY 1967-71	57
SMSS, AN/TSM-96.............	FY 1967-71	30
Test Set, AN/TSM-85.........	FY 1970-71	127
Test Set, AN/TSM-101........	FY 1970-71	9
Jack Level Support Sets.....	FY 1970-71	139
Alignment Set, XM-71........	FY 1970-71	85
Monitoring Set, AN/TSQ-T3...	FY 1971	116

*The planned fifth buy of 135 units in FY 1971 was cancelled.

SOURCE: Ms. O. Walters & Mr. C. H. Baucum, Item Mgrs, D/Mat Mgt, 4 Dec 74.

TABLE 6—(U) CHAPARRAL PEMA Cost Summary

Fiscal Year	Annual	Cumulative
1966	$26,029,663	$26,029,663
1967	63,080,980	89,110,643
1968	8,000,000	97,110,643
1969	71,645,067	168,755,710
1970	69,832,697	238,588,407
1971	47,382,240	285,970,647
1972	15,635,181	301,605,828
1973	5,391,418	306,997,246
1974	459,620	307,456,866*

*Includes $23,311,192 for equipment modifications in 1970-73 and a $459,620 customer order in FY 1974.

SOURCE: Sum of the CHAP Msl Sys by Qty & Dollar Value as of 30 Jun 74. Compiled by Johnny C. King, Budget Div, Compt, 7 Nov 74.

TABLE 7

(U) Production Contracts with Aeronutronic Division of Philco-Ford*

Contract Number	Date	Commodity or Service	Total Value
DA-01-021-AMC-14107	Apr 66	FY 66 Engrg Services	$ 3,112,648
DA-01-021-AMC-14745	Apr 66	Facilities	100,000
DA-01-021-66-C-0062	May 66	1st Buy FU Hardware	13,826,065**
DA-AH01-67-C-0183	Sep 66	New Equipment Training	516,598
DA-AH01-67-C-0905	Nov 66	FY 67 Engrg Services	5,005,164
DA-AH01-67-C-1542	Mar 67	1st Buy Wpn Sys Test Equip	2,286,153
DA-AH01-68-C-0548	Oct 67	2d Buy FU Hardware	17,641,207
DA-AH01-68-C-1024	Dec 67	FY 68 Engrg Services	4,734,831
DA-AH01-68-C-1031	Dec 67	Technical Publications	586,297
DA-AH01-68-C-1558	Apr 68	2d Buy Wpn Sys Test Equip	872,402
DA-AH01-68-A-0042	Jun 68	Rep Pts/Comps (FY 69 BOA)	4,684,345
DA-AH01-68-C-2116	Jun 68	Repair/Restore Equipment	698,302
DA-AH01-68-A-0059	Aug 68	Refurbish CHAPARRAL Units	1,368,811
DA-AH01-69-C-0368	Sep 68	3d Buy FU Hardware	26,831,991
DA-AH01-69-C-0845	Nov 68	FY 69 Engrg Services	4,400,563
DA-AH01-69-C-1079	Jan 69	FY 69 Technical Publications	363,317
DA-AH01-69-C-1940	Jun 69	Gnd Spt Equip/Maint Work	2,597,314
DA-AH01-69-A-0013	Jul 69	Inspect/Repair CHAP Comps	1,059,893
DA-AH01-70-C-0081	Jul 69	Repair/Rebuild	339,620
DA-AH01-70-C-0230	Sep 69	4th Buy FU Hardware	29,542,749
DA-AH01-70-C-0747	Jan 70	Changes to Tech Pubs	422,760
DA-AH01-70-C-0617	Feb 70	Wpn Sys Depot Tng Program	465,480
DA-AH01-70-C-0460	Mar 70	FY 70 Engrg Services	459,372
DA-AH01-70-C-1349	Jun 70	CHAP Gnd Spt Equipment	793,192
DA-AH01-71-C-0454	Dec 70	FY 71 Engrg Services	5,036,759
DA-AH01-71-C-0272	Jan 71	5th Buy Wpn Sys Test Equip	1,515,740
DA-AH01-71-C-0644	Jan 71	FY 71 Technical Publications	405,480
DA-AH01-71-C-1413	Jun 71	Personnel Training Courses	105,203
DA-AH01-72-C-0586	Feb 72	FY 72 Engrg Services	6,706,508
DA-AH01-72-C-0541	Feb 72	FY 72 Technical Manuals	435,766
DA-AH01-72-C-0466	Jun 72	GCG's - MOD 1A Pilot Pdn	2,807,698
DA-AH01-72-C-1082	Jun 72	Installation Kit	290,131
DA-AH01-73-C-1050	Jun 73	AN/DAW-1 (MOD 1A) Engrg Svcs	3,310,439
DA-AH01-73-C-1133	Jun 73	Technical Publications	244,651
DA-AH01-74-C-0167	Sep 73	Hand Control Assembly	109,075
DA-AH01-74-C-0304	Nov 73	Panel Control Indicator	135,280
			$143,811,804

*Contracts valued at $100,000 or more.

**Final contract value furnished by DCASD, Anaheim Ofc, 7 Oct 74.

SOURCE: Except as otherwise noted, contract data compiled from MICOM Contract Listings dated 1 Jul 72, 1 Oct 73, & 1 Apr 74.

Missile Production Problems

(U) As of 31 October 1974, all items of procured equipment had entered the Army inventory except 1,406 missiles which were scheduled for delivery by November 1975, and 34 M30 missile trainers which were to be available by the end of December 1974.[36] The delay in missile deliveries stemmed from continuing technical difficulties in production of the missile GCG, and coordination and support problems in the Army/Navy relationship.[37]

(U) Because of continued delays in missile deliveries in the late summer of 1967, MICOM gave serious consideration to the assumption of full missile procurement responsibility, including technical management of contracts. After a study of the proposition, the Procurement & Production Directorate concluded that such a move would not improve the missile production schedule, that the cost of missile and maintenance support would increase, and that the quality of the system could easily deteriorate. The study report noted that the CHAPARRAL missile was developed in-house by the Navy, without the use of industry as a prime contractor for engineering effort. Since MICOM did not possess the specialized knowledge necessary to manage the technical matters, it would still be dependent on the Navy for total technical support, and additional personnel would be needed to manage other aspects of the program, such as procurement planning, contracting, and contract administration. It was therefore recommended that procurement of the missile be left with the Navy, and that the Army assign liaison personnel to the Navy to keep MICOM informed of the general program status and problem areas. With specific reference to the continuing problems in GCG production, the Navy agreed to the assignment of an Army representative to work with the Navy on matters of contracting and contract management.[38]

(U) In the wake of continuing problems and difficulties in mid-1969, MICOM again considered the assumption of direct procurement responsibility for the CHAPARRAL missile. Citing some of the prevailing problems with the Navy, COL Donald H. Steenburn, chief of the CHAPARRAL Management Office, declared that the Naval Weapons Center (NWC) had been delinquent in providing updated documentation

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[36] Intvw, M. T. Cagle w Charles H. Baucum, Item Mgr, D/Mat Mgt, 4 Dec 74.

[37] *See* above, pp. 63, 65-66.

[38] DF Cmt #2, D/P&P to Chf, CMO, 24 Jun 69, subj: Proc of the CHAP Msl, w incl: Study of CHAP Msl Proc Resp, *circa* Sep 67. HDF.

and prompt technical evaluation. The NWC, he said, had effected unilateral design changes by means of deviation orders and revision directives without prior CMO approval as required in the initial agreement, and had experienced considerable difficulty in finalizing contracts, resulting in continually slipping procurement schedules. As a result of the latter, about $10 million in project funds had been carried over in the past three fiscal years. These problems were compounded by the decision of the Naval Air Systems Command (NASC) to procure the SIDEWINDER missile as an "all up" round under a single contractor and to convert the SIDEWINDER GCG to solid-state components beginning in FY 1970. In the absence of sufficient advancement in system performance, MICOM had decided not to convert the basic CHAPARRAL GCG to solid-state components. These considerations would cause MICOM to procure all missile components in smaller lots, thus removing the cost benefits derived from joint SIDEWINDER/CHAPARRAL procurement through NASC. Moreover, it was unlikely that the Navy would wish to continue procurement management of what would become strictly an Army item.

(U) COL Steenburn therefore proposed that MICOM assume direct responsibility for procurement of the CHAPARRAL missile, beginning in FY 1970, with the NWC being retained as the technical support agency directly responsible to the CMO.[39] The Procurement & Production Directorate, however, again rejected such a move on the same grounds as related in its earlier study of the subject.[40] In the end, the procurement of CHAPARRAL missile components was continued through the Navy, an MIPR for the FY 1970 buy being sent to NASC in July 1969.[41]

(U) Problems in both technical and procurement areas continued throughout FY 1970. In late April 1970, 237 missile units were delinquent as a result of delays in delivery of components under Navy contracts. Because of a lack of components, the Red River Army Depot's assembly schedule for complete missiles was adjusted to allow a 3-month break in assembly (April, May, and June 1970). In a letter to the NASC Commander, on 21 April, the Deputy Commanding General of MICOM reiterated the problems faced by the Army in

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[39](1) DF Cmt #1, Chf, CMO, to D/P&P, *et al.*, 16 Jun 69, subj: Proc of the CHAP Msl. (2) *Also see* SS AMSMI-I-2-69, D/P&P, 27 Jan 69, subj: Oblgn of FY 69 CHAP Msl Funds Under Navy Control, w incl: Ltr, CG, MICOM, to RAdm R. L. Townsend, NASC, 30 Jan 69, n.s. Both in HDF.

[40]DF Cmt #2, D/P&P to Chf, CMO, 24 Jun 69, subj: Proc of the CHAP Msl. HDF.

[41]CHAP/FAAR Chronology. HDF.

meeting CHAPARRAL assembly and deployment schedules, and urged that action be taken to insure delivery of components to meet the revised missile assembly schedule.[42] In mid-June 1970, LTC Monte J. Hatchett, who had succeeded COL Donald H. Steenburn as chief of CMO on 9 December 1969, observed that there were 20 active Navy contracts on the CHAPARRAL missile, and delivery problems—some of a very serious nature—were associated with every contract except for wings and dome protectors.[43]

(U) Only 1,181 CHAPARRAL missiles were delivered during FY 1970, bringing the total to 2,266. Deliveries during FY 1971 nearly doubled, with a total of 2,318. This made a cumulative total of 4,584 missiles delivered through 30 June 1971. The last four fire units were delivered in July 1971, completing the total requirement of 448.[44]

(U) During the ensuing 3 years, 3,610 missiles entered the Army inventory, bringing the total to 8,194 as of 31 October 1974. Of these, 5,452 were tactical missiles and 2,742 were for training. The remaining 1,406 missiles, scheduled for delivery by November 1975, were to consist of an optimum mix of training and tactical configurations, with training receiving first priority.[45]

Inventory Status of Missiles and Fire Units

(U) Of the 5,452 tactical missiles produced through October 1974, 4,852 were in the active inventory, 344 were expended in tests, 216 were sold to Israel, and 40 were on loan to the Navy. The basis of issue was a basic load of 12 missiles per fire unit (288 per battalion) and a command stock of 6 missiles per fire unit (144 per battalion) to be held at ammunition storage points.

(U) A total of 2,468 training missiles had been expended in training and quality assurance tests, leaving 274 in the active

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[42] (1) Ltr, DCG, MICOM, to RAdm T. J. Walker, Cdr, NASC, 21 Apr 70, n.s., atchd to SS AMSMI-I-54-70, D/P&P, undtd, subj: Ltr to RAdm T. J. Walker. (2) DF Cmt #1, D/P&P to CG, MICOM, 28 Apr 70, subj: Intensively Managed Items - Proc Scds RCS-AMCPP-134 - Weekly Rept, w incl. Both in HDF.

[43] DF Cmt #1, Chf, CMO, to D/P&P, 12 Jun 70, subj: CHAP/FAAR Pdn Mgt Func. HDF.

[44] AMC Hist Sum, FY 71, pp. 83, 85.

[45] Intvw, M. T. Cagle w Charles H. Baucum, Item Mgr, D/Mat Mgt, 4 Dec 74.

inventory. The basis of issue was 1 per fire unit per year for annual service practice, 1 per 10 trainees for advanced individual training, and 2 per fire unit for advanced unit training.

(U) In addition to the 503 M30 missile trainers delivered through October 1974, 4 were picked up from R&D rounds and 1 was lost in a fire, increasing the current assets to 506 units. Of these, 168 were located in Europe, 24 in Korea, 24 in Hawaii, 120 in the Forces Command (FORSCOM), 125 at Army schools and training centers, and 45 in depot storage.

(U) Twelve of the 448 CHAPARRAL fire units produced were sold to Israel, leaving 436 in the Army inventory. Of these, 182 were assigned to units in Europe and 24 to units in Korea. There were 200 at Army schools and training centers, 24 at the Red River Army Depot, and 6 out on loan. The basis of issue for the fire unit was 12 per weapon battery TOE 44-328 and 8 per weapon battery TOE 44-727.[46]

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[46] (1) Intvws, M. T. Cagle w C. H. Baucum and O. Walters, Item Mgrs, D/Mat Mgt, 4 Dec 74. (2) MICOM Rept, DA Msl Maj Item Distr Plan, 30 Jun 74, pp. 3, 5, 8. D/Mat Mgt Files.

CHAPTER V

(U) WEAPON SYSTEM DEPLOYMENT (U)

(U) The basic CHAPARRAL weapon system was fielded in 1969 before completion of testing and type classification of the equipment as Standard A. Although basically sound, it was approved for troop release with the knowledge that many improvements were yet required and with the understanding that later retrofitting would be made to improve performance. Moreover, the effectiveness of the weapon system was seriously degraded by the lack of an IFF capability and early warning system. As will be noted in Part 2 of this study, the Forward Area Alerting Radar (FAAR) fell behind schedule because of development and production problems and was not available for deployment until December 1972.

Initial Training and Unit Activation

(U) The initial training program was aimed at meeting three key target dates: 27 January 1969, when the first school battery would activate; 5 May 1969, when the two batteries for the first tactical battalion would activate at Fort Bliss; and November 1969, when trained personnel would be available for deployment with the first composite CHAPARRAL/VULCAN battalion to Europe. The approved man/equipment ratios and Military Occupational Specialties (MOS's) for the CHAPARRAL were as follows:

CHAPARRAL/VULCAN Crewman (MOS 16R): 5 for each system.

Organizational Maintenance
CHAPARRAL System Mechanic (MOS 24N): 5 per battalion
Precise Power Generation Specialist (MOS 52B20): 2 per battalion
Engineer Missile Equipment Maintenance Specialist (MOS 62C): 2 per battalion

Direct Support
Light Air Defense Systems Electronic Repairman (MOS 27F): 1 Detachment Electronic Contact Team per 12 systems

General Support: Same as Direct Support, except that 1 contact team was authorized per 72-96 systems and 2 Ammunition Supply Points.

New Equipment Training (NET)

(U) The NET program was designed to provide key personnel, already qualified in their operational and maintenance specialty, the instruction and/or orientation necessary to increase their skills, knowledge, and techniques to the degree required for operation and maintenance of the new weapon system. It consisted of various courses of instruction designed to meet the specific needs of staff planners and managers; personnel responsible for supervising and conducting ET/ST; CONARC and AMC instructors; support maintenance, depot, and key technical personnel; and theatre and unit commanders receiving the CHAPARRAL missile system. The Aeronutronic Division of Philco-Ford conducted the NET courses at its Anaheim, California, plant under a contract with MICOM.

(U) The first NET courses were for TECOM personnel who would conduct and supervise the CHAPARRAL ET/ST program. These courses began in May and continued into June 1967. They were followed by courses for key personnel and CONARC instructors to enable the various schools to prepare for resident training. Eight operator and organizational maintenance classes and four support maintenance classes were conducted between 8 January and 7 June 1968.

Resident Training

(U) The delivery of training devices, targets, and associated equipment to the various training centers and schools began in February and continued into June 1968. Individual training began at the Army Air Defense School at Fort Bliss on 11 October 1968 and at the Army Training Center on 18 November 1968. At Redstone Arsenal, the Missile & Munitions Center & School started training support maintenance personnel early in January 1969.[1]

Release for Unit Activations

(U) At the direction of the Department of the Army, a special combined in-process review (IPR) was held 10-12 December 1968 at the Army Air Defense Center, Fort Bliss, to assure that the

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[1](1) MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66, pp. IX-1 - IX-2. RHA Bx 14-7. (2) Rept, Rqrd Info [for] TCLAS, 10 Jul 70. Atchd to MICOM Rept, Pre-IPR, 9-10 Jun 70. RHA Bx 14-8. (3) CHAP Chronology. HDF. (4) CVADS PM Rept, Sp Comb IPR, CVADS, Dec 68 (Vol. I), p. 170. RHA Bx 14-7.

the CHAPARRAL system was suitable for activation of units and that the VULCAN was suitable for deployment. At that time, tests of the CHAPARRAL were still in progress and certain requirements of the QMR had not been met. Nevertheless, sufficient tests had been conducted to demonstrate most of the essential performance characteristics and to provide confidence that the weapon system could satisfactorily accomplish its assigned mission. Having concluded that the prevailing deficiencies and associated risks were not of sufficient magnitude to preclude unit activations, members of the review team recommended that the initial CHAPARRAL units be activated as scheduled and that a special IPR be held 60 to 90 days before the first unit deployment to assure that the system was suitable for field use. They also recommended that VULCAN units be deployed according to the approved schedule.[2]

(U) The results of the special combined IPR were approved, and the CHAPARRAL training unit was activated in late January 1969. This unit remained at Fort Bliss as part of the composite CHAPARRAL/VULCAN training battalion, which consisted of one battery each of the CHAPARRAL and the towed and self-propelled VULCAN for across-the-board training on all configurations. On 1 May 1969, the U. S. Army Materiel Requirements Directorate granted authority to issue CHAPARRAL equipment to CONARC for the initial tactical units. This was followed, later in May, by activation of the first two tactical CHAPARRAL batteries which were to be deployed to Europe in November 1969 with the 1st Battalion/59th Artillery.[3]

Advanced Resident and Unit Training

(U) Advanced resident and unit training for personnel of tactical CHAPARRAL/VULCAN batteries was conducted by Army schools at Fort Bliss, Texas; Redstone Arsenal, Alabama; Fort Gordon, Georgia; and Fort Belvoir, Virginia.

(U) The U. S. Army Air Defense Center at Fort Bliss provided Advanced Individual Training (AIT) for operators, transition training for Non-Commissioned Officers (NCO's) in grades E5 and E6, and unit training for organized battalions. The 8-week AIT courses were conducted at the U. S. Army Training Center (Air Defense). Operators were trained on both the VULCAN and CHAPARRAL, and,

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[2] *Ibid.*, pp. 176, 178-79, 184-85.

[3] (1) CVADS PM$_2$P, 4th Qtr, FY 67. RHA Bx 14-7. (2) Hist Rept, CMO, FY 69. HDF. (3) CVADS PMP Prog Repts, 1st - 4th Qtrs, FY 69. RHA Bx 14-7.

subsequent to AIT, received basic driver qualification on the prime movers. The NCO transition training conducted at the 1st AIT Brigade was oriented toward maintenance and operation of the weapon system.

(U) The U. S. Army Air Defense School (USAADS) at Fort Bliss trained personnel for organizational maintenance of the CHAPARRAL missile and launching station, and conducted officer and NCO qualification training in tactics and employment.

(U) The U. S. Army Missile & Munitions Center & School at Redstone Arsenal conducted Light Air Defense Systems Electronic Repairman courses for direct and general support maintenance of the VULCAN and CHAPARRAL weapon systems.

(U) The Electronic Instrument Repair courses taught at the U. S. Army Southeastern Signal School, Fort Gordon, Georgia, qualified enlisted personnel to perform direct and general support maintenance on test equipment used in the VULCAN/CHAPARRAL/FAAR systems. These courses, which also included other advanced types of test equipment, were about 17 weeks long with 4 to 5 weeks devoted specifically to the VULCAN/CHAPARRAL/FAAR test equipment.

(U) The U. S. Army Engineer School at Fort Belvoir, Virginia, trained organizational and direct and general support maintenance personnel for all electrical power generators, environmental equipment (heaters, air conditioners), high pressure air compressors, purification units, and other related air system components used in the VULCAN/CHAPARRAL/FAAR systems.

(U) The USAADS and AIT classes were scheduled so that, upon graduation, personnel would be integrated into a package for commencement of unit training. The 15th Artillery Group (Air Defense) at Fort Bliss was responsible for the final phases of unit training, which consisted of a 3-week activation period, 7 weeks of Basic Unit Training (BUT), 6 weeks of Advanced Unit Training (AUT), and about 5 weeks of Preparation for Overseas Movement (POM). The BUT phase was oriented toward individual fire unit and crew training, concluding with a week of firing at the range. During the AUT phase, training was elevated to the battalion level, with the battalion commander assuming control. It ended with a 2-week Army Training Test (ATT), which included a 1-week tactical phase and a week of range firings, followed by the final POM phase.[4]

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[4]Rept, Rqrd Info [for] TCLAS, 10 Jul 70. Atchd to MICOM Rept, Pre-IPR, 9-10 Jun 70. RHA Bx 14-8.

(U) Between 9 January 1969 and 24 July 1971, CONARC personnel fired 990 CHAPARRAL missiles in AIT and ATT at McGregor and Dona Ana Ranges, Fort Bliss. Seventy-two of these tests were invalid, 146 were failures, and 772 were successful, for a success rate of 84.1 percent. Since CONARC firings were not instrumented, results were based on visual observer estimates.[5]

Release for Deployment and Type Classification

(U) In accordance with the approved recommendations of the December 1968 special combined IPR*, several CHAPARRAL reviews were held during the first quarter of FY 1970 to assure that the weapon system was suitable for deployment. The liklihood that the system released for initial production would not meet all Qualitative Materiel Requirements (QMR's) had been recognized during the prototype system IPR held at Fort Bliss on 1-2 November 1967. A formal Army position paper, signed on 2 November, stated in part:

> Certain requirements of the QMR may not be met, and appear to be beyond the capability of the developers to provide satisfactory solutions within present resources and time available. Although addressed at the IPR, their recognition in no way waives the QMR requirements.[6]

(U) During a pre-IPR held at Aberdeen Proving Ground on 23 July 1969, it was determined that sufficient testing had been completed to demonstrate that the system would meet most of the major performance requirements except the effectiveness rate of 0.5. The test results indicated that this effectiveness rate was unrealistically high for the standard Navy missile which was adapted to the Army environment. Later in July, the Commanding General of AMC conducted a special CVADS** review as part of a series of intensive reviews of the larger, more critical projects. In a letter to the Army Chief of Staff, on 15 August 1969, he stated that he was recommending that either the QMR for system effectiveness for a single missile be changed from 0.5 to 0.25, or that the QMR be changed to specify 0.39 and 0.45 as specified from multiple missile firings; and that the inner engagement boundry requirement be changed from 0.8 to 1.1 kilometers (km).[7]

(U) The special IPR for deployment release was held at the

*In-Process Review
**CHAPARRAL/VULCAN Air Defense System

[5] CHAP Prog Repts, CVADS PM, Jul 70 - Sep 71. RHA Bx 14-8.

[6] Quoted in Hist Rept, CMO, FY 68, p. 3. HDF.

[7] Hist Rept, CMO, FY 70, p. 1. HDF.

Army Air Defense Center 16-18 September 1969, as the first two CHAPARRAL batteries were preparing for movement to their duty station in Germany. During the review, primary attention was focused on the unsolved problem areas which prevented the weapon system from meeting certain materiel requirements. Of prime concern were problems and/or deficiencies associated with system effectiveness, missile performance, and shear pin design.

(U) The failure of the CHAPARRAL to meet the required 0.5 system effectiveness rate had been a major problem since the initiation of engineering and service tests in 1967. Based on service test firings and Army Materiel Systems Analysis Agency (AMSAA) lethality data for a "K" kill, a point estimate of system effectiveness against a Fishbed type target was 0.42 using MOD 1* and 0.33 using MOD 2.** While recognizing that the existing missile design did not provide the effectiveness required by the QMR, the conferees agreed that the achieved effectiveness should not be a bar to deployment.

(U) The problem with missile performance had to do with the inner boundary. The CHAPARRAL missile retained the original magnetic amplifier time constant, which prevented the system from meeting the minimum inner boundary requirement of 0.8 km. The demonstrated inner boundary capability was 1.08 km. The reviewing team concluded that a waiver of the QMR would be acceptable as an interim measure and that this should not be a bar to deployment provided measures were taken to correct the problem.

(U) The shear pin design planned for initial deployment had a shortcoming in that it was sensitive to breakage during fire unit travel. The breakage problem was solved by removal of the missile canards during non-combat road travel, which, in turn, lengthened the time required for march order and emplacement. During combat road travel, the canards would be left on the missile and the resultant degradation due to breakage would be accepted. The final design would be developed, tested, released by engineering change proposal, and incorporated in all guidance sections by Department of the Army Modification Work Order.

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*The MOD 1 lethality represented the probability of a warhead kill based on the rod or section of the rod impacting a vulnerable portion of the target after rod breakup.

**The MOD 2 confined lethality probability to a kill that would occur as a result of the continuous rod warhead impacting a vulnerable portion of the target before rod breakup.

(U) Yet another problem addressed during the review concerned the lack of an early warning capability for the deployed units, the FAAR system having fallen behind schedule because of technical and production difficulties. (The original QMR had also specified a requirement for IFF equipment for the basic CHAPARRAL; however, this was deleted by a change published in February 1968.*)

(U) Although the weapon system did not fully meet the QMR, the members of the review team concluded that the demonstrated missile performance and system effectiveness were sufficient to warrant release for deployment. In consonance with the urgent requirement to field a low altitude forward area air defense system, they therefore recommended (1) that CHAPARRAL units continue to be activated and deployed as scheduled, (2) that system effectiveness be improved through modifications or product improvements, and (3) that DA recognize the need for an interim early warning system pending availability of the FAAR.[8]

(U) While the CHAPARRAL system effectiveness, calculated from service test firings by TECOM as 0.26, did not meet the DA-approved minimum of 0.5, the weapon was released for deployment with the understanding that changes would be made in the QMR. In December 1969, following overseas deployment of the first battalion in November, the Combat Developments Command (CDC) concurred in a number of relatively minor changes in the QMR, but opposed any change in the system effectiveness requirement. During a meeting on 13 January 1970, representatives of OCRD, ACSFOR, and DCSLOG agreed that waivers should be obtained for those materiel requirements not met, as a basis for type classification of the system.[9]

(U) On 24 June 1970, DA approved a program to incorporate an improved directional doppler (DIDO) fuze and blast-fragmentation warhead in the CHAPARRAL missile as a means of solving the system effectiveness problem. An AMSAA evaluation, based on anticipated lethality predictions, indicated that these new components would increase system effectiveness to a value of 0.52. A proposed solid state GCG program, forwarded to DA on 29 June 1970, was expected to improve missile performance against the inner boundary target, as well as enhance system reliability, maintainability, and producibility.

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*Ltr, CG, CDC, to Distr, 29 Feb 68, subj: Ch 1 to DA Apprd QMR for a LA Fwd Area AD Msl Sys (CHAP). AAA Files.

[8] AMC Rept, Sp Comb IPR of CHAP/VULCAN AD Sys, 16-18 Sep 69. RHA Bx 14-8.

[9] CVADS PMP Prog Repts, 2d & 3d Qtrs, FY 70. RHA Bx 14-7.

(U) At the time of the production validation IPR on 15-16 July 1970, the CHAPARRAL was already in full-scale production and units had been deployed. Consequently, the primary area of interest addressed at the IPR was the acceptability of the weapon system for type classification. The only essential elements of the QMR not met and requiring a waiver for type classification purposes were those relating to system effectiveness and inner boundary. In view of the aforementioned product improvement program, CONARC, DCSLOG, and AMC recommended that waivers be granted for these characteristics, that the system be reclassified from LP to Standard A, and that fielding of the weapon system be continued. The CDC representative non-concurred in the majority position until the product improvements were verified. The OCRD approved the majority position on 3 November 1970.[10]

(U) Some 2 weeks later, on 19 November, the CHAPARRAL weapon system, consisting of the following items, was officially reclassified from LP-Urgent to Standard A:[11]

Guided Missile, Intercept Aerial, MIM-72A (Tactical)
Guided Missile, Intercept Aerial, MIM-72B (Training)
Guided Missile, Training, M30
Guided Missile System, Intercept Aerial, Carrier Mounted, M48
Guided Missile System, Intercept Aerial, M54
Carrier, M730
CHAPARRAL Missile Container, M570*
Alignment Set, Launch, M71
Test Set, Guided Missile System, AN/TSM-85
Shop Equipment, Guided Missile System, AN/TSM-95
Shop Equipment, Guided Missile System, AN/TSM-96
Boresight Tester Collimator
Jack Set, Leveling Support, Launching Station
Tool Kit, GM Maintenance: Organizational Maintenance

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*Shipping and storage container for the full-up missile assembled at the Red River Army Depot. Containers for the missile components were the M586 for the guidance section; M587 for the warhead; M588 for the TDD; M589 for the safe-arming device; and MK-37 for the rocket motor. CHAP Pocket Guide, p. 26. HDF.

[10](1) CVADS PM Prog Rept for Jul 70. RHA Bx 14-8. (2) AMCTCM 8465, Mtg No. 6-70, & incls thereto: Ltr, CG, AMC, to CRD, DA, 2 Sep 70, subj: Xmitl of CHAP PV IPR Results, w 1st Ind, CRD to CG, AMC, 3 Nov 70. RSIC.

[11]1st Ind, ACSFOR to CG, AMC, 19 Nov 70, on Ltr, CG, AMC, to ACSFOR, 14 Sep 70, subj: CHAP TCLAS STD A. Atchd as incls to AMCTCM 8350, Mtg No. 4-71. RSIC.

Tool Kit, GM Maintenance: Support Maintenance
Shop Equipment, GM Organizational Maintenance
Shop Equipment, GM Special Direct Support/General Support
Shop Equipment, GM Support Maintenance

(U) The only item of equipment not ready for type classification in November 1970 was the AN/TSQ-T3 monitoring set (simulator/evaluator), which was still undergoing engineering/service tests.[12] It was classified Standard A by a separate action on 16 June 1971.[13]

(U) Except for the system effectiveness and inner boundary performance requirements which were waived, and the towed version of the CHAPARRAL which was dropped,* the standard M48 weapon system met or exceeded all of the original and expanded program objectives. It was a fair weather, daylight system using visual techniques for target acquisition and modified Navy SIDEWINDER infrared homing missiles. Because of seeker limitations in the basic system, the normal mode of operation against high-speed jet aircraft was to attack in the rear hemisphere or receding leg of the target flight. Against low performance aircraft and helicopters, the system could engage targets in most aspects.

(U) With sufficient infrared energy presented to the missile seeker, the CHAPARRAL system could effectively engage fixed and rotary wing aircraft having velocities up to 310 meters per second and altitudes from 15 to 3,000 meters. The engagement envelope was dependent upon target speed. The maximum range varied from about 5 to 10 kilometers.

(U) One of two primary weapons of the composite air defense battalion, the M48 CHAPARRAL system consisted of the M730 carrier; the M54 fire unit (launching station) which was capable of operating autonomously on the carrier or while emplaced on the ground; a basic load of 12 MIM-72A missiles; and a crew of five men.[14] A physical description of the system is presented earlier in this chapter.** Following is a selection of photographs of the weapon system and support equipment.

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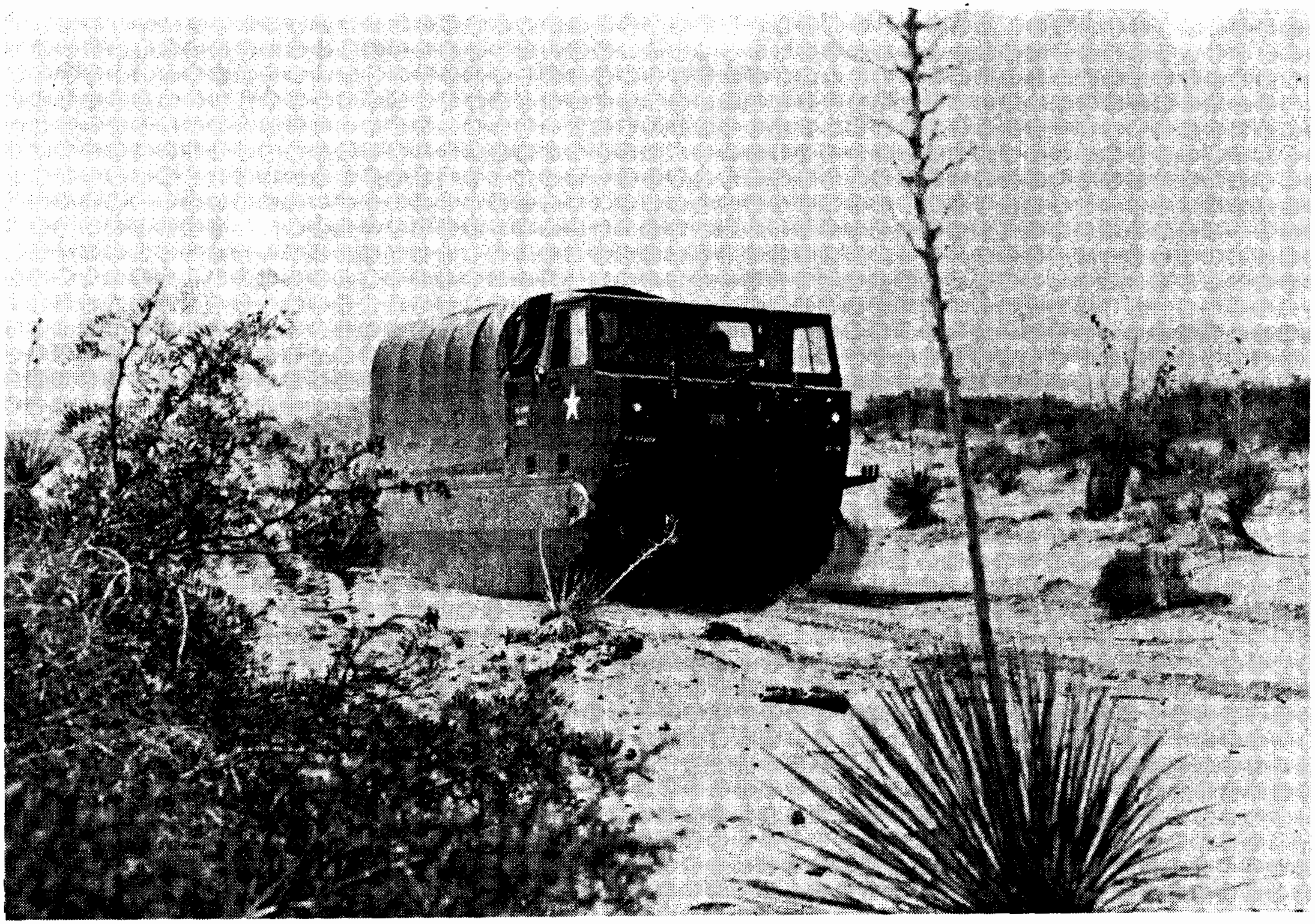
*See above, pp. 50-51, 55-56, 91.

**See above, pp. 70-73.

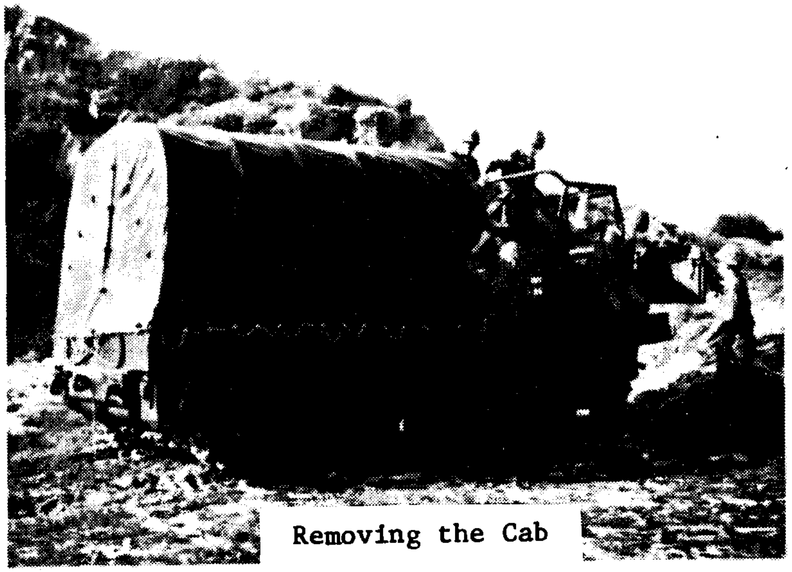
[12]See above, pp. 75-76.

[13]AMCTCM 8588, Mtg No. 8-71, & incl thereto: Ltr, ACSFOR to CG, AMC, 16 Jun 71, subj: STD-A TCLAS for CHAP Simulator/Evaluator, RSIC.

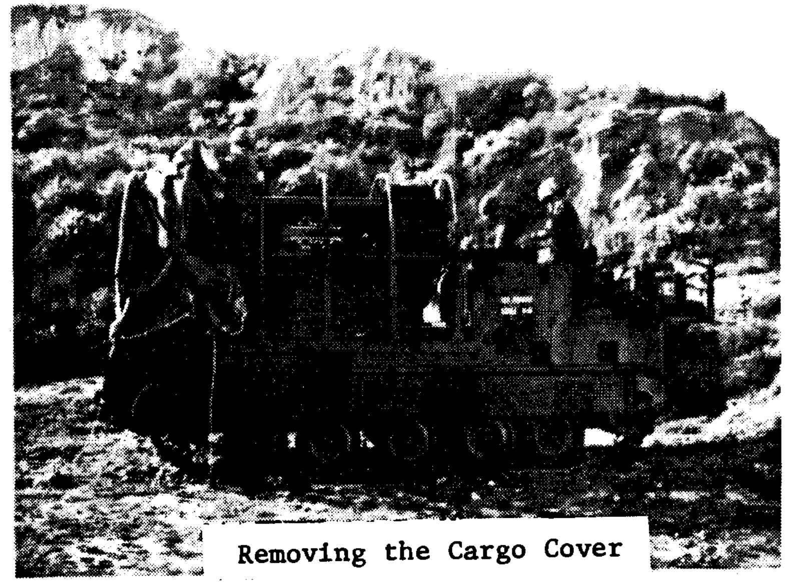
[14](1) AMCTCM 8350, Mtg No. 4-71. RSIC. (2) CHAP Pocket Guide.



CHAPARRAL Fire Unit in Travel Mode

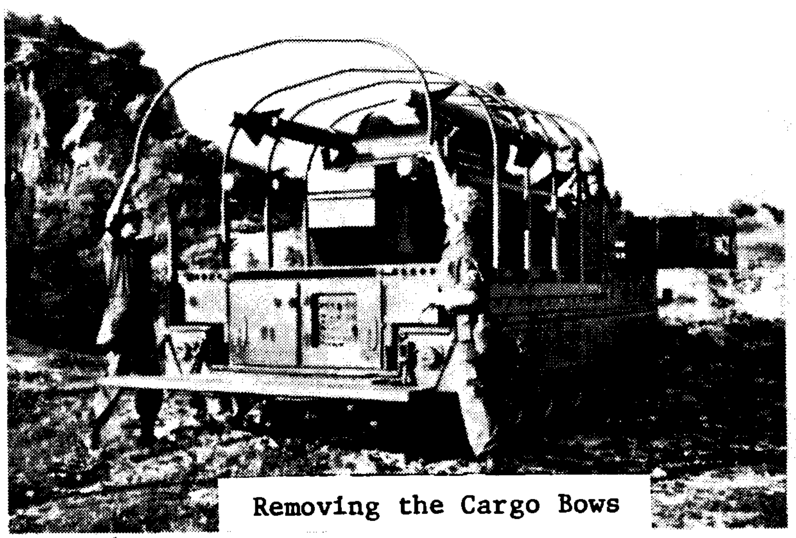


Removing the Cab



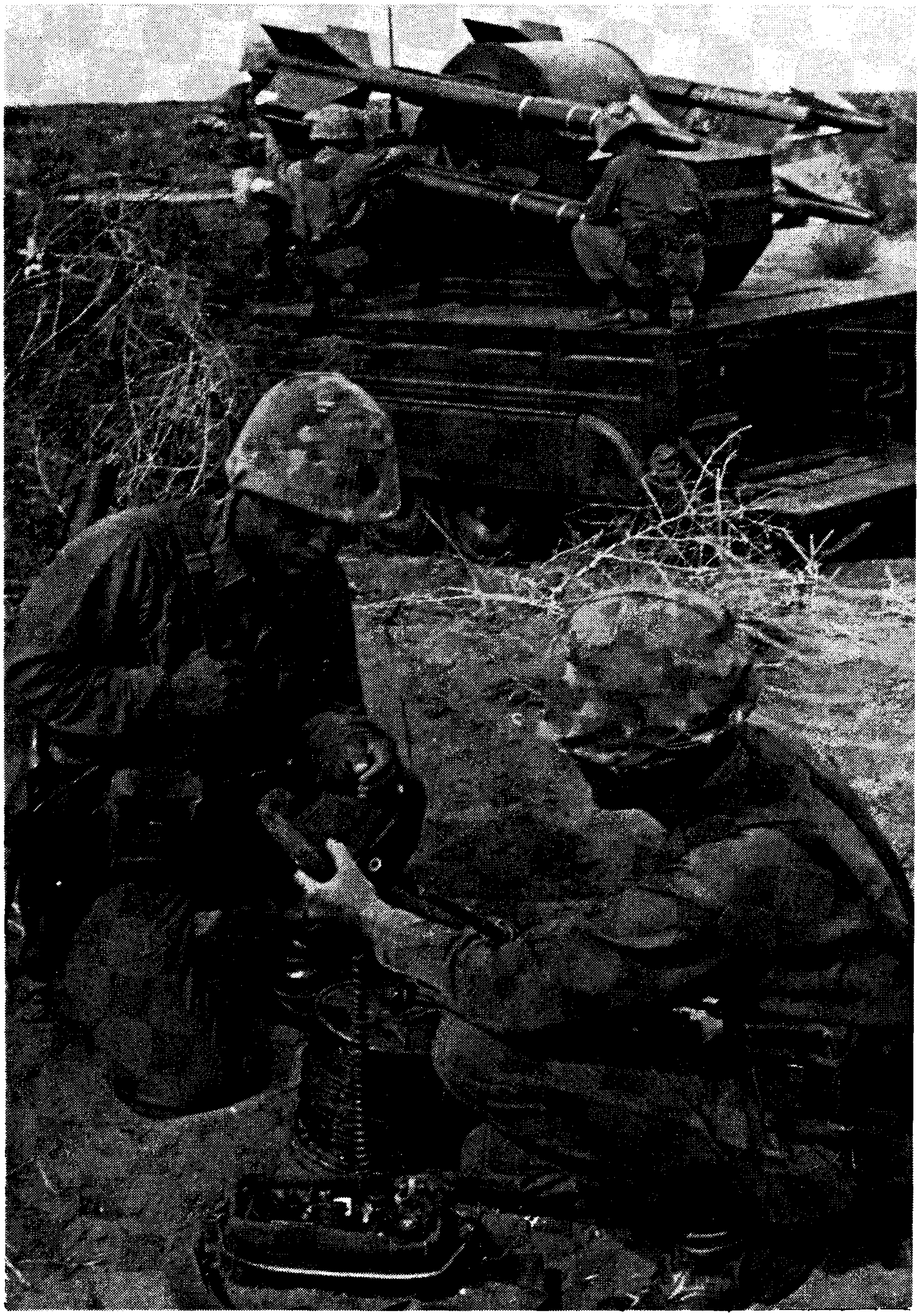
Removing the Cargo Cover

PREPARING THE CHAPARRAL FOR FIRING

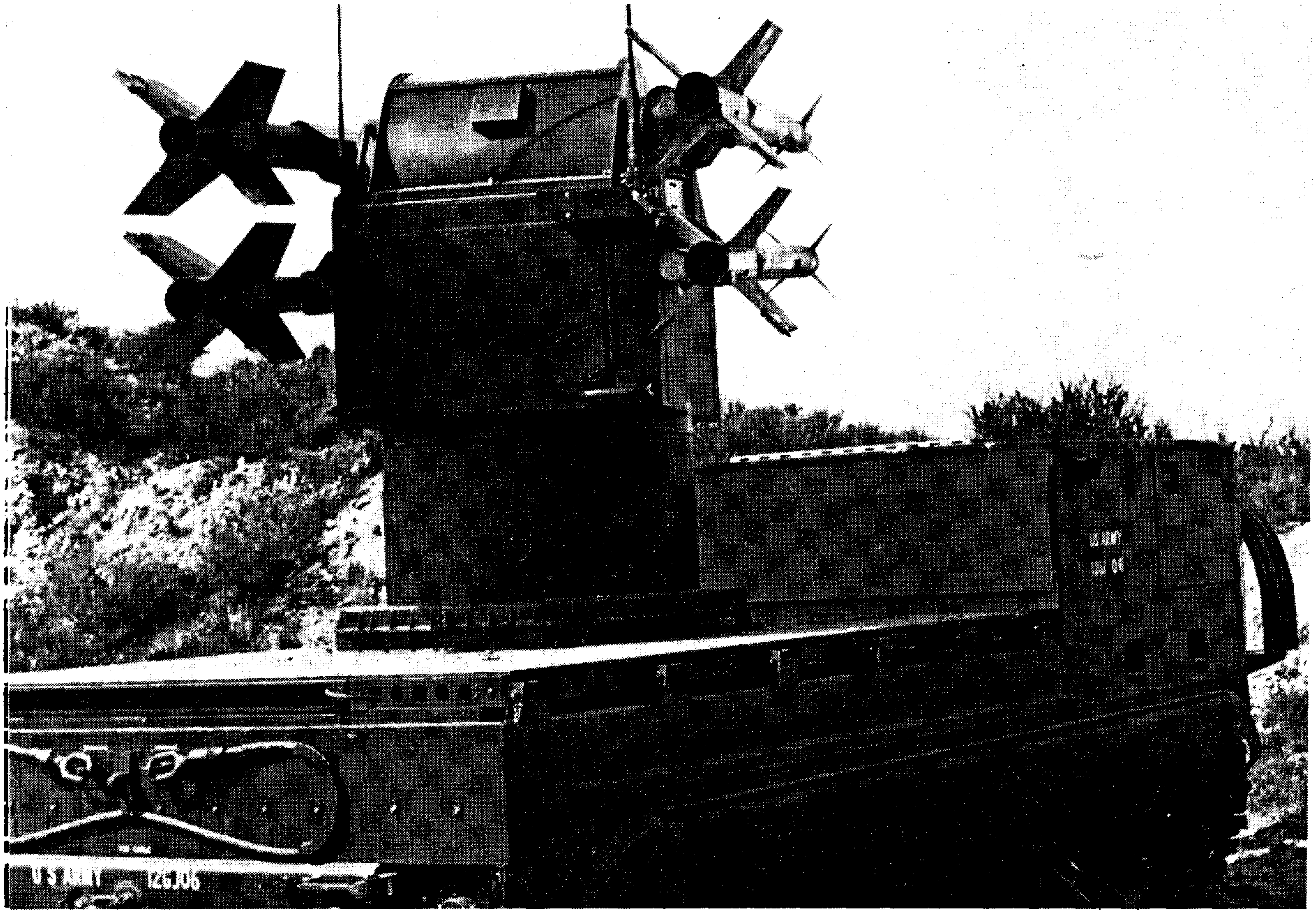


Removing the Cargo Bows

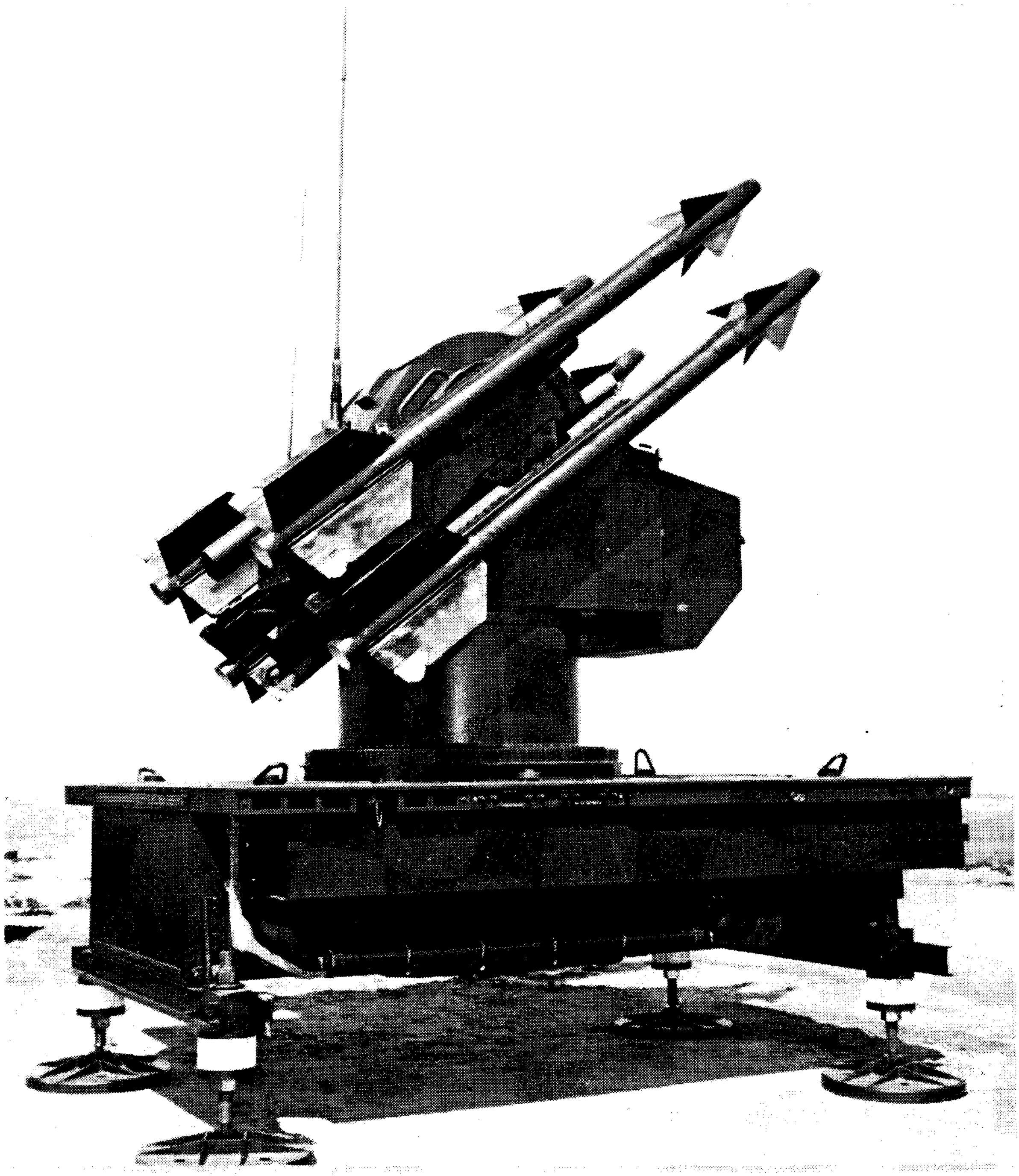
Fire Unit Emplaced Ready to Fire



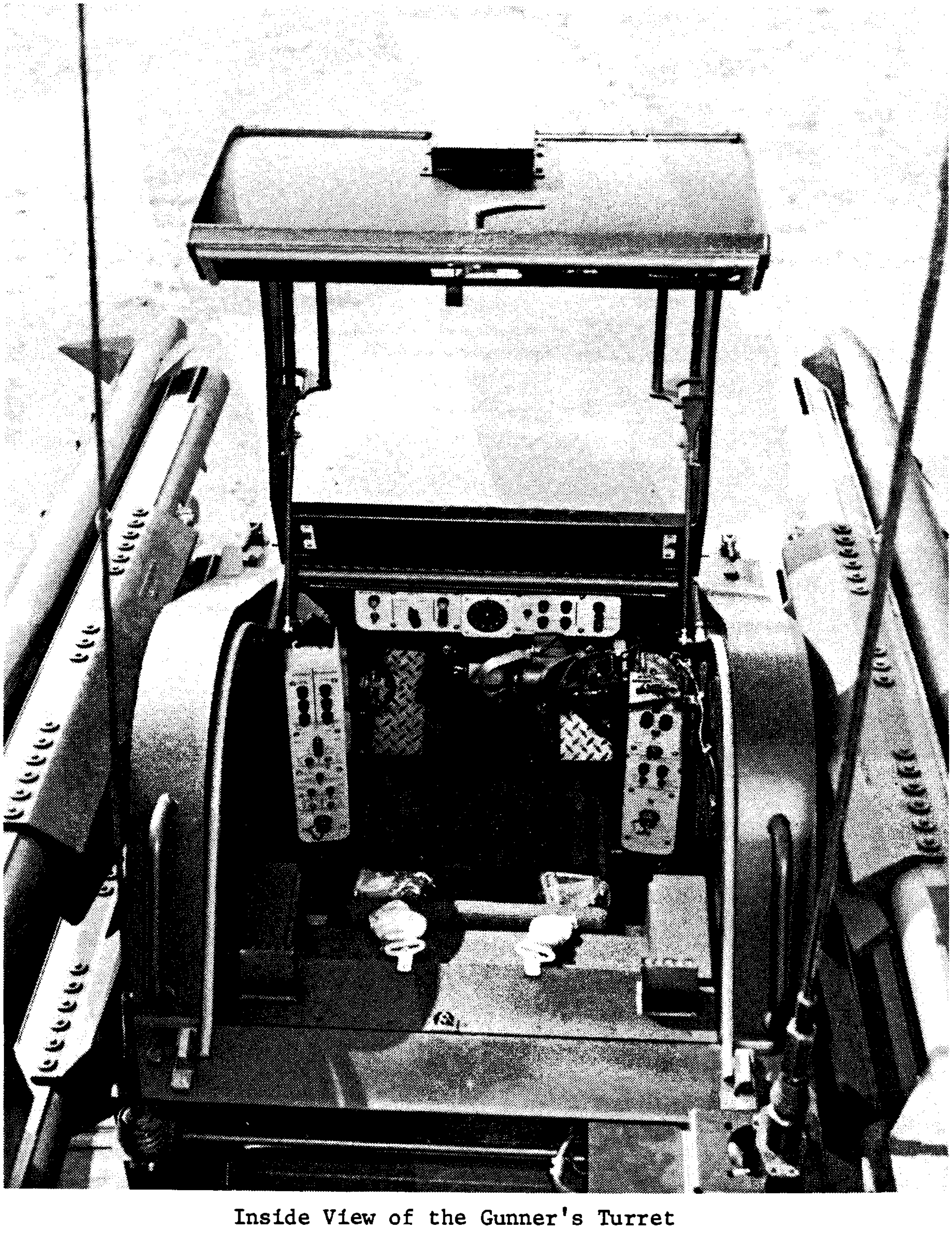
Checking Out Telephone Equipment (foreground)



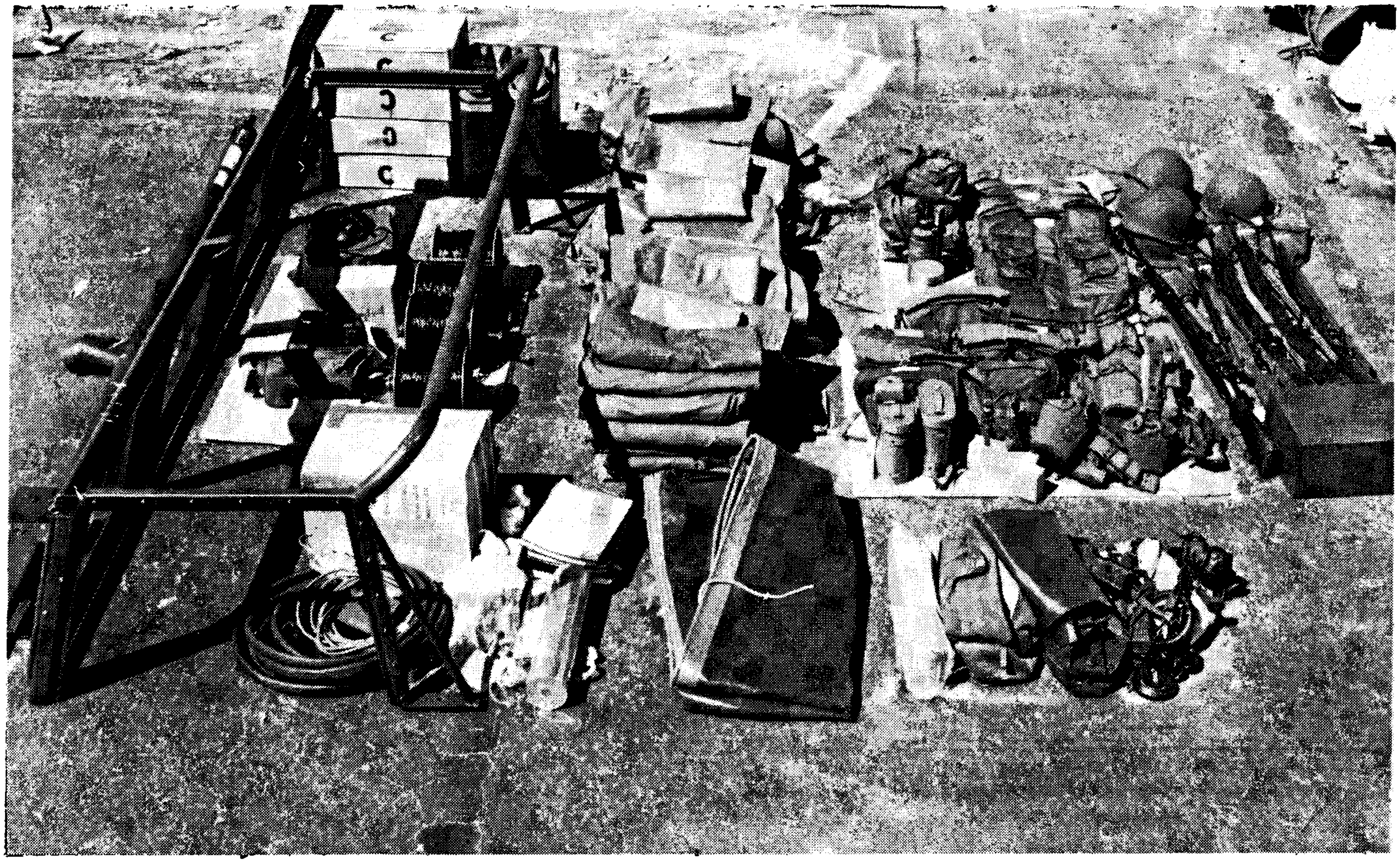
Gunner Tracking Target in Distance



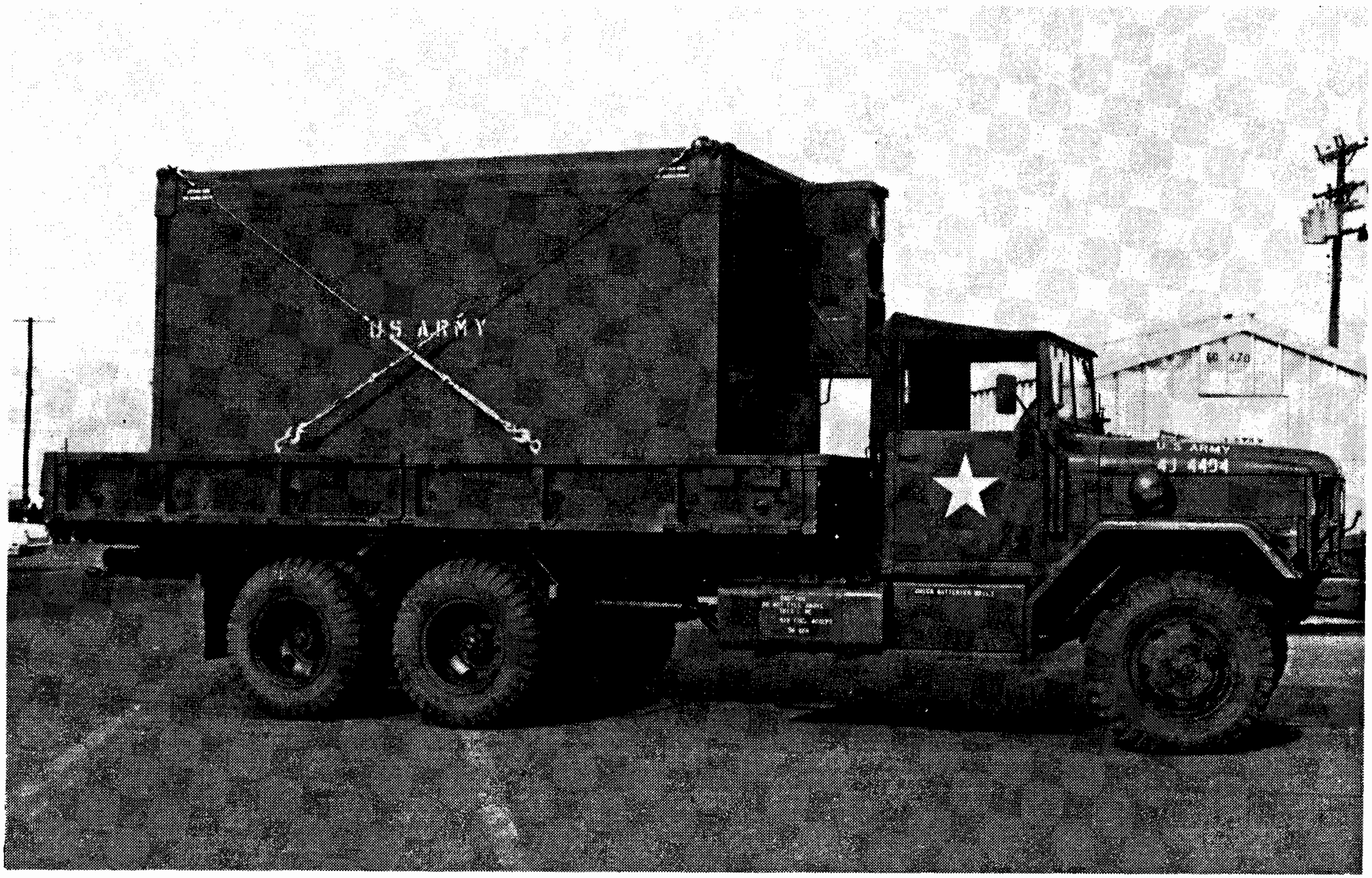
Ground Emplaced Fire Unit for Site Defense



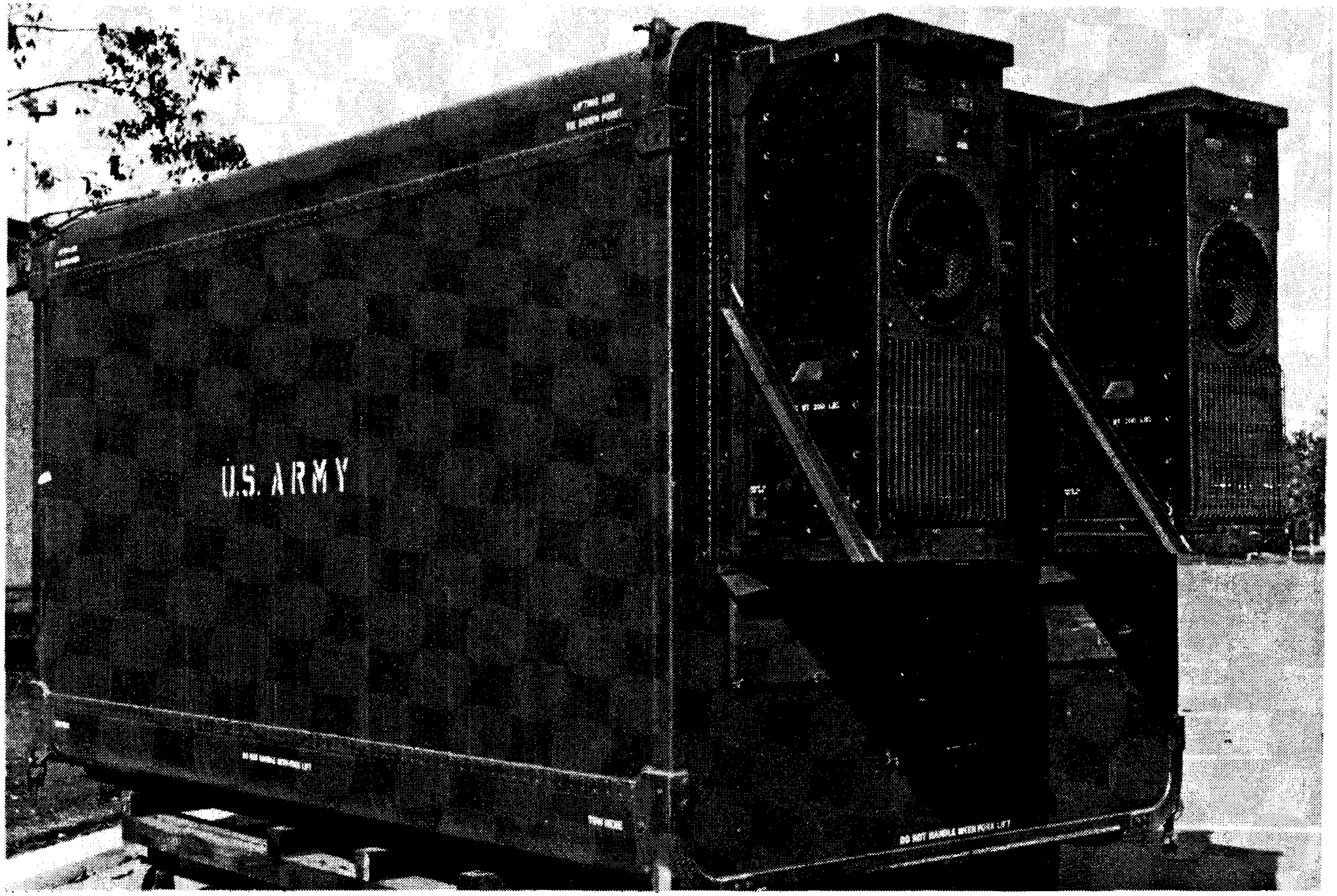
Inside View of the Gunner's Turret



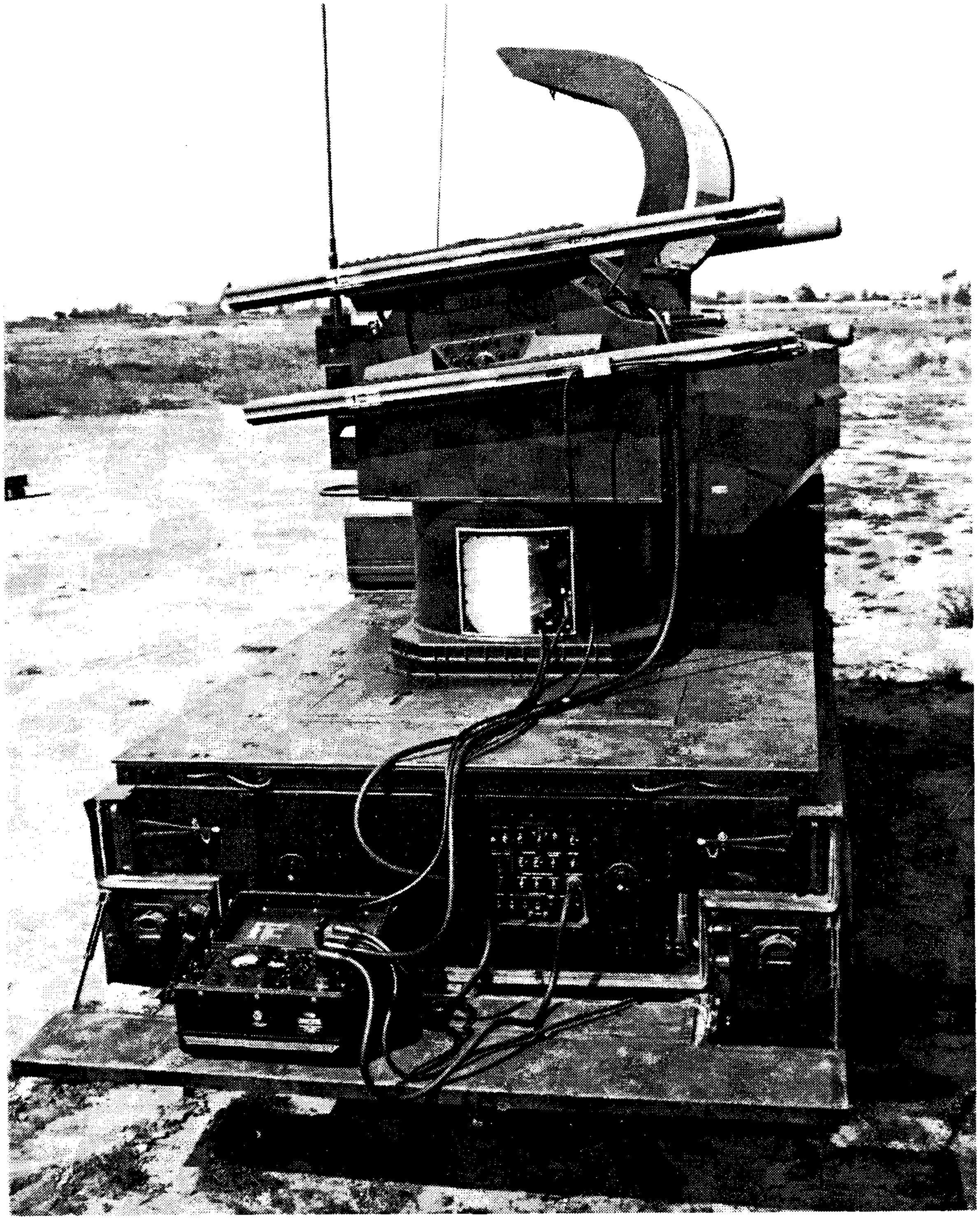
Crew Equipment for CHAPARRAL Fire Unit



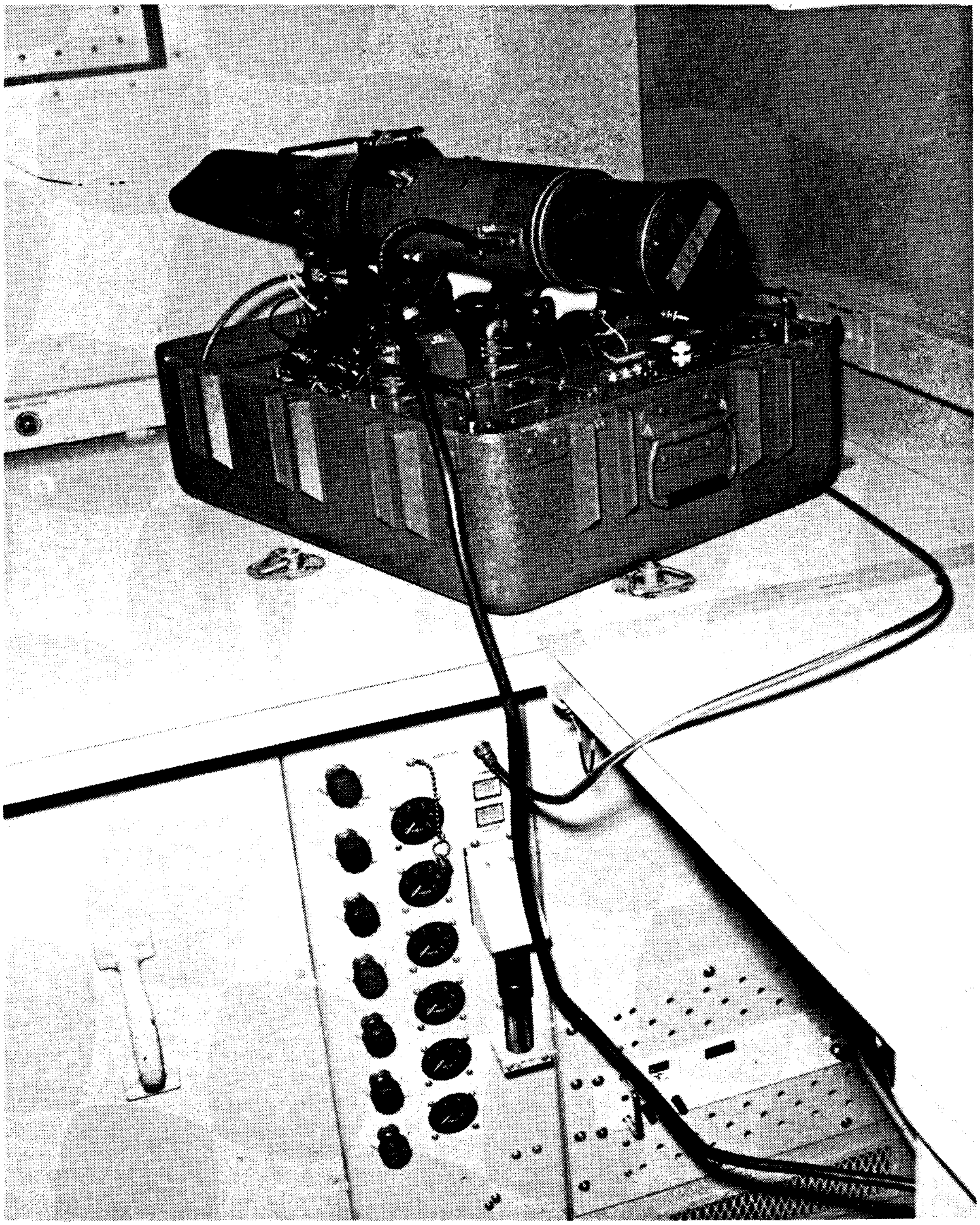
AN/TSM-95 Organizational Maintenance Shop Set Mounted on 6 x 6 Truck



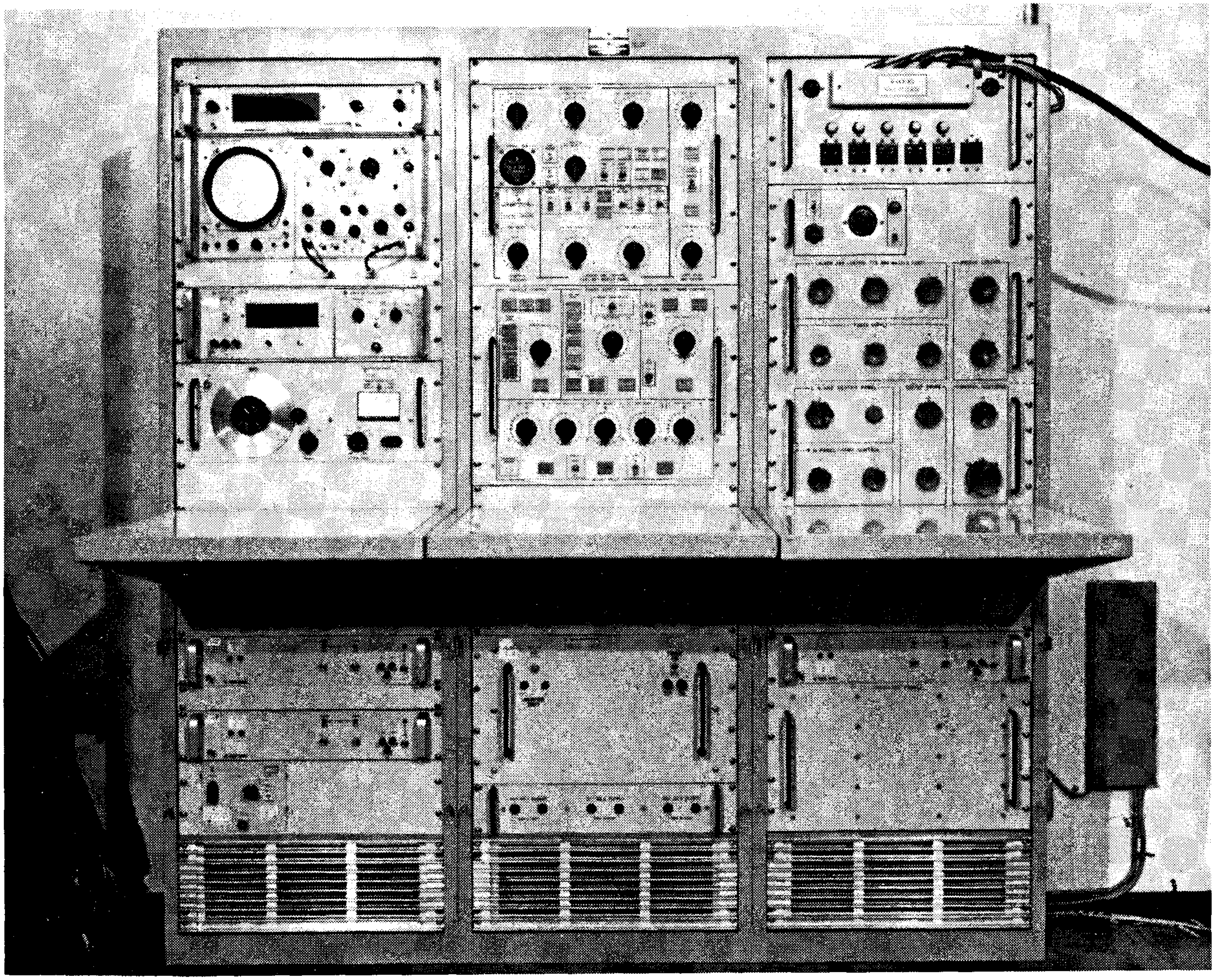
AN/TSM-96 Support Maintenance Shop Set Shelter



Testing of the M54 Launching Station with the AN/TSM-85 Test Set



Testing the Missile Guidance Section with the AN/DSM-79 Test Set



AN/TSM-101 Test Set - Principal Item in the AN/TSM-96 Support Maintenance Shop Set

Employment and Operational Concepts

(U) The CHAPARRAL weapon system was part of a group of proliferation weapons designed to counter the tactical aircraft threat to combat forces in the forward area. The threat was postulated on attacks by aircraft flying at low altitudes to avoid detection by longer-range, radar-directed weapon systems. These radar systems had poor coverage at low altitudes because of earth curvature and terrain masking. Proliferation weapons, which could be placed far enough forward of the division area, could effectively fill the air defense gaps. The daytime, fair weather capabilities of these weapons were acceptable because of the existing limitation on aircraft in foul weather or darkness.

(U) The CHAPARRAL guided missile system and the 20-mm. VULCAN gun system complemented each other in the daytime, fair weather role by combining the quick reaction and extremely low altitude capability of the VULCAN with the longer range capability of the CHAPARRAL. They, in turn, complemented the shoulder-fired REDEYE guided missile system and the low- and medium-altitude air defense role of the self-propelled HAWK missile system. These weapons, together with the Forward Area Alerting Radar (FAAR), filled the gap in forward area air defense, which was left by termination of the MAULER program in November 1965.

(U) Although the basic CHAPARRAL system would primarily engage targets in the receding leg of their flight from the fire unit, a sufficient number could be employed in the forward division area to assure that hostile aircraft flying over the area would come within the lethal range of more than one system. Thus, the CHAPARRAL would prevent penetration or roll-up by tactical aircraft. It did possess some forward hemisphere capability and this was considered a bonus, since the decision to field the system was based on tail-chase only.

(U) The characteristics of the basic CHAPARRAL and VULCAN systems dictated different but complementary employment concepts. The CHAPARRAL, with its high engagement kill probability, intercept range, capability against high speed aircraft, and essentially tail-chase-only mode of operation against jet aircraft, was best suited to an area defense role. Normally, its deployments would be concentrated along the most likely avenues of low altitude air approach into the defended area. The VULCAN, with its shorter range, lower engagement kill probability, and aim-spoiling capability, was best suited to a local defense role, such as command posts, bridges, and supply points.

(U) Organic to each CHAPARRAL platoon would be a FAAR to provide early warning information and indications as to whether aircraft were hostile or friendly. The radars would be positioned on an area basis to provide complete coverage of the airspace adjacent to and over the division area. While CHAPARRAL systems would predominantly tie into their organic radars, it was possible for both types of systems, guns and missiles, to tie into the same radar. It was also possible for one fire unit to tie into more than one radar.[15]

Summary of Deployments

(U) The force level approved by DOD in December 1965 provided for the equivalent of 21 composite CHAPARRAL/VULCAN battalions for world-wide deployment. Each of the Army's 16 divisions was authorized an organic battalion. In addition, two battalions were authorized to augment the air defense of the U. S. Seventh Army service area; one battalion for air defense of the U. S. Eighth Army in Korea; one battalion for the U. S. Army Forces, Strike Command; and one battalion for CONARC school support. As originally planned, the composite air defense battalion was to consist of two CHAPARRAL missile batteries, two VULCAN gun batteries, and a Headquarters & Headquarters Battery (HHB). The CHAPARRAL battery would contain 4 firing platoons, each with 4 fire units for a total of 16 per battery and 32 per battalion. The VULCAN battery would have 2 platoons, each with 8 fire units for a total of 16 per battery and 32 per battalion.[16]

(U) In December 1968, DOD revised the weapon mix for CHAPARRAL/VULCAN battalions from 32/32 to 24/24. Under the reoriented program established in January 1969, the composite air defense battalions would be organized with an HHB, 2 batteries of 12 CHAPARRAL fire units each, and 2 batteries of 12 VULCAN fire units each.[17] The plan issued by ACSFOR in July 1969 called for the activation and deployment of 21 HHB's, 41 CHAPARRAL batteries (equivalent of 20 1/2 battalions), 27 SP VULCAN batteries, and 15 towed VULCAN batteries.[18] The planned deployments were reduced

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[15] MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66, pp. II-7 - II-10. RHA Bx 14-7.

[16] (1) *Ibid.*, pp. II-8 - II-9. (2) *Also see* Program Change, SECDEF Decn A-5-069, 6 Dec 65, subj: Tac AD Program. RHA Bx 14-8.

[17] CVADS PM$_2$P Prog Rept, 2d & 3d Qtrs, FY 69. RHA Bx 14-7.

[18] DA Msg 02/2332Z Jul 69, ACSFOR-AD. Cited in CVADS PM Monthly Milestone Prog Rept, 28 Nov 69. RHA Bx 14-215.

in 1971 to 31 CHAPARRAL batteries (equivalent of 15 1/2 battalions), 19 HHB's, 27 SP VULCAN batteries, and 17 towed VULCAN batteries.[19]

(U) Activation of the CHAPARRAL/VULCAN training units (5th Battalion/67th Artillery*) began in August 1968 and was completed in June 1969. One HHB and one SP VULCAN battery were activated at Fort Bliss in August 1968, followed by one CHAPARRAL battery in January 1969, and one towed VULCAN battery in June 1969. The first two tactical CHAPARRAL batteries were activated in May 1969 and deployed with the 1st Battalion/59th Artillery to Mainz, Germany, in November 1969, along with one HHB and two SP VULCAN batteries.[20] By mid-1974, 29 of the planned 31 CHAPARRAL batteries had been activated and deployed. One battery of CHAPARRAL fire units was scheduled for the National Guard in FY 1975, but it was cancelled. No further deployment was firm as of January 1975; however, additional fire unit procurements were planned for FY 1976, 1977, and 1978.[21]

(U) In most cases, the CHAPARRAL and VULCAN batteries were fielded at the same time, but there were a few instances where deployment of the CHAPARRAL lagged the VULCAN by a number of months. For example, the HHB and VULCAN batteries were fielded with the 6th Battalion/67th Artillery** in June 1969, and the CHAPARRAL joined the group in December 1970.[22] In the absence of complete deployment information on the VULCAN system, the table which follows deals only with the CHAPARRAL.

(U) The CHAPARRAL missile "killed" a Russian-made MIG-17 supersonic jet fighter for the first time in combat during the Yom Kippur war on the Golan Heights during October 1973. The missile was fired by Israeli troops who had been supplied with both the CHAPARRAL and VULCAN air defense systems.[23]

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*Later redesignated as the 3d Battalion/6th Artillery.

**Later redesignated as the 2d Battalion/67th Artillery.

[19] CVADS Fielding Scd, May 71. HDF.

[20] CVADS PMP Prog Repts, 2d & 3d Qtrs, FY 70. RHA Bx 14-7.

[21] CMO Rept, CHAP Fielding (Jan 75). HDF.

[22] CVADS Fielding Scd, May 71. HDF.

[23] The *Huntsville Times*, 10 Aug 74.

[redacted]

TABLE 8—(~~C~~ u) Deployment of the CHAPARRAL Weapon System (U)

UNIT DESIGNATION	ASSIGNMENT/LOCATION	ACTIVATION	DEPLOYMENT	BTRYS
3d Bn/6th Arty	School Support, Fort Bliss	Jan 69	--	1
1st Bn/59th Arty 91st Ord Det	8th Inf Div, Germany	May 69	Nov 69	2
3d Bn/67th Arty 218th Ord Det	3d Inf Div, Germany	Jul 69	Mar 70	2
6th Bn/56th Arty 224th Ord Det	32d AADCOM, Germany	Nov 69	Jun 70	2*
2d Bn/60th Arty 92d Ord Det	32d AADCOM, Germany	Jan 70	Jul 70	2*
3d Bn/61st Arty 509th Ord Det	3d Armored Div, Germany	Mar 70	Sep 70	2
2d Bn/59th Arty 280th Ord Det	1st Armored Div, Germany	May 70	Nov 70	2
2d Bn/67th Arty 172d Ord Det	1st Inf Div, Germany	Jun 70	Dec 70	2
2d Bn/61st Arty 90th Ord Det	2d Inf Div, Korea	Sep 70	Mar 71	2
2d Bn/5th Arty 159th Ord Det	2d Armored Div, Ft Hood	Nov 70	Jun 71	2
4th Bn/1st Arty 118th Ord Det	STRICOM, Ft Bliss	Jan 71	Aug 71	2
1st Bn/62d Arty 157th Ord Det	25th Inf Div, Hawaii	Mar 71	Sep 71	2
4th Bn/61st Arty 178th Ord Det	4th Inf Div, Ft Carson	Sep 71	Mar 72	2
1st Bn/67th Arty 100th Ord Det	9th Inf Div, Ft Lewis	Sep 72	Mar 73	2
1st Bn/68th Arty 23d Ord Det	1st Calvary Div, Ft Hood	Apr 74	Jun 74	2
				29

*These battalions were reorganized under MTOE 44-727 as three composite batteries of eight CHAPARRAL and eight VULCANS each. All other battalions, organized under TOE 44-328, consisted of two composite batteries of 12 CHAPARRALS and 12 VULCANS each.

SOURCE: Compiled by James R. Pierce, CMO, Jan 75, from DA Msg 08/2318Z Feb 71, subj: CHAP/VULCAN Program, as amended by DA Msg 22/2230Z Mar 72.

[redacted]

CHAPTER VI

(U) PRODUCT IMPROVEMENT PROGRAM (U)

Background

(U) The basic CHAPARRAL weapon was conceived in 1965 as a stop-gap system that could be fielded in a relatively short time to help fill the void in forward area air defense left by termination of the MAULER program. The need for product improvements was recognized as early as August 1965, upon completion of the initial military potential tests. The improved design of the engineering model fire unit delivered to the Army at that time was more acceptable to the user than the quick-fix concept, and was expected to give the system additional years of useful life. However, the initial flight test results disclosed a number of limitations requiring design improvements.

(U) Of prime concern was a smoke problem with the rocket motor; i.e., the smoke signature obscured gunner visibility, lengthened the time between firing the first round and engaging a second target, and betrayed the fire unit to artillery counteraction. The existence of this problem had been recognized from the beginning and had been taken into consideration in approval of the tactical concept pending a product improvement effort at a later date. Among other product improvements considered necessary for expanded system usage and longer service life were these:

1. An advanced Guidance & Control Group (GCG) to improve head-on engagement capability against incoming targets, reduce guidance errors, improve background rejection, and enhance system accuracy and kill probability.

2. An optimized fuze/warhead combination to improve lethality and reliability.

3. Observer and gunner acquisition aids to improve detection and acquisition of targets in the forward hemisphere and provide for night and adverse weather operations.

4. Installation of a lightweight IFF system on the fire unit to provide positive target identification.

5. A method to reduce canopy glare.

(U) The TAMIRAD study report of August 1965 stated that the above limitations were tactically unattractive and should be overcome by a funded product improvement program. Justification for such a program followed from the fact that some system shortcomings would have to be accepted in order to obtain the earliest possible operational capability to reduce risks inherent in the national defense posture. With assurance of a follow-on product improvement, the smoky rocket motor appeared to be tactically acceptable as "something that can be 'lived with' in the interim." Approval criteria for other product improvements would include essentiality, feasibility, cost, and useful life remaining prior to 1975, when a new system might be available. In the event that the CHAPARRAL should fail to be acceptable, the options appeared to be to field more REDEYE and gun systems, field an advanced proliferation weapon, or field a foreign system, such as the ET-316 or ROLAND, through an offshore procurement.[1]

(U) On 18 December 1965, the Secretary of Defense approved the initiation of studies to determine feasible and effective improvements to the basic CHAPARRAL system. These studies were to be based on current state-of-the-art techniques or minor extrapolations therefrom, and maximum use was to be made of existing CHAPARRAL hardware. The lack of adequate RDTE funds, however, presented a problem from the very outset of the program. The CHAPARRAL Project Manager at AMC was under orders to develop, produce, and field the basic CHAPARRAL system as a matter of great urgency. There was a continuing problem with respect to producibility of the GCG, and the Department of the Army had considerable difficulty in providing even minimum funding to keep the basic program alive. Although some product improvement studies and exploratory development effort were begun in FY 1966-67, the basic program necessarily received the highest funding priority. The estimated RDTE funds required to meet all objectives of the initial Product Improvement Program (PIP) totaled $58.9 million for the FY 1968-72 period.[2]

(U) As stated earlier in this study, the basic CHAPARRAL met all essential requirements of the QMR and the criteria for type classification except in the areas of system effectiveness and inner boundary. The Chief of Research & Development, in November

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[1](1) CDC Study M-6098, Aug 65, subj: TAMIRAD, Vol. II, pp. E-9, E-V-2, E-V-3, E-V-5, E-V-7. RSIC. (2) *Also see* MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66. RHA Bx 14-7.

[2](1) CHAP PM_2P, Jul 67. HDF. (2) MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66. RHA Bx 14-7.

1970, approved waivers for these requirements and type classified the system as Standard A, with the understanding that existing deficiencies would be addressed in an expedited product improvement program. Although the system effectiveness and inner boundary capabilities were of prime importance, it was imperative that other improvements also be made. The basic CHAPARRAL had been designed using a maximum of available inventory hardware. Many of these items (such as the military standard engine, air compressor, and vacuum tubes for the missile) were already becoming obsolete and going out of production when the weapon system reached the field. Other major items (such as the fuze/warhead combination, guidance unit, and rocket motor) were no longer abreast of the state of the art and needed to be improved to meet existing and future requirements. These improvements took on added importance in light of the extended service life of the CHAPARRAL, which was expected to be 12-15 years (into the mid-1980's) instead of 5-8 years.[3]

(U) As of January 1975, some 4 years after type classification of the basic missile system, major component improvements had been made, but none of them had been approved for production and retrofit. A brief summary of the product improvements follows.

System Studies

(U) In April 1966, MICOM awarded the Stanford Research Institute a $356,940 contract (DA-01-021-AMC-14822) for supporting research and tactical system studies. This was followed, in September 1966, by the award of a $443,878 contract (DA-AH01-67-C-0217) to the Aeronutronic Division of Philco-Ford for a CHAPARRAL improvement study.[4] Others conducting component studies and exploratory development were the MICOM Propulsion Laboratory (rocket motor propellant); Naval Weapons Center (missile component technology); Harry Diamond Laboratories and Picatinny Arsenal (fuze and warhead); Ballistic Research Laboratories (lethality); and Army Electronics Command (IFF equipment).[5]

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[3] AMCTCM 8465, Mtg No. 6-71, & incls thereto [re: CHAP PV IPR, Jul 70]. RSIC.

[4] MICOM Contr Listing, 1 Jul 72. HDF.

[5] MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66. RHA Bx 14-7.

Smokeless Rocket Motor

(U) The development of a new rocket motor was necessary to eliminate the smoke problem and to reduce system reaction time for a forward hemisphere capability. The MICOM Propulsion Laboratory conducted an intensive investigation of the smoke characteristics of propellants of interest to the CHAPARRAL. A great deal of the smoke common to the basic rocket motor was caused by the aluminum constituents which were placed in the propellant to obtain the required motor impulse. Since any overall reduction in motor performance would be unacceptable, a new propellant or new approach had to be tried. The investigations included CHAPARRAL-supported work in 1966-67 and subsequent in-house supporting research work in conjunction with the Rohm & Haas Company. The studies indicated that propellants containing ammonium perchlorate formed contrails (smoke) which were not present with pure double base propellants. The elimination of aluminum from a composite propellant reduced the initial primary smoke (particle matter), but secondary smoke occurred. It therefore appeared that double base propellants had the best qualities for CHAPARRAL use.[6]

(U) In mid-1971, the Department of the Army approved a program to demonstrate a modified rocket motor that would eliminate the primary smoke. The Naval Weapons Center poured four smokeless rocket motors for ballistic flight tests in September and October 1971. Two of these were conducted under ambient hot and dry conditions—one at China Lake, California, and one at WSMR. The other two tests were conducted under high humidity conditions at Eglin Air Force Base. All of the rocket motors exhibited a smokeless performance except one fired under early morning fog conditions at Eglin.

(U) Late in 1974, the Propulsion Directorate of the Missile Research, Development, & Engineering Laboratory static tested four CHAPARRAL-size rocket motors to determine performance under environmental conditioning. All of these were successful except one which experienced a burn-through at -65°F. The smokeless rocket motor was expected to provide increased impulse and eliminate all of the primary smoke and about 90 percent of the secondary smoke.

(U) Pending approval of the engineering development and production programs, future effort on the smokeless motor would

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[6](1) *Ibid.* (2) Ltr, Chf, CHAP SIMO, to CG, AMC, 13 Apr 71, subj: CHAP Smokeless Rkt Mtr Dmstn. HDF.

be confined to further exploratory development work.[7]

Target Acquisition Aid

(U) A Target Acquisition Aid (TAA) was needed to improve the gunner's ability to detect and acquire targets, particularly at night and under conditions of reduced visibility, thereby increasing the capability of the improved CHAPARRAL missile to engage targets within the system's forward hemispheric engagement envelope. A proposed program for provision of such a device was forwarded to DA in August 1971. Fifteen months later, on 21 November 1972, MICOM awarded Philco-Ford a contract (DA-AH01-73-C-0193) for a prototype development effort. The value of the contract as of November 1974 was $5,046,280.[8]

(U) Like the smokeless rocket motor, the TAA was yet to be approved for engineering development. Funds for development of the device were deleted from the FY 1975 budget.[9]

IFF Equipment

(U) The product improvement plan called for the installation of a lightweight IFF system on the fire unit to provide the gunner with a means of positive target identification. Although the Forward Area Alerting Radar would have an IFF system of greater capacity, it was deemed advisable for each fire unit to have its own IFF equipment to overcome the possibility of misinterpretation of multiple target information from the FAAR, to allow the fire unit to operate independently from the FAAR, and to aid in the identification process for the gunner in the case of incoming targets and during periods of minimum light. In addition, the IFF would permit identification at all aspects, alleviating the difficulty in visually identifying targets at sufficient ranges to allow optimum use of the missile capability.

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[7](1) CVADS PM Prog Repts for Jul 71 & Sep 71. RHA Bx 14-8. (2) RDTE Program Data Sheet, Fwd Area AD - CHAP, Nov 74. HDF. (3) Intvw, M. T. Cagle w Eugene J. Palm, Propulsion Drte, Msl RDE Lab, 21 Jan 75.

[8](1) CVADS PM Prog Rept for Aug 71 & Sep 71. RHA Bx 14-8. (2) *Also see* Table 4, p. 78.

[9]Ltr, CHAP/FAAR Div, SSMO, to Distr, 19 Aug 74, subj: CHAP Improvement Program IPR's - Revised. HDF.

(U) Early in the program, the Army Electronics Command investigated an antenna and electronics unit that could be rotated with the mount and be turned on by the gunner at the last moment before firing to be sure that he was pointing at the right target. However, it was later decided to use a modified version of the lightweight IFF system being developed under the STINGER project. In 1974, this IFF system, with minor modifications, was tested as part of the CHAPARRAL TAA prototype program. These tests proved the feasibility of adapting the STINGER IFF equipment for use in the improved CHAPARRAL system. Subject to the release of FY 1975 RDTE funds, a contract was to be awarded for design and development of the CHAPARRAL IFF equipment, making maximum use of STINGER hardware and development and test data.[10]

Optimized Fuze/Warhead Combination

(U) The XM-817 directional doppler (DIDO) fuze and the XM-250 blast fragmentation (BF) warhead developed for the improved CHAPARRAL missile were derivatives of the MAULER program. Initial studies, in fact, were conducted with MAULER funds. The Mark 322 Mod 0 fuze and continuous rod warhead used in the basic CHAPARRAL missile were optimized for the tail-chase mode. The forward engagement aspect imposed additional terminal intercept geometries, hence more stringent requirements on the fuze and warhead.

(U) Early studies indicated that a combination of the DIDO fuze and BF warhead would not only increase system effectiveness, but also improve reliability and lethality and reduce susceptibility of the missile to electronic countermeasures. Data provided by the Army Materiel Systems Analysis Agency, in early 1970, indicated that the BF warhead was 1.5 to 2.0 times more effective than the continuous rod warhead, and that the DIDO fuze/BF warhead combination would provide a system effectiveness of .56.

(U) The Department of the Army approved a product improvement program for the proposed fuze/warhead combination on 24 June 1970. Engineering development was successfully completed with a series of flight tests conducted in conjunction with the improved AN/DAW-1 guidance section during 1974. The XM-817 fuze and XM-250 warhead were classified as Standard A on 22 November 1974; however, they

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[10](1) MICOM Rept, Fwd Area AD Sys (CHAP) IPR, 29-30 Aug 66. RHA Bx 14-7. (2) RDTE Program Data Sheet, Fwd Area AD - CHAP, Nov 74. HDF.

still had not been approved for production and retrofit as of January 1975.[11]

Guidance Section Improvement

(U) The guidance section phase of the product improvement program was directed toward the development of an improved seeker to provide the CHAPARRAL a full head-on detection capability, to reduce the dead zone of the system, and to reduce susceptibility to modulated infrared countermeasures. The initial program proposal, submitted to DCSLOG on 29 June 1970, called for a solid state (tubeless) guidance package to improve producibility, reliability, and maintainability. At the behest of DCSLOG, MICOM prepared a modified proposal calling for an all-aspects (forward hemisphere) capability in conjunction with solid state guidance.

(U) In December 1970, MICOM and the CVADS Project Manager evaluated two proposals for such a program. One of these was the MOD 1A* guidance section designed by the Aeronutronic Division of Philco-Ford. The other was a CHAPARRAL version of the Navy's AIM-9L missile, which was proposed in a 30-day Navy study of an improved capability for the SIDEWINDER and CHAPARRAL systems. Philco-Ford's AN/DAW-1 proposal was determined to be a more cost-effective and timely improvement for Army requirements.

(U) The proposed product improvement plan, submitted to DCSLOG in February 1971, called for the early completion of AN/DAW-1 development and for its initial procurement by retrofit of tube version missiles, with follow-on new procurement upon completion of development. Pending final approval of the program, DA, in April 1971, authorized $400,000 in PEMA funds for interim continuation of the AN/DAW-1 effort. This was followed, in July 1971, by the release of $1.2 million for continuation of testing.[12]

(U) During tracking tests, the AN/DAW-1 seeker successfully demonstrated a target acquisition capability in the forward hemisphere at a range of 4 to 6 kilometers. This capability was

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*Later redesignated and hereafter referred to as the AN/DAW-1.

11 (1) CHAP PM_2P, Jul 67. HDF. (2) Ltr, Chf, CMO, to CG, AMC 26 Feb 70, subj: CHAP Fuze/Whd Program. HDF. (3) CVADS PM Prog Rept for Jul 70. RHA Bx 14-8. (4) Intvw, M. T. Cagle w Ralph Kay, CMO, 22 Jan 75. (5) *Also see* below, pp. 119-20.

12 (1) CVADS PM Prog Repts, Jul 70 thru May 71. RHA Bx 14-8. (2) AIM-9L SIDEWINDER/CHAP 30-Day Study Rept, NWC, 23 Oct 70. CMO Files.

further verified in a series of seven prototype flight tests conducted during the period 4 May 1971 to 10 August 1971. Five of the seven rounds were completely successful, four of them scoring contact hits and one achieving a near miss of 5 inches. One of the two unsuccessful tests resulted from a random component failure and the other from a seeker design failure.[13]

(U) In September 1971, MICOM prepared a Limited Production - Test (LP-T) classification action for procurement of 88 AN/DAW-1 guidance units. The Department of the Army finally approved the AN/DAW-1 program on 3 December 1971; however, DOD withheld funds until June 1972, when the Low Altitude Forward Area Air Defense System (LOFAADS) Design Concept Paper was signed. Meanwhile, effort at the contractor's plant was incrementally funded on a month-by-month basis.[14] In June 1972, MICOM awarded Philco-Ford a $2,807,698 contract (DA-AH01-72-C-0466) for 88 preproduction prototypes of the AN/DAW-1 guidance section. A year later, Philco-Ford received a $3,310,439 contract (DA-AH01-73-C-1050) for AN/DAW-1 engineering services. The period of performance was June 1972 to December 1973 for the former, and July 1973 to October 1974 for the latter.[15]

(U) Flight tests of the preproduction prototypes began on 24 May 1973. By 21 November 1974, a total of 53 rounds had been flight tested, including 4 Engineering Tests (ET), 6 Operational Tests (OT), and 43 Performance Improvement Tests (PIT) by TECOM. A few of the missiles were equipped with the improved blast fragmentation warhead; the others were telemetry rounds. Eight of the 53 tests were invalid for scoring purposes because of such things as misfires and personnel error. Of the 45 valid tests, 42 (93 percent) were completely successful, 37 of them scoring contact hits and 5 achieving near misses which were within lethal range of the warhead and which resulted in normal fuze function. The remaining three valid tests failed to achieve intercept.[16]

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[13] Sum Table of Improved CHAP Flt Test Results, 21 Nov 74. Atchd as incl to Ltr, Philco-Ford to Cdr, MICOM, 25 Nov 74, subj: Sum Table of Improved CHAP Flt Test Results, Contr No. DA-AH01-73-C-1050. HDF.

[14] (1) CVADS PM Prog Rept for Sep 71. RHA Bx 14-8. (2) Hist Rept, CHAP SIMO, FY 72, p. 2. HDF.

[15] MICOM Contr Listing, 1 Oct 73. HDF.

[16] Sum Table of Improved CHAP Flt Test Results, 21 Nov 74. Atchd as incl to Ltr, Philco-Ford to Cdr, MICOM, 25 Nov 74, subj: Sum Table of Improved CHAP Flt Test Results, Contr No. DA-AH01-73-C-1050. HDF.

Classification of the Improved XMIM-72C Missile

(U) Although PIT tests were not scheduled for completion until December 1974, TECOM issued a risk statement, on 30 September, indicating that the improved missile was a low risk improvement program and represented a significant improvement over the basic CHAPARRAL missile.[17] On 20 November 1974, a production validation IPR was held at MICOM to determine the acceptability of the XMIM-72C missile for type classification and full-scale production. Members of the review team all agreed that the missile was acceptable for the mission intended and met regulatory prerequisites for entry into the Army inventory. Accordingly, they recommended that the XMIM-72C missile be classified Standard A as a replacement for the basic MIM-72A missile, which would be reclassified Standard B. MG Vincent H. Ellis, Commander of MICOM, approved the recommended classification action on 22 November 1974.

(U) Informally known as the CHAPARRAL I, the improved MIM-72C missile consisted of the AN/DAW-1 guidance section; the M817 target detection device (DIDO fuze); the M250 blast fragmentation warhead; the basic Mark 50 rocket motor; the Mark 13 S&A device; and the Mark 4/Mark 5 wing assembly. The fin assembly from the basic MIM-72A missile would be slightly modified to improve missile response. In November 1974, full-scale production contract administration action was initiated for a contract award by 15 March 1975 for modification of MIM-72A missiles to the MIM-72C configuration, or a contract award by 1 June 1975 for new production of MIM-72C missiles.[18]

(U) Although engineering development of several desirable improvements, such as the smokeless rocket motor, had not been funded, the improved MIM-72C missile, when produced and deployed, would eliminate shortcomings in system effectiveness and inner boundary, as well as provide the system with a forward hemisphere engagement capability. Despite the fact that expedited improvements in the areas of system effectiveness and inner boundary were a condition of type classification and release for deployment, there appeared to be no particular rush to get them into the field

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[17] TECOM Significant Actions Rept for Pd 1-31 Oct 74, p. 2. Atchd to Ltr, Cdr, TECOM, to Distr, 2 Nov 74, subj: Significant Actions Rept. HDF.

[18] Ltr, Chf, CHAP/FAAR Mgt Ofc (Prov), to Distr, 25 Nov 74, subj: Xmtl of Mins of the PV IPR for the GM, Intcp-Aerial MIM-72C (CHAP), & incls thereto: U. S. Army Position - PV IPR, GM, Intcp-Aerial XMIM-72C, 20 Nov 74, & TCLAS Recmn, 22 Nov 74. HDF.

once they were developed. As of mid-April 1975, the retrofit of MIM-72A missiles to the MIM-72C configuration had been ruled out in favor of new production of the MIM-72C missile; however, no PEMA funds for the program had been released.[19]

Follow-On Product Improvement Plan

(U) Meanwhile, the CHAPARRAL/FAAR Management Office at MICOM proceeded to chart plans for a follow-on product improvement program aimed at providing an advanced CHAPARRAL to cope with the threat through the mid-1980's. Aside from engineering development of the smokeless rocket motor, TAA, and IFF system, the proposed improvement program of November 1974 included a new guidance section using the rosette scan seeker developed by General Dynamics for the STINGER missile. This new guidance section would provide an all-aspect engagement capability with infrared counter-countermeasure to defeat the postulated threat. Another task involved the development of a method to eliminate the canopy glare problem. The RDTE cost of the program was estimated at $64,667,000 for the FY 1975-79 period.[20] Although the proposed improvement program was approved, RDTE funds for the FY 1975 effort were deferred pending a DSARC* decision.

(U) The future of the advanced CHAPARRAL system was apparently tied in with the selection of an all weather Short Range Air Defense (SHORAD) system to defend rear-area point targets. The Army began the search for an advanced all weather SHORAD system soon after the basic CHAPARRAL reached the field in November 1969. Aside from an improved version of the CHAPARRAL, proposed by Philco-Ford, the contenders included three already developed foreign systems: the French-German ROLAND II, the British RAPIER, and the French CROTALE. Following evaluation tests of the candidates, the Army selected the ROLAND II for the SHORAD role, and awarded a $108,394,160 engineering and development contract to the Hughes Aircraft-Boeing Company team on 9 January 1975. These contractors, who had arranged for a license to build and market the ROLAND in the United States, would essentially split the work, with Hughes Aircraft serving as the prime contractor.

(U) The ROLAND II being produced for the French and German armies bore a striking resemblance to the MAULER all weather

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*Defense Systems Acquisition Review Council

[19] Intvw, M. T. Cagle w Ralph Kay, CMO, 14 Apr 75.

[20] RDTE Program Data Sheet, Fwd Area AD - CHAP, Nov 74. HDF.

forward area air defense system, which was cancelled in November 1965 after an RDTE expenditure of some $200 million.* It consisted essentially of acquisition and tracking radars, IFF equipment, a fire control unit, and conventional guided missiles mounted on a tracked vehicle. The U. S. version of the ROLAND II, however, would be mounted on the GOER vehicle. The plan was to deploy the ROLAND II SHORAD system with troops in central Europe to defend rear-area, high-value targets, such as air fields, depots, ports, troop encampments, and other support and combat facilities. A DSARC decision on its assignment to Army divisions was yet to be made.[21]

(U) The DSARC decision could have a profound impact on both the use of the CHAPARRAL weapon system and the mobility requirements of the SHORAD system. If the ROLAND's mission were restricted to the defense of rear-area point targets, its mobility could be reduced and the CHAPARRAL system would continue to defend the division area or forward combat zone. On the other hand, expansion of the ROLAND's air defense mission to include the division area would allow CHAPARRAL units to be phased into the Army reserves. But whatever the decision, the CHAPARRAL/VULCAN, together with the shoulder-fired REDEYE and self-propelled HAWK systems, would continue to fill the gap in forward area air defense until the new generation of weapons became available.[22]

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*Members of the North Atlantic Treaty Organization closely followed the MAULER development program and intended to buy the weapon system to counter the forward area low altitude air threat in the late 1960's. When the program was cancelled, France and Germany developed a "Mauler" of their own and offered it, in 1970, as a successor to the basic CHAPARRAL/VULCAN with which the U. S. Army was then being equipped. (1) Mary T. Cagle, *History of the MAULER Weapon System* (MICOM, 19 Dec 68), pp. 85, 92-96. (2) *Government Executive* Magazine, Oct 70, pp. 15-16.

[21](1) The *Huntsville Times*, 19 Aug 74, 10 Jan 75, & 12 Jan 75. (2) *Government Executive* Magazine, Oct 70, pp. 15-16.

[22]Intvw, M. T. Cagle w Ralph Kay, 6 Jun 75.

The ROLAND II Air Defense System - 72,100 lbs.

Artist's Conception of the SHORAD (ROLAND II) System Mounted on the GOER Vehicle - 43,000 lbs.

CHAPTER VII

(U) COST SUMMARY

(U) Throughout its 10-year history, the CHAPARRAL program was plagued by a variety of administrative, financial, and technical problems. As explained in the chapter dealing with project management, prosecution of the program at MICOM was hampered by a fragmented management structure, serious manpower deficiencies, piecemeal funding, and a lack of timely guidance from higher echelons. These impediments, together with technical problems and the redesign effort resulting from changes in military requirements, led to a 22-month slippage in the deployment schedule and an enormous increase in total program cost.

(U) The actual RDTE/PEMA investment totaled $369,938,000 for the 1965-74 period, compared to the original estimate of $95,401,000 for the 1965-69 period. A large part of this increase was attributed to changes in military requirements, the cost of which was not included in the initial estimate.

(U) During the 1965-74 period, the Army invested $62,481,000 in development of the basic weapon system and product improvements thereto, an increase of 257 percent over the original cost estimate of $17.5 million for the 1965-67 period. An additional $64,667,000 would be needed to complete the follow-on improvements planned for the 1975-79 period. If approved, this would bring the total RDTE cost to $127,148,000.

(U) The actual PEMA investment totaled $307,457,000 for the 1966-74 period, compared to the original estimate of $77,901,000.

(U) Program costs by appropriation and fiscal year are depicted in Table 9.

TABLE 9—(U) CHAPARRAL Cost Summary
(In Millions of $)

	ORIGINAL ESTIMATE*			ACTUAL**		
FY	RDTE	PEMA	TOTAL	RDTE	PEMA	TOTAL
1965	5.000	.300	5.300	5.160	--	5.160
1966	9.500	38.952	48.452	19.486	26.030	45.516
1967	3.000	36.343	39.343	17.125	63.081	80.206
1968	--	1.433	1.433	7.251	8.000	15.251
1969	--	.873	.873	5.456	71.645	77.101
1970				2.492	69.833	72.325
1971				.605	47.382	47.987
1972				1.193	15.635	16.828
1973				.375	5.391	5.766
1974				3.338	.460	3.798
	17.500	77.901	95.401	62.481	307.457	369.938

**See* Table 1, p. 17.

***See* Table 3, p. 77, & Table 6, p. 80.

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PART TWO

THE FORWARD AREA ALERTING RADAR SYSTEM

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CHAPTER VIII

(C) ORIGIN AND OBJECTIVES OF THE FAAR PROGRAM (U)

Background

(U) The need for a lightweight, short range, low altitude acquisition radar evolved from the inability of existing radar systems to detect high speed targets at very low altitudes in heavy ground clutter* environments. Further, a means of providing alert warning other than by ground observer teams was needed to increase the effectiveness of the CHAPARRAL/VULCAN and REDEYE air defense weapons.** One of the main limiting factors in effective operation of the CHAPARRAL/VULCAN systems was the capability of fire unit personnel to detect and identify incoming targets by visual means. The employment of a search radar at the platoon or battery level would ease the burden of the observer and mount operator, especially if the radar output could indicate the launcher pointing direction which would yield the highest probability of acquiring the target at the earliest time prior to fly-over. Once the operator detected an aircraft, he had to decide quickly and accurately when and at what target to fire the missile. There was the possibility that a hostile aircraft might not be identified as such until either the launcher or some nearby target was taken under fire. Hence, without a positive means of target identification, the value of the system would be seriously degraded.[1]

(U) The requirement for a forward area search or early warning radar and a positive means of target identification was established in Option 4 of the ACSFOR study dated 30 September 1964. This study, approved by the Secretary of Defense on 17 November 1964, specified that "each CHAPARRAL firing platoon will

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*Radar clutter is defined as unwanted signals, echoes, or images on the face of the display tube which interfere with observation of desired signals.

**These weapons were selected to fill the gap left by cancellation of the self-propelled MAULER weapon system which contained both tracking and acquisition radars and IFF equipment.

[1]MICOM Rept, Prelim Tech Dev Plan - CHAP LA AD Sys, 14 Jan 65, p. I-7. RSIC.

be equipped with a continuous wave acquisition radar and IFF for early warning and identification."[2]

Selection of the R&D Contractor

(U) Early in 1965, MICOM initiated a program aimed at providing a suitable early warning and identification system within the same timeframe as the interim CHAPARRAL; i.e., initial operational capability by January 1968.[3] As originally planned, the Forward Area Acquisition Radar* was to be an off-the-shelf item. To determine if an existing system could be adapted, MICOM conducted a survey of Army, Navy, and Air Force radars, as well as various commercial and foreign radar equipment. None of the radars surveyed was found to be technically suitable for the FAAR application without major redesign. Owing to the necessity to field the FAAR in a timeframe compatible with the interim CHAPARRAL/gun air defense system, the development approach considered the most feasible was to select a radar system or radar components that would require minimum modifications.

(U) The initial technical requirements were based on several proposed concepts and discussions with various government laboratories, contractors, and the user agency, the Combat Developments Command (CDC). The general concept that met these requirements was a conventional pulse doppler acquisition radar. The concept was necessarily a conservative one because of the short development time allowed. Therefore, sophisticated and highly complex techniques requiring extensive engineering design and analysis were not considered.[4]

(U) Existing radars were investigated to determine the modifications required and the capabilities of the system following modification. The systems initially considered as the

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*Later redesignated and hereafter referred to as the Forward Area Alerting Radar (FAAR).

[2](1) ACSFOR Rept, 30 Sep 64, subj: Program for AD - Fld Army. Cited and summarized in CDC Study M-6098, Aug 65, subj: TAMIRAD, Vol. I. RSIC. (2) SECDEF Decision/Guidance Z-4-048, 17 Nov 64, subj: Fwd Area AD Wpns. CMO Files. (3) *Also see* above, pp. 10, 12.

[3]MICOM Rept, Prelim Tech Dev Plan - CHAP LA AD Sys, 14 Jan 65, p. I-7. RSIC.

[4](1) IADS PM Rept, Aug 65, subj: Prog Rept on Fwd Area AD, p. D-2. CMO Files. (2) Hist Rept, CMO, FY 69, p. 5. HDF.

leading contenders were the VIGILANTE acquisition radar developed by the Sperry-Utah Corporation, the MAULER acquisition radar developed by the Raytheon Manufacturing Corporation, and the TPQ-12 radar being developed by Sanders Associates. The Army Missile Command received unsolicited proposals from these three contractors and from several other companies. These proposals, however, were not responsive to the actual requirements, and the Command decided to allow competitive bidding for the FAAR system.[5]

(U) In late September 1965, MICOM issued Technical Requirements 850 (TR-850) to industry in a formal request for quotation. The FAAR was to consist of a lightweight, highly mobile, very low altitude aircraft detection device, a radio frequency (RF) data link, Mark XII IFF equipment (GFE), primary power supply, and a vehicle (GFE). Among significant performance and operational requirements were these:

Probability of Detection: 0.9 against a 0.2 square meter nonfluctuating target, at a range of 10 kilometers required (20 kilometers desired).

Altitude: Coverage at 45° up to a minimum altitude of 3 kilometers required; coverage up to 60° desired.

Target Velocity: 50 to 400 meters per second.

Clutter Requirement: Clutter reflection coefficient -10 decibels (db).

IFF: The radar was to be compatible with Mark XII IFF equipment and the AIMS* program.

Weight: Maximum weight of the radar (antenna unit, transmit/receive unit, and display unit) not to exceed 500 lbs. Total

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*Air Traffic Control Radar Beacon IFF Mark XII System. The purpose of the AIMS program was to provide secure identification and altitude of friendly aerial traffic to air defense and air traffic control sources. It was derived from the Mark X military IFF electronic beacon system originally developed during World War II as the Mark V IFF system. CDC Study M-6098, Aug 65, subj: TAMIRAD, Vol. II, p. E-IX-1. RSIC.

[5](1) *Ibid.* (2) Intvw, M. T. Cagle w Charles H. Kirchner, CMO, 6 Feb 75. (3) CHAP Monthly Highlight Sum for Jan 65. AD Cmdty Mgr, 8 Feb 65. HDF. (4) CHAP Significant Actions and/or Problems, Act AD Cmdty Mgr, 19-23 Apr 65. HDF.

system weight not to exceed load limitation of a 3/4-ton truck.

Transportability: System with prime mover was to be Phase I air transportable in accordance with AR 705-35.

Emplacement, March-Order, & Operation: Set up, checkout, and warmup not to exceed 20 minutes. Warmup 5 minutes. March-order 15 minutes. Each operation by a three-man crew.[6]

(U) The original cost estimate, based on use of a modified off-the-shelf radar, was $5 million for the R&D system. However, the funding level was set at $2,110,000, and the request for quotation was written to reflect this austere philosophy. These funds were considered adequate for procurement of essential test hardware (one engineering model and two R&D prototypes) and appropriate testing of the interim system for use in the temperate zone.

(U) With the change in military requirements calling for world-wide deployment and an expanded service life of 8 to 10 years, the CHAPARRAL Commodity Manager prepared an amended funding program for essential performance improvements and additional test hardware. The revised program, presented to AMC, OCRD, and the Director of Defense Research & Engineering (DDRE), on 8 October 1965, called for additional RDTE funding of $3,835,000, increasing the total cost estimate to $5,945,000 for the FY 1965-71 period. Included in the program were funds for one additional engineering model and two R&D prototypes, which were needed to meet existing test and fielding schedules.[7]

(U) The CHAPARRAL Commodity Office received 13 proposals for development of the FAAR system, including two from foreign industries. The top three bidders were Sanders Associates, which proposed a modified version of its developmental TPQ-12 radar; the Sperry-Utah Corporation, which proposed a German-made radar; and the Hazeltine Corporation, which offered a French-made system. Sanders Associates was selected as the prime R&D contractor for

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[6](1) Hist Rept, CMO, FY 69, p. 6. HDF. (2) IADS PM Rept, Aug 65, subj: Prog Rept on Fwd Area AD, p. D-1. CMO Files.

[7](1) *Ibid.*, p. D-3. (2) DF, CHAP Cmdty Mgr to R&D Drte, 12 Oct 65, subj: TAMIRAD, & Incl thereto. RHA Bx 14-8. (3) Ltr, IADS PM, AMC, to CG, MICOM, 10 Feb 66, subj: Review of CHAP Program & Funding. RHA Bx 14-8.

the FAAR system on 25 April 1966.[8]

Program Management

(U) Though assigned to the same organization as the CHAPARRAL, the FAAR program was a major subtask requiring management on a separate "system" basis. As such, it required the normal engineering, tests, maintenance and support, configuration management, scheduling, and all other managerial reporting tasks as needed for the CHAPARRAL. The problems and frustrations stemming from the fragmented management structure, manpower deficiencies, and other administrative impediments have already been detailed in Chapter II and will not be repeated here. The impact of these problems on the prosecution of the FAAR program will become obvious as the story unfolds.

[8](1) Intvw, M. T. Cagle w Charles H. Kirchner, CMO, 6 Feb 75. (2) DOD Appns for 1973, Hearings Before Subcom of the Com on Appns, House of Representatives, 92d Congress, 2d Session, Part F - Proc, p. 107. HDF. (3) Hist Rept, CMO, FY 69, p. 7. HDF.

CHAPTER IX

(C) EXECUTION OF THE DEVELOPMENT PROGRAM (U)

(C) The FAAR development program officially began on 13 May 1966, when MICOM awarded Sanders Associates a $4,856,843 firm-fixed-price contract (DA-01-021-AMC-15008). The 24-month contract called for engineering design, development, fabrication, and test of one engineering model and three R&D prototypes in accordance with TR-850, as amended. The addendum to TR-850, issued on 11 May 1966, contained the following changes:[1]

Target Velocity (radial): Changed from 50-400 meters per second to 20-500 meters per second.

Maximum Range of Radar: Changed from 16-24 kilometers to 20 kilometers.

Probability of Detection: Changed from 0.9 at 10 kilometers to 0.9 at 17 kilometers.

Altitude Coverage: Changed from a specified coverage to maximum antenna size of 72 inches horizontal and 42 inches vertical.

(U) During the latter part of 1966, one additional FAAR prototype with RF data link was added to Sanders' R&D contract to provide more hardware for the test program. Another contract modification added a requirement for antenna masts to permit operational flexibility and made the S-250 shelter Government-furnished equipment (GFE). The latter change was necessary because Sanders could not procure the shelter in time to meet the schedule. These and other modifications increased the final value of the initial R&D contract to $5,457,638.[2]

Qualitative Materiel Requirement (QMR)

(C) The Combat Developments Command (CDC) initially submitted

[1] (1) MICOM Hist Sum, FY 69, p. 97. (2) Hist Rept, CMO, FY 69, p. 7.

[2] (1) *Ibid.* (2) MICOM Contr Listing, 1 Jul 72.

proposed requirements for the FAAR system in a Small Development Requirement (SDR) format in March 1966. The draft of the first proposed QMR was prepared in December 1966. The coordinated QMR, approved by DA in April 1968 and amended in December 1968, described a mobile FAAR system with Mark XII IFF equipment, capable of detecting and identifying low flying aircraft of 0 to 3 kilometers altitude to a range of about 20 kilometers, and a one-way digital alerting identification data link between the radar and supported fire units. The transmitter would be an integral part of the radar, and each fire unit would be provided a Rapid Alerting Identification Display (RAID) as a receiver. Twelve FAAR's (one per CHAPARRAL and VULCAN platoon) would be organic to each CHAPARRAL/VULCAN battalion. One RAID would be issued to each CHAPARRAL/VULCAN fire unit, one to each CHAPARRAL/VULCAN platoon headquarters, one to each FAAR, one to each FAAR platoon headquarters, one to each REDEYE team, and one to each REDEYE section headquarters. The FAAR system was to have a useful service life of 10 years. Its major performance and physical characteristics, as reflected in the approved QMR and changes to TR-850 through March 1968, were as follows:[3]

<u>Radar</u>

<u>Coverage</u>: Range - 1 to 20 km; Elevation - 30° vertical; Altitude - 0 to 3,000 meters at maximum range.

<u>Accuracy</u>: Azimuth $\pm 2°$; Range ± 500 meters.

<u>Probability of Detection</u>: 0.8 against a $.2m^2$ nonfluctuating target at 15 km within one antenna scan essential (0.9 desired).

<u>Subclutter Visibility</u> (i.e., ability to detect moving targets submerged in a background of echoes from terrain and other reflecting objects): Greater than 40 decibels.

<u>Reliability</u>: Inherent availability - 98%; Mean-Time-Between-Failure (MTBF) - 100 hours essential (300 hours desired); Mean-Time-to-Repair (MTTR) - Not more than 2 hours essential (1 hour desired).

<u>Set Up & Warmup Time</u>: 20 minutes (warmup 5 minutes).

<u>March Order (Shut Down from Operational Status)</u>: 15 minutes.

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[3](1) Ltr, CDC HQ to Distr, 5 Apr 68, subj: DA Approved QMR for Fwd Area AD Alert Radar Sys (FAAR)(CDOG Para 737a[1]). CMO Files. (2) Ltr, CDC HQ to Distr, 20 Dec 68, subj: DA Approved QMR for Fwd Area AD Alerting Radar (FAAR). Atchd as incl to AMCTCM 6840, Mtg No. 5-69. RSIC.

<u>Transportability</u>: System with prime mover to be Phase I air transportable in C-123 aircraft and CH-47 helicopter with antenna and mast stowed. The system (radar and data transmitter) in a standard shelter, plus crew and all crew-oriented equipment, to be transported on a vehicle that would provide mobility compatible with that of the supported unit.

<u>Weight</u>: Maximum weight of the radar (antenna unit, transmit/receive unit, and display unit) not to exceed 500 pounds. Total system weight not to exceed 2,500 lbs., or load limitation of a 1 1/4-ton vehicle. (Load originally limited to a 3/4-ton vehicle.)

<u>RAID/RF Data Link System</u>

<u>Displays</u>: 7 x 7 matrix equal to area displayed by radar.

<u>Data Capacity</u>: Location and IFF Status for 1 friend and 1 foe for each unit area (49 squares - 98 targets).

<u>Reaction Time</u>: 2 seconds per target from designation to display.

<u>Weight & Size</u>: Weight of receiver not to exceed 13 lbs. with batteries (8 lbs. desired). Overall dimensions not to exceed 5" high by 11" long by 9" wide.

Performance: Continuous for 24 hours without battery charge.

Engineering Design of the FAAR Prototype

(U) The FAAR prototype system developed during the 1966-68 period consisted of a lightweight radar, the S-250 shelter, RAID units, Mark XII IFF equipment, 5 kilowatts of prime power, VRC-46 communications equipment, and the M561 1 1/4-ton (Gama Goat) vehicle.[4] Developed by Ling-Temco Vought under contract with the Tank-Automotive Command (TACOM), the M561 vehicle consisted of a tractor and cargo section connected by an articulating joint which permitted pitch and roll movements while keeping all six wheels driving. The first production contract was awarded to the Consolidated Diesel Electric Company on 11 June 1968, following road tests of three advance production engineering (APE) pilot vehicles. Two of the M561 pilot vehicles, modified to include a communications shelter and stabilizing jacks on the cargo section and a 5-kw 400-cycle alternator kit on the engine, were delivered to Sanders Associates early in 1968 for use in

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[4] Hist Rept, CMO, FY 69, pp. 3-4. HDF.

the FAAR test program. The first production vehicles were scheduled for delivery in October 1969.[5]

(U) Sanders completed fabrication of the FAAR engineering model in April 1967 and began engineering design tests which continued into 1968. The first prototype FAAR, delivered in January 1968, was examined during the prototype system pre-IPR, held in February 1968. Significant performance parameters addressed as problem areas concerned the system weight and air transportability. The system weight exceeded the QMR limitation by some 1,200 lbs., and the shelter had to be removed from the vehicle for transport by C-123 aircraft.

(U) During system acceptance tests of Prototype #1, completed in March 1968, more problems arose. The objective of these tests was to demonstrate that the system could meet the operational requirements in a limited environment before the initiation of a formal evaluation of system performance, maintainability, availability, and reliability in engineering and service tests. Among the problems arising during the tests were low detection range, system overweight, range gate inoperative, excessive march order and emplacement times, interference of antenna mast with the vehicle tail gate, and failure to meet the close-in clutter rejection requirement.[6]

(U) The FAAR prototype system IPR was held at Fort Bliss on 24-25 April 1968, following delivery of the fourth and last unit. Members of the review committee agreed that there were four areas in which provisions of the QMR would not be met: system weight, nuclear hardening, RAID/data link performance, and transportability.

(U) The actual weight of the prototype system (including a 170-lb. kit of jacks and stabilizing struts for use in high winds) was 3,738 lbs., in contrast to the QMR limit of 2,500 lbs. Several weight reduction measures were under study, but their feasibility from an engineering and tactical viewpoint was yet to be demonstrated. This effort was expected to result in a total system weight of 2,600 to 2,700 lbs. The measures selected would be defined and accomplished in all production units and incorporated by retrofit into the prototype units.

(U) The DA-approved QMR required nuclear hardening to certain levels and minimum susceptibility to electromagnetic radiation,

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[5] TACOM Hist Sum, FY 68, Vol. III, pp. 2-3, 5-8, 10.

[6] Hist Rept, CMO, FY 69, pp. 8-9. HDF.

chemical, biological, and radiological agents, consistent with overall system costs. These were new requirements not contained in the proposed or draft proposed versions of the QMR. The major redesign effort needed to meet these requirements would not be undertaken without specific direction by the Department of the Army.

(U) Some degree of interference to the data link could be expected on the same or adjacent channels from other transmitters located in the same area as the RAID unit. Design changes were being made in the RAID unit to minimize this interference, but there was a possibility that such changes would increase the size and weight of the unit beyond QMR limits. Included in the changes were the incorporation of a 920-channel receiver, a means of rapid frequency selection over the 30-76 megacycle band, discrete address coding, and other digital circuits to reduce susceptibility to interference.

(U) The system with prime mover would be Phase I air transportable; however, for transport in C-123 aircraft the shelter would have to be removed from the vehicle. Similar disassembly would not be required for transport in C-130 aircraft.

(U) In addition to the foregoing problem areas, the review committee pointed to a critical space and power problem relating to communications equipment. The DA-approved TOE 44-326-T included an AN/GRC-106 radio with the M561 Gama Goat vehicle. In view of the need to maintain a low center of gravity and in keeping with human factors considerations, it appeared that there would be no space available for the radio on the vehicle or within the FAAR shelter. Moreover, the radar primary power unit could not support the additional load imposed by the AN/GRC-106, and a larger power unit was not desirable because the system was already overweight. Recommended solutions to this problem were to be forwarded for DA staff approval in time for their incorporation in the initial production prototypes.

(U) Despite the prevailing technical problems, the review committee concluded that the R&D prototype equipment was ready for engineering and service tests. The results of engineering design tests showed that detection was achieved for most elevations between 0 and 30° and at altitudes from 500 to 3,000 meters.[7]

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[7](1) Ltr, DCG, AMC, to CRD, DA, 9 May 68, subj: Prototype IPR of the FAAR, & Incl 4 thereto: USA Pos - FAAR Prototype IPR, 25 Apr 68. Atchd to AMCTCM 6722, Mtg No. 3-69. RSIC. (2) *Also see* Hist Rept, CMO, FY 69, pp. 9-10. HDF.

(U) Except for engineering design tests of the prototype system, which continued until October 1968, development effort under the initial R&D contract ended in June 1968. The Army Test & Evaluation Command (TECOM) began engineering tests of FAAR Prototype #1 at WSMR in April 1968, and service tests at Fort Bliss in September 1968. Two major end items not delivered for the initial TECOM tests were the RAID unit, which was being modified to reduce its susceptibility to interference, and the field maintenance test set.[8] The disappointing results of these tests will be discussed later.

Transition from Development to Production

(U) The transition from development to initial production began with the award of an APE contract to Sanders Associates in April 1968, and ended with negotiation of the first production contract in November 1968. It was characterized by considerable debate, numerous decision briefings, continuing technical problems and delays, and increasingly sharp criticism of the contractor's performance.

(U) Under the $1,562,593 APE contract, awarded on 30 April 1968, Sanders was to complete the product and engineering design studies and update documentation from the R&D contract by August 1968; establish a pilot production line for the radar/RAID by 31 October 1968; and fabricate and test two APE FAAR systems to verify that the system's technical characteristics were not affected by the pilot production line techniques. Acceptance tests of the first APE FAAR system were to be completed by 3 December 1968, followed by a reliability and maintainability demonstration which was to be finished by 31 March 1969. Acceptance tests of the second APE system were to be completed by 31 January 1969. A reliability demonstration of this pilot production system was not required. The value of the APE contract (DA-AH01-68-C-1930) was later increased from $1,562,593 to $3,752,117 in a settlement of claims and counterclaims between the Government and Sanders Associates.[9]

(U) Assuming the successful execution of the APE effort, the plan was to secure approval of LP authority by 3 September 1968

[8](1) TECOM Rept, FAAR Presn to CG, AMC, 31 Jul 69. (2) FAAR Bfg for GEN P. D. Adams (Ret), 20 Jun 68. Both in RHA Bx 14-8.

[9](1) Contr C-1930, 30 Apr 68. CMO Files. (2) SS AMSMI-I-140-71, D/P&P, 22 Oct 71, subj: APE FAAR, FY 68 Pdn Base Proj #1681166 (CHAP/VULCAN). HDF. (3) *Also see* below pp. 154-55.

and award the production contract on 30 September 1968, with the initial production deliveries scheduled to begin in March 1969.[10] It soon became evident, however, that the magnitude of the problem areas had been underestimated and that Sanders would not be able to meet its commitments under the APE contract. In addition, difficulties were encountered in securing DA staff approval of the LP classification action, and MICOM and the CVADS Project Manager became embroiled in a dispute over the readiness of the contractor and the FAAR system for initiation of production. In view of the subsequent realization that the FAAR system was prematurely released to production, an account of the events leading to the decision appears to be in order.

(U) In a letter to ACSFOR, on 31 July 1968, COL Robert C. Daly, the CVADS Project Manager at AMC, requested DA approval of the LP classification for the FAAR/RAID system by 3 September, in order to meet the procurement review and notation at MICOM no later than 6 September and award a contract on 30 September 1968. The quantities programmed for initial procurement in FY 1969 included 90 FAAR's, 935 RAID units, 57 Organizational Maintenance Test Sets (OMTS), and 24 Field Maintenance Test Sets (FMTS).[11]

(U) Among those opposing the proposed classification action was the Commander of CDC, who concurred in limited production of the FAAR only to the extent necessary to meet FY 1969 deployment schedule requirements and not to exceed a total of 20. In support of this position, he pointed out that the ET/ST program had not progressed to the point that interim results were available; that the RAID unit was in the process of redesign; that the FAAR prototype had been found unsatisfactory in environmental and transport areas and might not meet QMR criteria for reliability and maintainability; and that necessary modifications to the M561 Gama Goat had created a non-standard vehicle.[12]

(U) In response to a verbal request for information on the impact of withholding LP approval of the RAID while approving limited production of the FAAR and associated test equipment, COL Daly advised ACSFOR that the radar would be essentially useless without the RAID unit; that the contract price of the radar would go up; and that the contractor would undoubtedly take advantage

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[10](1) FAAR Bfg for GEN P. D. Adams (Ret), 20 Jun 68. RHA Bx 14-8. (2) Ltr, CVADS PM to ACSFOR, DA, 31 Jul 68, subj: LP TCLAS of FAAR. CMO Files.

[11]*Ibid.* & incl thereto.

[12]1st Ind, CG, CDC, to ACSFOR, 21 Aug 68. CMO Files.

of the limited courses of action open to the Government, with a resultant sharp increase in the RAID price. He further stated:

> RAID is considered to be a low risk item, since all techniques, processes and components are well within the state of the art. While assembly of these techniques and components into a unique functional package may run into engineering implementation problems as with any new device, this office and the developing contractor are highly confident of successful implementation in a timely manner.[13]

(U) Meanwhile, Sanders Associates encountered serious difficulties in producing the pilot system and acceptable documentation on which to establish a production base line. As a result of numerous reviews, conferences, and visits to the contractor's plant, LTC Donald H. Steenburn, chief of the CHAPARRAL Management Office, concluded that the APE effort at Sanders was severely handicapped by insufficient manpower and test equipment and the inability to obtain needed management decisions and support. In mid-August 1968, Mr. Royden C. Sanders, Jr., president of the company, and members of his FAAR program staff were informed that drastic improvements in performance of the APE effort would be essential before any contractual action. Of primary concern was the unsatisfactory condition of the software (documentation) package and slippages in hardware deliveries. During a conference with top officials of the company, on 26 August, MG Charles W. Eifler, Commanding General of MICOM, stated emphatically that there would be no production contract until he was completely satisfied that the APE schedules and performance would be met.

(U) On 10 September 1968, Colonel Steenburn and key members of his staff toured Sanders' manufacturing facilities at Nashua and Bedford, Massachusetts, and received a briefing on the status of the program. Although substantial progress had been made in preparing for the production contract, the documentation package was still incomplete and the test program had not progressed to the point where major problem fixes had been retested.[14]

(U) In an attempt to expedite approval of the LP action, which was still being held at OCRD, Colonel Daly asked a member of Colonel Steenburn's staff and the program manager at Sanders

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[13] TT AMC-34762, CVADS PM to ACSFOR, 10 Sep 68. CMO Files.

[14] MFR, LTC Donald H. Steenburn, 4 Oct 68, subj: FAAR Pdn Delay. CMO Files.

to assist him in a status briefing for a group of DA action officers. During the briefing, on 14 September, the CVADS Project Manager stated that, in his judgment, the program was ready for production release and that the risks involved were minimal. The AMC position was stated as recommending immediate approval of LP authority for award of the first production contract on 30 September 1968.[15] Following a review of the FAAR development, testing, and APE effort, held at Fort Bliss on 17 September 1968, the CVADS Project Manager reaffirmed his contention that "procurement on schedule was an acceptable risk in order to meet DA planning schedules."[16]

(U) The Commanding General of MICOM and the FAAR project staff disagreed. Following a status briefing on 20 September, General Eifler decided to delay initial procurement by a minimum of 30 days so that fixes for mechanical deficiencies could be retested and proven to an acceptable extent before entering into a firm contract.[17] He relayed this decision to the CVADS Project Manager by telephone on 23 September, whereupon Colonel Daly recommended that AMC send a teletype directing MICOM to award the contract on 30 September, as scheduled. Wisely rejecting this tack, LTG William B. Bunker, the DCG of AMC, directed that arrangements be made for a briefing by MICOM personnel outlining the status of the program and reasons for the procurement delay.[18]

(U) During the decision briefing to General Bunker, on 24 September, Mr. Marvin Snipes, deputy chief of the CHAPARRAL Management Office, enumerated the major problem areas and the impact of the 30-day delay on the program schedule. In support of General Eifler's decision to delay the initial production contract, he pointed out that the R&D configuration was unacceptable for field use; that there was no real assurance that all of the problems could be classed as minor—some could become major ones; and that premature award of the production contract would result in the purchase of items which might have to be changed later as

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[15](1) *Ibid.* (2) TT AMC-35816, CVADS PM to CG, MICOM, 23 Sep 68. CMO Files.

[16]Memo for: DCG, AMC, undated, subj: Decn Bfg to LTG Bunker, DCG, AMC, Subj: FY 69 FAAR Proc, 24 Sep 68. CMO Files.

[17]MFR, LTC Donald H. Steenburn, 4 Oct 68, subj: FAAR Pdn Delay. CMO Files.

[18](1) TT AMC-35816, CVADS PM to CG, MICOM, 23 Sep 68. (2) Memo for: DCG, AMC, undated, subj: Decn Bfg to LTG Bunker, DCG, AMC, Subj: FY 69 FAAR Proc, 24 Sep 68. Both in CMO Files.

a result of tests. It was therefore considered in the best interest of the Government and the FAAR program to delay procurement until documentation, costs, and technical risks were better defined.

(U) Aside from the system weight and space problems outlined in the prototype system IPR during April 1968, there were four major problem areas: low minimum discernible signal, vibration damage to the shelter under shake test, overheating in the shelter, and power supply switching transients. Having determined that the system weight could not be reduced to the M561 vehicle limit, MICOM had issued a change to TR-850, on 12 September 1968, authorizing the addition of an M-101 trailer. (Removal of the prime power and other ancillary equipment to the trailer relieved the problem but did not completely solve it, for the system was still more than 800 lbs. overweight.*) At the same time, the AN/PRC-74B radio was substituted for the AN/GRC-106 radio to solve the space and power problems identified in the prototype system IPR. Fixes for all of the major problems were expected to be available for test in at least one prototype within 2 weeks. The R&D drawings were available on 16 September 1968 but were considered unsatisfactory for production. The updated APE documentation would be available by 8 November.

(U) While recognizing a 45-day slip in the initial production contract (from 30 September to 8 November), General Bunker criticized what he termed the leisurely pace of the program at MICOM and classified the problems on the FAAR as minor. Emphasizing the urgency of the program and the relatively low dollar risk involved, he directed that MICOM attempt to negotiate at least the price portion of the contractual action no later than 8 November. In any event, the contract was to be definitized by 30 November 1968 if at all possible.[19] On 27 September 1968,

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*Intvw, M. T. Cagle w Charles H. Kirchner, CMO, 25 Feb 75.

[19](1) *Ibid.* (2) Hist Rept, CMO, FY 69, p. 10. HDF. (3) Sum of Remarks by COL Robert C. Daly [CVADS PM], 15 Nov 68. CMO Files. (4) MFR, LTC Donald H. Steenburn, 4 Oct 68, subj: FAAR Pdn Delay. CMO Files.

Forty-two months later—21 months of which were spent in a production hold because of recurring problems—the first FAAR system was yet to reach the field and DA staff officials found themselves standing before a House appropriations committee admitting that "the decision to produce, obviously, in retrospect, was not correct. . . ." DOD Appns for 1973, Hearings Before Subcom of the Com on Appns, House of Representatives, 92d Congress, 2d Session, Part F - Proc, p. 107. HDF.

General Bunker advised ACSFOR that the contractual delay would result in a 60-day slippage in availability of FAAR equipment to the user, and requested approval of the LP classification action by 25 October.[20]

(U) Early in October 1968, following several team visits to Sanders' plant, the DCG/ADS of MICOM wrote the president of the company expressing concern over the lack of progress in meeting hardware and documentation deliveries and the resultant impact on the proposed production program. Emphasizing that any further delays could seriously jeopardize the planned procurements, he urged that the necessary resources be applied to assure successful completion of tasks in the very critical period ahead.[21]

(U) On 24 October 1968, ACSFOR approved the LP classification action for initial procurement of 90 FAAR's, 935 RAID units, 57 OMTS's, and 24 FMTS's.[22] The 2 1/2-ton M35A2 vehicle was designated as the prime mover for the FMTS and as the interim FAAR vehicle pending availability of the 1 1/4-ton M561 Gama Goat. The official identification of the major line items was as follows:[23]

Radar Set, AN/MPQ-49 (XO-1) - Mounted on M561 Vehicle
Radar Set, AN/MPQ-49 (XO-2) - Mounted on M35A2 Vehicle
Display Set, Target Alert Data (RAID), AN/GSQ-137 (XO-1)
Test Set, Radar: AN/MPM-59 (XO-1) (OMTS/FAAR)
Test Set, Radar: AN/MPM-57 (XO-1) (FMTS/FAAR)

ACSFOR had approved the Mark XII (AN/TPX-50) IFF set for limited production on 8 March 1968. Following this approval, ECOM had contracted with the Hazeltine Corporation, on 13 March, for FY 1968 procurement of 23 AN/TPX-50 IFF sets to meet leadtime requirements of the FY 1969 FAAR procurement. Limited deliveries were scheduled to begin in March 1969.[24]

(U) In the meantime, MICOM ran into contractual difficulties

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[20] TT AMC-36330, DCG, AMC, to ACSFOR, 27 Sep 68. CMO Files.

[21] Ltr, DCG/ADS, MICOM, to Royden C. Sanders, Jr., 4 Oct 68, n.s. CMO Files.

[22] 1st Ind, ACSFOR to CG, AMC, 24 Oct 68, on Ltr, CVADS PM to ACSFOR, 27 Aug 68, subj: FAAR Clas as LP Type. CMO Files.

[23] AMCTCM 7312, Mtg No. 12-69. RSIC.

[24] (1) CVADS PM_2P Prog Rept, 3d Qtr, FY 68. RHA Bx 14-7. (2) *Also see* above, p. 131.

with Sanders. The last submission of drawings was rejected because of inadequacies, placing the Engineering Release Record (ERR) due date of 8 November 1968 in jeopardy. As of 24 October 1968, price agreements had been reached on all items except direct labor hours. The Government's estimate for the total contract was $15.5 million, whereas the contractor's latest offer was about $16.8 million. Since Sanders rejected the Government's last offer, it was evident that at least a week beyond the 8 November target date would be needed to complete negotiations. Moreover, the requirement for ASA(I&L)* approval of the production contract and the lack of an ERR production base line made early definitization of a contract impracticable. Estimates as to when the ERR would be acceptable ranged from 8 November 1968 to the first of January 1969.

(U) The Procurement & Production Directorate recommended that MICOM request a release to let a letter contract for up to 100 percent of the negotiated contract price, that delivery be established on an 8-month production leadtime, and that the contract provide for loss of fee for late delivery. The contractor had proposed a 6-month delivery schedule; however, a MICOM team evaluation concluded that the most optimistic schedule that would be reasonable, using the pilot line for the production units, would be 8 months. This production leadtime would mean a 90-day delay in delivery of the production units. The contract negotiations would be based on the configuration that was to be depicted on the documentation to be released by ERR as of 8 November 1968, regardless of the date on which the ERR was finally approved. The 90-day letter contract would stipulate that the negotiated price was based on the ERR to be released at a later date and that the contractor would make all production units on the pilot line.[25]

(U) In mid-November 1968, the negotiation of contract costs still had not been finalized, and there was evidence that the delay might continue until completion of documentation, which had slipped into December. During a decision briefing to the DCG of AMC, on 15 November, MICOM representatives recommended awarding a letter contract when a firm price could be negotiated, then finalizing the contract after release of all documentation. The previous 2-month slip in production roll-off had now become 4 months because of the additional 2 months added for production

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*Assistant Secretary of the Army (Installations & Logistics)

[25]MFR, D/P&P, MICOM, 24 Oct 68, subj: Contr for FAAR Pdn Rqrmts (FY 69). CMO Files.

leadtime. As a result, initial availability of equipment to CONARC for the training base would slip from May and June 1969 to the end of October 1969, with a commensurate delay in availability of equipment to tactical units. CONARC had stated that 5 1/2 months were required after availability of hardware for preparation of training courses. This would put first availability of equipment to CONARC troops at mid-April 1970.[26] Following the decision briefing, the Commanding General of MICOM was directed to "obtain a letter contract by Tuesday 19 Nov or call General Bunker."[27]

(U) The Missile Command executed the initial (FY 1969) production contract with Sanders Associates on 29 November 1968. Letter contract DA-AH01-69-C-0749 was funded for $7,500,000 (one-half of the total estimated definitive contract) and covered a 60-day performance period, which was later extended to 90 days. The definitized contract was signed on 29 February for $14,302,133. A modification issued in June 1969 reduced the total contract price to $14,196,750, including a target profit of $1,406,885. The major line items procured and the production delivery schedule were as follows:

Item	Qty	Delivery Schedule
FAAR AN/MPQ-49 (XO-2) w M35A2 Vehicle	72	Jul 69 - Jun 70
FAAR AN/TPQ-32 (XO-1) Unmounted	7	Sep 69 - Dec 69
FAAR AN/TPQ-32 (XO-1) w/o Shelter, Generator, or Vehicle	11	Sep 69 - Dec 69
RAID, AN/GSQ-137 (XO-1)	935	Jul 69 - Jun 70
OMTS, AN/MPM-59	57	Jul 69 - Jun 70
FMTS, AN/MPM-57	19	Jul 69 - Jun 70
FMTS, w/o Shelter	5	Sep 69 - Nov 69

(U) In addition to the initial production contract, Sanders Associates received other FY 1969 industrial contracts totaling $5,895,743, along with a $997,450 R&D contract (DA-AH01-69-C-1136), on 3 February 1969, for follow-on development of the FAAR system.[28]

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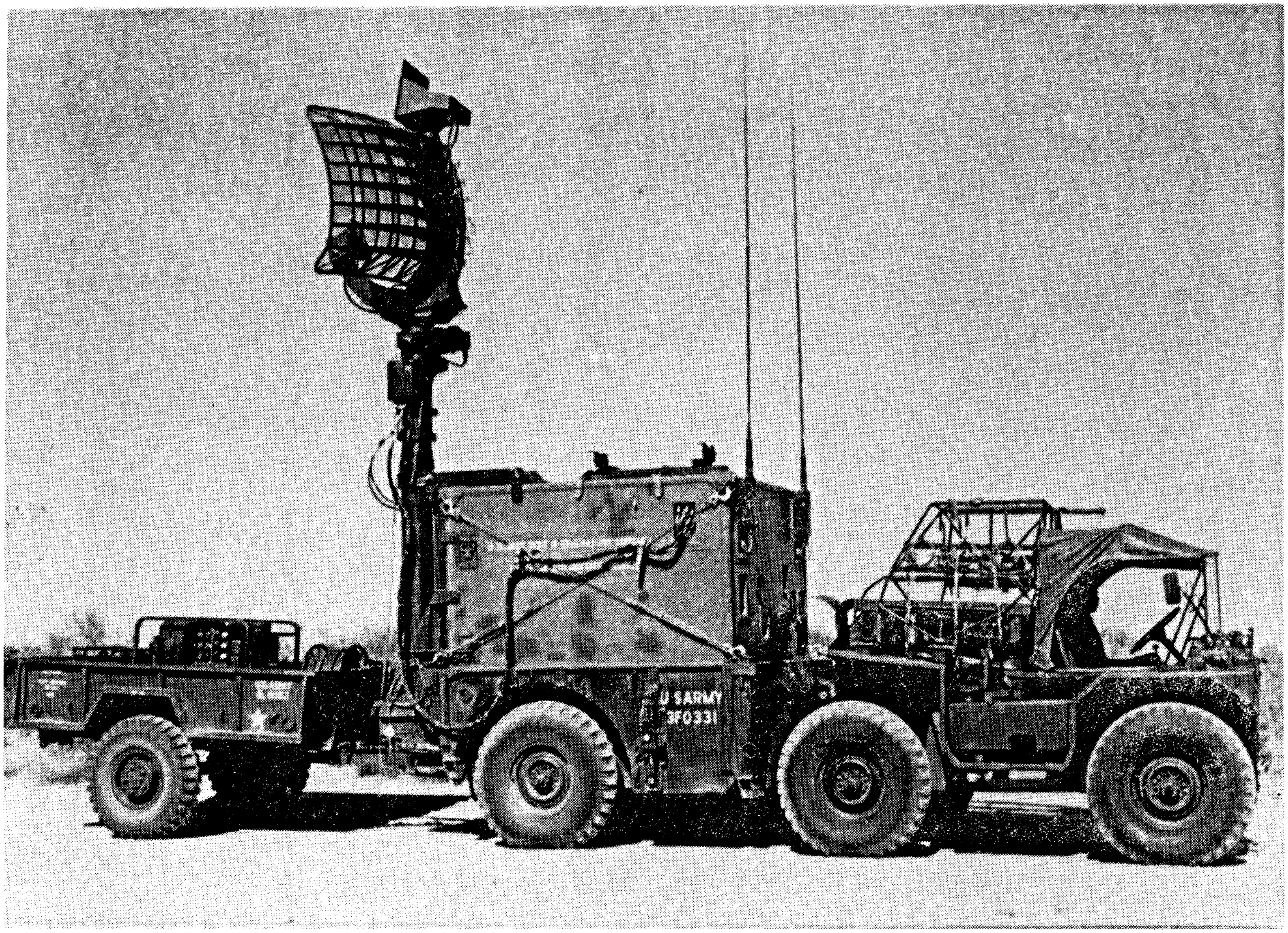
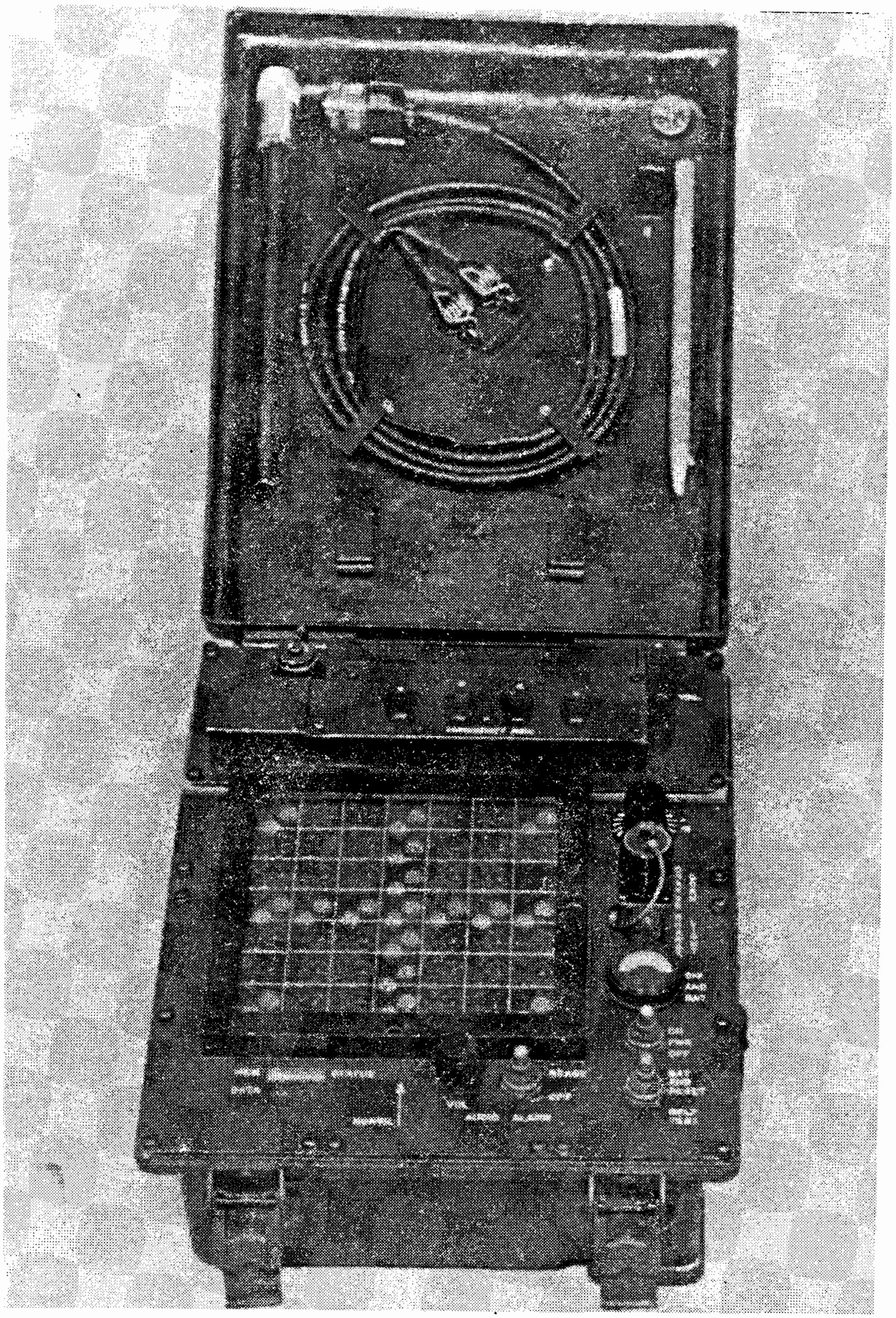
[26] (1) Sum of Remarks by COL Robert C. Daly, 15 Nov 68. CMO Files. (2) CVADS PM_2P Prog Repts, FY 69. RHA Bx 14-7.

[27] TT AMC-40489, CVADS PM to CG, MICOM, 15 Nov 68. CMO Files.

[28] (1) MICOM Contr Listings, 1 Jul 72, 1 Apr 73, & 1 Oct 73. HDF. (2) *Also see* CMO Contr Files & Table 10, Chapter X.



FAAR Prototype System Mounted on Pilot Model of the M561 Gama Goat Vehicle and M101 Trailer



Rapid Alerting Identification Display (RAID)

CHAPTER X

(U) EVOLUTION OF THE STANDARD FAAR SYSTEM (U)

(U) The ink had scarcely dried on the initial industrial contract when it became abundantly clear that the production decision was a grave mistake. Late deliveries of acceptable hardware and continuing technical problems requiring major redesign led to the suspension of service tests in March 1969 and a stop-work order on the production contract in July 1969, with a consequent stretchout in the service availability date and an escalation in program costs. During the production hold, which lasted for some 21 months, the program effort was concentrated on solutions to system shortcomings and deficiencies, updating of documentation, and acceptance tests of the two modified APE systems. Production resumed in April 1971 and the first unit was accepted by the Army 7 months later, in November. The first FAAR unit was deployed in December 1972—some 3 years after initial deployment of the CHAPARRAL—and the system was classified as Standard A in February 1973. The engineering design, development, and test effort continued to varying degrees through FY 1973, increasing the RDTE cost from the initial estimate of $5,945,000 for the 1965-71 period, to $9,504,000 for the 1965-73 period. The adjusted price of the initial production contract from $14,196,750 to $27,576,889, and the production line standby cost of $1,723,240, together with retrofit costs and related expenses, drove up the total PEMA funding requirements and significantly reduced the cost effectiveness of the FAAR system.

Suspension of Service Tests

(U) TECOM testing of the FAAR prototype system began in March 1968 and continued until March 1969. During this period of 1 year, engineering tests were conducted at WSMR; Aberdeen Proving Ground; Army Electronic Proving Ground; Fort Huachuca, Arizona; and the General Equipment Test Activity (GETA), Fort Lee, Virginia. The Army Air Defense Board conducted the initial phase of service tests at Fort Bliss, Texas, between September 1968 and March 1969. The fact that the FAAR system possessed numerous shortcomings was brought out very early in the service test program and before award of the first production contract. In a letter to MICOM, on 25 October 1968, the Air Defense Board listed 42 mechanical and electrical shortcomings in the system. The equipment was returned to Sanders for corrective action, delaying the service test until

18 November 1968.

(U) At first, it was thought that the technical problems encountered in the service tests were minor in nature and could be readily corrected. As time went by, however, it became increasingly apparent that the system was unsuitable for Army use and that major redesign would be necessary to meet the QMR. Consequently, the service tests were terminated in March 1969 and the program was returned to an engineering design test status.

(U) The suspension of tests was based on the need to improve radar performance in four critical areas: detection of slow-moving low altitude targets; detection of high altitude close-in targets (elevation coverage up to 30° required, 18° achieved); detection of targets flying crossing courses; and electronic countermeasure susceptibility. Other technical problems contributing to the decision included incompatibilities between the radar and AN/TPX-50 IFF equipment (e.g., ambiguous IFF target display on the Plan Position Indicator scope and unreliable communications between the radar and the RAID display on a number of channels); excessive warmup time (5 minutes required, 15 minutes achieved); excessive emplacement time (20 minutes required, 67 minutes achieved); and excessive march order time (15 minutes required, 50 minutes achieved).[1]

Suspension of Production

(U) At the time of the decision to suspend service tests, the plan was to validate corrective actions with as much engineering design test as possible, then incorporate the changes into an APE model for resumption of the service test in June 1969. This plan was predicated on the APE deliveries in May, with a 30-day MICOM acceptance test program. By the end of May 1969, however, the APE effort had slipped some 5 months, setting the resumption of service tests back to 1 November 1969.

(U) The program slippage was attributed primarily to problems encountered in the manufacture and delivery of Special Acceptance

[1](1) CVADS PM$_2$P Prog Rept, 2d Qtr FY 69. RHA Bx 14-7. (2) Hist Rept, CMO, FY 69, p. 11. HDF. (3) TECOM Rept, FAAR Presn to CG, AMC, 31 Jul 69. RHA Bx 14-8. (4) CHAP/FAAR Bfg to BG Edwin I. Donley, CG, MICOM, 26 Nov 69. RHA Bx 14-8. (5) CMO Rept, FAAR Tech Review as Presented to CG MICOM on 13 May 69, AMC Staff on 16 May 69, & DA Staff on 20 May 69. RHA Bx 14-8.

Inspection Equipment* (SAIE) under a companion contract to the APE effort. The SAIE program was plagued with late delivery of hardware and poor documentation, schematics, and instructional manuals. Overriding these problems was a quality control condition, particularly in the area of soldering. The acceptance of SAIE items proceeded very slowly and, since this equipment paced assembly of the first APE model, it had a significant impact on the production effort. Moreover, the quality of workmanship on some cable harnesses and printed circuit boards for the first APE model was unacceptable, requiring considerable rework and, in some cases, remanufacture. Although the contractor had begun to show marked improvement, delays caused by the manufacturing problems precluded the 15 May delivery date for the two APE models.[2]

(U) Because of unresolved technical problems and delays in the APE/SAIE program, MICOM issued a stop-work order against Sanders' production contract effective 25 July 1969. During the production hold, the contractor was to use no further overtime, employ no new personnel, and place no further orders with subcontractors for materials or services. No subcontracts, however, were to be terminated. The estimated cost of the stop-work order was $137,500 per month.[3] Sanders was finally paid $1,723,240 in standby costs in order to keep the production line and the engineering force intact, to insure retention of key production personnel, and to update and complete all production drawings in consonance with design changes made during the production hold.[4]

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*This industrial test equipment would be certified as a standard and used on the production line by the Defense Contract Administration Services (DCAS) inspectors. Its 20 stations would test and assure acceptable quality components and subsystems and, finally, the last station would check the entire system before offering the radar for sale to the Government. This sequence was necessary to meet full contractual requirements. Deliveries under the production contract were predicated on successful completion of the requirements of both the APE and SAIE contracts. The SAIE could not be fully accepted by the Government until the two APE units had successfully passed across the 20 stations, thus proving the pilot production line.

[2] *Ibid.*

[3] (1) Hist Rept, CMO, FY 70, p. 6. HDF. (2) CVADS PMP Prog Repts, 4th Qtr, FY 69, & 2d Qtr, FY 70. RHA Bx 14-7.

[4] (1) *Ibid.* (2) DOD Appns for 1973, Hearings Before Subcom of the Com on Appns, House of Representatives, 92d Congress, 2d Session, Part F - Proc, p. 108. HDF.

The Long Road to Recovery

(U) Efforts to establish specific hardware improvements for DA approval dominated the first half of FY 1970. Shortly after issuance of the production hold, agreement was reached with AMC on recommendations for hardware improvements. The CDC concurred in the recommendations; however, CONARC felt that more changes would be required for satisfactory radar elevation coverage. LTG Henry A. Miley, Jr., who had replaced LTG William B. Bunker as DCG of AMC, held a FAAR review, on 29 September 1969, to resolve this difference of opinion. Two basic approaches were considered:

1. Modification of the current model to permit performance under the usual field conditions, with wind velocities up to 32 knots, and limited compliance with the DA-approved QMR. These modifications were designed to correct all deficiencies uncovered during ET/ST except the antenna elevation coverage and drive and the RAID receiver difficulties.

2. All of the above modifications, plus a redesigned antenna and antenna drive system, and correction of the RAID receiver deficiencies. The resulting system would comply with the QMR as nearly as technically practical.

General Miley directed that an in-depth study be made by a team consisting of AMC, CDC, and CONARC representatives to determine if the current radar elevation coverage characteristics were sufficient to provide adequate alerting information to the air defense weapons.

(U) As a result of the in-depth study and discussions with ACSFOR, General Miley, on 4 November 1969, decided to continue the engineering services and related effort for a period of not more than 6 months at a cost not to exceed $2 million, for the purpose of completing acceptance tests of the two APE models by the end of January 1970. At that time, another review would be made to determine appropriate action concerning continuation of the program. He appointed Dr. Craig M. Crenshaw, Chief Scientist of AMC, as chairman of an Ad Hoc committee to accomplish an independent evaluation of a special FAAR demonstration test in January 1970 and make recommendations regarding the adequacy of the radar design and performance for the resumption of production. The committee consisted of members from AMC, CDC, CONARC, ECOM, MICOM, and Harry Diamond Laboratories.[5]

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[5](1) CHAP/FAAR Bfg for BG Edwin I. Donley, CG, MICOM, 26 Nov 69. RHA Bx 14-8. (2) CVADS PMP Prog Rept, 2d Qtr, FY 70. RHA Bx 14-7. (3) Hist Rept, CMO, FY 70, pp. 6-8. HDF.

(U) During the last 2 weeks of January 1970, APE model #1, with modifications to correct deficiencies observed in the service test, underwent a special demonstration test at Fort Bliss under the direction of Dr. Crenshaw's Ad Hoc committee. After an evaluation of the demonstration, the committee concluded that the radar, with design fixes, was very satisfactory and that its performance nearly met QMR requirements for volume coverage without degradation to the very low target (25-50 feet above terrain). However, a QMR waiver would be required on the elevation angle coverage. The committee recommended that limited production be undertaken for the purpose of ET/ST and training base requirements; that full production be delayed until completion of service tests; and that the production schedule allow sufficient flexibility for thorough quality engineering and documentation.[6]

(U) As a result of the above evaluation and a subsequent briefing to General Miley on costs and scheduling relating to the resumption of production, letters were sent to the Army Chief of Staff and the Chief of Research & Development, on 25 March 1970, indicating AMC's recommendations and CDC and CONARC concurrences therein. Included in the recommendations was a request for $21,051,000 of PEMA funds to permit resumption of limited production under the FY 1969 contract and continuance of the FAAR program through FY's 1970, 1971, and 1972. Of this amount, MICOM already had $1.2 million in previously authorized funds, plus an additional $2 million which could be reprogrammed for use in FY 1970, leaving a balance of $17,851,000 in new PEMA money for the FY 1970-72 period. In April 1970, MICOM received $4,122,000 in FY 1969 funds to support the production effort, along with $13,663,000 in FY 1970 funds to pay standby costs, start-up costs, and related effort in support of the FY 1969 production contract.

(U) Since the initial LP classification for FY 1969 procurement had expired on 31 October 1969, AMC requested a time extension for the previously approved LP quantities of 90 FAAR's, 935 RAID units, 57 OMTS's, and 24 Support Maintenance Test Sets (SMTS's)—formerly referred to as Field Maintenance Test Sets. ACSFOR extended the expiration date for these items to 10 October 1971.[7]

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[6](1) Rept of FAAR Ad Hoc Sp Eval Com, 3 Feb 70. Atchd as incl to AMCTCM 7903, Mtg No. 7-70. RSIC. (2) TECOM Hist Sum, FY 73, p. 31.

[7](1) Hist Rept, CMO, FY 70, pp. 8-9. HDF. (2) Ltr, DCG, AMC, to ACSFOR, 3 Apr 70, subj: Time Extension of LP-U for FAAR Sys, & 1st Ind, ACSFOR to CG, AMC, 10 Apr 70. Atchd as incl to AMCTCM 7903, Mtg No. 7-70. RSIC.

(U) With General Miley's approval, MICOM awarded Sanders two contracts, in April 1970, for FAAR pilot production engineering and production engineering services to update hard modifications on the two APE systems, which became known as Pilot Production Engineering (PPE) models. Contract DA-AH01-70-C-0997 was awarded on 11 April 1970, in the amount of $4,329,785, for production engineering services during the period April to December 1970. The period of performance was later extended to 1 June 1971, to permit completion of radar and SMTS tests, assembly of the SMTS and SAIE, support to the Physical Configuration Audit, and completion and validation of DA technical manuals. The additional manhours and funds needed to complete the effort increased the value of the contract by $2,771,738, from $4,329,785 to $7,101,523. The purpose of Contract DA-AH01-70-C-0996, awarded on 11 April 1970 for $1,268,778, was to continue the pilot production engineering tasks not completed under the APE contract (DA-AH01-68-C-1930). The final value of Contract C-0996, which expired in December 1970, was $1,329,627.[8]

(U) With the award of the pilot production engineering contract (C-0996), in April 1970, the original APE contract (C-1930) was set aside. Subsequent negotiations to close out the APE contract were characterized by claims and counterclaims between Sanders Associates and the Contracting Officer. Sanders claimed that all requirements of the contract had been met and filed a claim, in March 1970, for $4,157,000 based upon alleged constructive changes and late and unsuitable Government-furnished equipment. After a thorough review of the claim, the Contracting Officer advised the contractor, on 14 May 1971, that he was entitled only to $828,596. At the same time, the Contracting Officer filed a counterclaim asserting the Government's entitlement to payment of $1,682,660, because of Sanders' failure to complete all the effort required under the fixed-price contract. Sanders promptly appealed this decision. When a series of meetings between Sanders Associates and the MICOM legal staff failed to produce an agreement, the Commander of MICOM, in October 1971, directed that one final effort be made to reach a settlement, with limitations. These discussions resulted in a bilateral contract modification, whereby the Government withdrew its counterclaim for $1,682,660 and the APE contract price was

[8](1) Hist Rept, CMO, FY 70, p. 8. HDF. (2) Fact Sheet, CMO, 6 Jan 71, subj: Fact Sheet for CG AMC - Sta of FAAR Program as of 5 Feb 71. Atchd as incl to Ltr, LTC Monte J. Hatchett, Chf, CMO, to CG, AMC, undtd, subj: same. RHA Bx 14-8. (3) *Also see* CMO Contr File & MICOM Contr Listing, 1 Jul 72.

increased by $2,189,524, from $1,562,593 to $3,752,117. There was an additional amount of $24,341 for GFE items, raising the total APE project requirement to $3,776,458.[9]

(U) Meanwhile, the Contracting Officer, in conjunction with the CHAPARRAL Management Office, proceeded with efforts to reinstate the production contract amid mounting concern over the contractor's ability to produce a satisfactory product in a timely and cost effective manner. To minimize standby costs, the initial plan for resumption of production was predicated on the early production of seven radars to the APE #2 configuration. These seven radars, referred to as Block I units, were to be delivered by June 1971. They would be retrofitted to the APE #1 (Block II) configuration. Upon completion of the Configuration Audit Review (CAR) in January 1971, the new Engineering Release Record would be incorporated into the production contract, which would change the configuration to the APE #1 baseline, and Block II units (the remaining 83) would roll off the production line to the desired design. The test program and retrofit sequence were designed to support a tactical release of the system in early February 1972.[10]

(U) On 10 July 1970, Sanders submitted a proposal for the resumption of production by September at a cost of $11,194,773 over the FY 1969 contract price. The Contracting Officer rejected this quotation and requested new cost and delivery proposals, including a warranty provision regarding liability of the company for the correction of any design deficiencies which might show up in the end item.[11]

(U) A revised proposal for the full FY 1969 procurement program, submitted on 15 September, called for an additional cost of $12.9 million, some $1.7 million more than the previous quotation. An in-depth review of the proposal and the contractor's performance, including 3 weeks on site by a team of MICOM engineers and specialists, disclosed numerous deficiencies.

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[9](1) SS AMSMI-I-88-71, D/P&P, 24 Jun 71, subj: Trf of Sanders Associates Indebtedness Case to COA, w Ltr, DCG, MICOM, thru CG, AMC, to COA, 30 Jun 71, subj: Trf of Sanders Associates Indebtedness Case. (2) Ltr, DCG, MICOM, to CG, AMC, 7 Jul 71, subj: APE FAAR, FY 68 Pdn Base Proj No. 1681166 (CHAP/VULCAN), w 2d Ind, same to same, Oct 71. All in HDF.

[10]CHAP/FAAR Bfg for GEN Guthrie, 28 May 70. RHA Bx 14-8.

[11]Ltr, W. L. Armstrong, Contr Off, to Sanders Associates, Inc., 30 Jul 70, n.s. HDF.

Labor rates were overstated and material quotes were filled with errors, overstatements, and omissions. Direct labor and engineering labor were overstated. The preliminary manufacturing layout had not been updated. The contract required Sanders to analyze the impact of changes on the manufacturing plan and tooling, and to update the plans and designs accordingly. Neither of these actions had been accomplished. Management within the contractor's plant operated without discipline, leading to a lack of production control.[12]

(U) The magnitude of management deficiencies within the contractor's plant had been brought to the attention of the CHAPARRAL Management Office some 3 months earlier. In a report to LTC Monte J. Hatchett, who had replaced Colonel Steenburn as chief of the office in December 1969, 1LT Algis Lapsys noted that a great portion of the difficulties being encountered in the program stemmed from the fragmented management structure and a lack of coordination. There were basically two chains of command: the Program Management Office and the Engineering Section—neither directly responsible to either, only to the front office. The Program Management Office was only superficially informed of what the Engineering Section was doing and spent a great deal of time generating schedules that were not met, manhour breakouts that were untimely, and reports that were not truly representative of actual accomplishments.

(U) There was also a noticeable lack of a well-functioning systems engineering effort. The tendency was to approach problem areas on a piecemeal basis with minimal investigation into the overall impact on the system. Many of the component designs were of an evolutionary nature. The R&D components were not systematically redesigned, but, rather, a series of individual fixes were incorporated. As the program progressed, it became more and more difficult to incorporate changes necessary to a clean design. At no point was the total system viewed as an entity, only as a collection of components. The standard answers to these recriminations were schedule, cost, and MICOM direction. System engineering inexperience, company policy of unrealistically stringent budget control, and a lack of coordination were never cited or recognized as reasons for poor system performance.[13]

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[12] (1) Fact Sheet, D/P&P, 6 Jan 71, subj: Fact Sheet on FAAR for GEN Miley. (2) CVADS PM Prog Rept for Nov 70. Both in RHA Bx 14-8.

[13] DF, 1LT Algis Lapsys to LTC [Monte J.] Hatchett, 15 Jun 70, subj: Gen Perf & Manpower Utilization. HDF.

(U) In view of the continuing technical problems, schedule slippages, and price escalations, contingency plans were drawn up for termination of Sanders' contracts and proceeding on a competitive basis. In this connection, MICOM made arrangements in October 1970 for comparison tests of the FAAR PPE model #2 and a similar radar produced by Westinghouse, so that an alternate system would be available if the FAAR should prove to be unsatisfactory from a performance and/or production standpoint.[14] In the meantime, negotiations for resumption of production were continued and a team of MICOM engineers and specialists was permanently stationed at the contractor's plant to monitor progress and assist in solutions to longstanding deficiencies.

(U) Acceptance tests of PPE #2 began at the contractor's plant on 15 October and continued until 21 November 1970, when the unit was shipped to Fort Bliss for Pre-Production Tests (PPT's) which began on 23 November. The purpose of the PPT's was to assure engineers and test personnel that the system was ready for engineering and service test. This program, completed in mid-December 1970, consisted of 622 F-100 aircraft and 57 H-23 helicopter passes, with TECOM providing support. All performance parameters evaluated reportedly met or exceeded the QMR. A fix for a noise problem with the Stable Master Oscillator (STAMO) at low temperatures was incorporated in the system and it was turned over to TECOM on 23 December for engineering tests at WSMR. TECOM completed low temperature, high temperature, and humidity tests of PPE #2 on 10 February 1971. The radar was then remounted on the Gama Goat vehicle and moved back to Fort Bliss, where service tests began on 10 February.

(U) Sanders conducted engineering design tests on PPE #1 using most of the acceptance test procedures. Progress on this unit was slower than on PPE #2, because problems had to be isolated and corrected before proceeding. The system had 31 of the 40 fixes found in testing PPE #2. MICOM and DCAS personnel completed the Configuration Audit Review of PPE #1 at the factory in March 1971. On 5 April, the unit arrived at WSMR for use in the remainder of the engineering tests, while service tests continued on PPE #2.[15]

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[14] (1) Ltr, Chf, CMO, to CG, TECOM, 22 Oct 70, subj: Req for Test Spt. HDF. (2) CVADS PM Prog Rept for Nov 70. RHA Bx 14-8.

[15] (1) Fact Sheet, CMO, 6 Jan 71, subj: Fact Sheet for CG AMC - Sta of FAAR Program as of 5 Feb 71. Atchd as incl to Ltr, LTC Monte J. Hatchett, Chf, CMO, to CG, AMC, undtd, subj: same. RHA Bx 14-8. (2) CVADS PM Prog Repts, Nov 70 - Apr 71. RHA Bx 14-8. (3) FAAR Sta Bfg for HQ AMC Comd Gp, 17-18 Mar 71. RHA Bx 14-8.

Resumption of Production

(U) The negotiations between MICOM and Sanders regarding the resumption of production were completed in March 1971. Since $8,843,355 of the original contract price ($14,196,750) had already been spent when the stop-work order was issued, the cost subject to negotiation was the additional amount needed to complete the programmed procurement. Including this so-called "sunk" cost, Sanders' quotation of 15 September 1970 had totaled $24,091,436 (including a profit of $2,585,788), with a ceiling price of $27,527,229. The negotiated price was $22,150,000 (including a profit of $2,150,000), with a ceiling price of $24,400,000.* The final agreement removed the positive delivery incentive from the basic contract and included a design deficiency liability clause.[16] In addition to the negotiated contract price, there were four other items totaling $2,794,873. Among these was a negotiated standby cost of $1,723,240 which was paid to Sanders during the production hold.[17]

(U) On 17-18 March 1971, MICOM briefed the AMC Command Group on the results of the contract negotiation and the status of the FAAR program. Based on the satisfactory results of the initial

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*In the end, however, the reductions realized from the prolonged negotiations were eroded by a stretchout of early production deliveries, cost overruns, and inflation. The final value of Contract C-0749 was $27,576,889. MICOM Contr Listing, 1 Oct 73. HDF.

[16](1) *Ibid.* (2) The design deficiency clause stated that the drawings must reflect hardware capable of meeting all performance and technical requirements. If testing should establish that the requirements were not met, the Contracting Officer would declare that the resultant Engineering Change Proposal (ECP) was applicable to the design deficiency clause. The cost and extent of the deficiency would be negotiated at a later date. Essentially, the clause established a maximum pool of $1.2 million for design deficiency costs which the Government and contractor would share on a 35-65 basis—35% for the Government and 65% for the contractor. Mathematically, this set a $780,000 ceiling on the design deficiency liability to the contractor. There would be no profit on payments or cost increases of design deficiency origin. By March 1972, the Contracting Officer had established 15 design deficiency ECP's at a cost of $176,467. DOD Appns for 1973, Hearings Before Subcom of the Com on Appns, House of Representatives, 92d Congress, 2d Session, Part F - Proc, p. 108. HDF.

[17]FAAR Sta Bfg for HQ AMC Comd Gp, 17-18 Mar 71. RHA Bx 14-8.

engineering tests and the Configuration Audit Review, it was recommended that the stop-work order be lifted for the resumption of production of the first 90 radar units on 1 April 1971. Assuming approval of this recommendation, the revised schedule would provide for completion of service tests in July 1971, delivery of the first two production units in November 1971, Initial Production Tests (IPT's) in December 1971, release for training in February 1972, and the tactical release in March 1972.[18]

(U) On 25 March 1971, the Commanding General of AMC held a general officer review of the FAAR program to decide if the system, as then designed, was suitable for Army use. Participating in the review were representatives of ACSFOR, DCSLOG, OCRD, CDC, CONARC, and AMC. It was the general consensus that adequate testing had not been completed to prove the suitability of the system. LTG (later GEN) Henry A. Miley, Jr., who had taken over as Commander of AMC on 1 November 1970, directed that MICOM determine the cost of delaying production for 90 days (from 1 April to 30 June) to complete additional testing.

(U) Because of the relatively high cost of delaying production, General Miley decided to resume production on a limited schedule, whereby early deliveries would be cut in half and the contractor would hold the number of personnel and procurement of material to an absolute minimum. Specifically, the revised schedule would provide the Army with 17 FAAR systems in the first 6 months of delivery, as opposed to the 35 systems called for in the recent contract negotiations. The additional cost incurred by this stretchout of early deliveries was $895,000, plus a profit of 10.75 percent.

(U) Modification No. 32 to Contract C-0749, signed on 1 April 1971, rescinded the stop-work order and authorized the resumption of production, with the first two radars scheduled for delivery in November 1971.[19] Sanders also received a $1,981,255 contract (DA-AH01-71-C-0973) for FY 1971 engineering services, and another for $139,397 covering instructor and key personnel training courses (DA-AH01-71-C-1492). The final value of these contracts was $2,229,654 for C-0973 and $153,169 for C-1492.[20]

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[18] *Ibid.*

[19] (1) CVADS PM Prog Repts, Mar & Apr 71. RHA Bx 14-8. (2) AMC Hist Sum, FY 71, pp. 88-89. (3) *Also see* Data on Contr C-0749 in CMO Contr Files.

[20] (1) MICOM Contr Listing, 1 Jul 72. HDF. (2) *Also see* CMO Contr Files.

(U) The resumption of production in April 1971 proved to be as premature as the decision to initiate production in November 1968. During the FY 1972 budget hearings, in the spring of 1971, Army witnesses had assured the House Appropriations Committee that "all problems encountered during testing have been corrected * * * all technical problems which stopped production of the FAAR have been resolved and production has been resumed as of April 1971." A year later, in March 1972, Army staff officials went before the same committee to justify $1.6 million in FY 1973 PEMA funds to cover the cost of modification kits needed to correct major deficiencies in the initial FY 1969 buy of radars. In the course of the hearings, which one MICOM official called the "gory details of the March [1972] testimony regarding FAAR," they conceded that "the decision to produce [in November 1968], obviously, in retrospect, was not correct. There were certain things and had we known about them we would have made additional changes before initiating the production decision. . . ." They also conceded that the decision to resume production was wrong: "Basically we weren't ready to go because the number of deficiencies that came up in the initial production testing demonstrated additional deficiencies."[21]

The PPE Test Program

(U) At the time of the go-ahead on production, in April 1971, the items which had been considered problem areas before were thought to be solved from an engineering standpoint. These items were then placed in the documentation and applied to the initial production units scheduled for delivery in November 1971.[22] Engineering and service tests of the two PPE units, completed in September 1971, disclosed 18 deficiencies and 46 shortcomings which rendered the FAAR system unsuitable for Army use.

(U) The Air Defense Board reported 15 deficiencies in service test (ST) of the PPE unit, and other agencies of TECOM reported 3 deficiencies in the engineering test (ET). To insure that both user and engineering viewpoints had been considered, TECOM conducted a thorough analysis of both test reports. The deficiencies were either approved, consolidated with similar findings, reclassified, or declassified. As a result, TECOM reported a total of

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[21] DOD Appns for 1973, Hearings Before Subcom of the Com on Appns, House of Representatives, 92d Congress, 2d Session, Part F - Proc, pp. 102, 105, 107.

[22] *Ibid.*, p. 103.

6 deficiencies requiring correction (these including a consolidation of the 3 ET and 7 of the 15 ST deficiencies). The remaining eight ST deficiencies* were either corrected by redesign, reclassified as a shortcoming,** or removed as a deficiency. The six deficiencies requiring correction were as follows:[23]

1. Changing the FAAR system mode switch from radiate to passive, or vice versa, caused extraneous/erroneous friend-and-foe symbols to be displayed on the radar scope and Target Alerting Data Display System (previously referred to as the Rapid Alerting and Identification Display—RAID), confusing the operator as to the validity of the presented symbol.

2. The Target Alerting Data Display System (TADDS) was deficient in three respects: its battery was unable to operate for the required number of hours without recharging; it was inoperable at low temperature extremes; and many of the indicator dots stuck in either the red (foe) or green (friend) position, giving the crew an incorrect identify of the target.

3. The system was unable to provide alerting data to the TADDS within the prescribed time after target detection.

4. The technical manuals and repair parts provided with the

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*A deficiency is a defect or malfunction discovered during the life cycle of an equipment that constitutes a safety hazard to personnel; will result in serious damage to the equipment if operation is continued; or indicates improper design or other cause of failure of an item or part, which seriously impairs the equipment's operational capability. A deficiency normally disables or immobilizes the equipment, and if occurring during the test phases, will serve as a bar to type classification action. AR 310-25, Jun 72.

**A shortcoming is an imperfection or malfunction occurring during the life cycle of equipment, which should be reported and which must be corrected to increase efficiency and to render the equipment completely serviceable. It will not cause an immediate breakdown, jeopardize safe operation, or materially reduce the useability of the materiel or end product. If occurring during test phases, the shortcoming should be corrected if it can be done without unduly complicating the item or inducing another undesirable characteristic, such as increased cost, weight, etc. AR 310-25, Jun 72.

[23](1) *Ibid.*, pp. 108-110. (2) TECOM Hist Sum, FY 73, p. 31.

maintenance test package were not adequate for proper operation and maintenance.

5. The mean-time-between-failure requirement was not met.

6. The M561 Gama Goat vehicle failed to meet the mobility reliability requirement for the FAAR to keep pace with the supported air defense units.

(U) As stated earlier, the M561 vehicle was a new item developed by Ling-Temco Vought and produced by the Consolidated Diesel Electric Company under contracts with the Tank-Automotive Command (TACOM).[24] Initial Production Tests (IPT's) of the M561 Gama Goat, conducted by TECOM in FY 1971, disclosed numerous deficiencies requiring hardware changes. After the installation of fixes to eliminate these problems, the vehicle was subjected to further tests, and production was allowed to continue.[25] During road tests of the FAAR system, completed in September 1971, 76 Equipment Performance Reports were submitted, almost 75 percent of which were on the Gama Goat vehicle or the M101 trailer. Deficiencies in the Gama Goat involved the transmission, suspension, and axle shafts. Testing was conducted using the pilot production vehicles, and the deficiencies that occurred in the FAAR road tests also occurred during the above mentioned IPT's of the vehicle. Fixes for the problem areas were retrofitted to the vehicles that were supplied to Sanders for initial production units of the FAAR system.[26]

(U) Of the 46 shortcomings noted in the PPE units, the one of prime concern stemmed from the extreme sensitivity of the radar which caused it to display false images on the scope; i.e., targets that were outside the normal range were actually picked up and displayed as if they were actual targets at about half the range. This ambiguity problem was first discovered in engineering tests of the PPE unit, and corrective action was taken before the service tests began. It was later listed as a shortcoming in both test reports. Although the problem did not render the radar inoperable, it was confusing to the operator. Consequently, the automatic ambiguity modification was developed and funds were requested for procurement of modification kits. At the time of the decision to

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[24] *See* above, pp. 136-37, 144.

[25] TACOM Hist Sum, FY 71, pp. 198-201.

[26] TT, CG, MICOM, to CG, AMC, 16 Sep 71, subj: Weekly FAAR Sta Rept. HDF.

apply this modification, no production FAAR's had been accepted by the Army, but component hardware procurement was essentially complete and assembly was well underway. This left the Army with two possible courses of action. It could stop production for the second time and cut in the modification, or it could continue production and make the necessary modification afterwards. Having determined that the latter course of action would be more cost effective, the Army requested $1.6 million in FY 1973 PEMA funds to cover the cost of modification kits.[27]

Initial Production Tests

(U) Initial Production Tests (IPT's) of the FAAR started in December 1971 and continued through July 1972. Only two of the four production units scheduled for delivery in November and December 1971 were accepted. One of these was allocated for use by the ET agency at WSMR and the other by the ST agency at Fort Bliss. The maintainability demonstration began on 3 January and was completed on 28 January 1972.

(U) Because of continuing production problems and delays, only two of the seven radars scheduled for delivery during the first quarter of CY 1972 were accepted. Production radars 3003 and 3004 were accepted in February 1972. Sanders used radar 3003 for new equipment training and radar 3004 was delivered to the Air Defense Board for use in IPT's.

(U) The fifth production unit (radar 3005) was retained by Sanders for maintenance evaluation. The last three production test units (3006, 3007, and 3008) were accepted by the Government on 28 April 1972. MICOM used radar 3006 for the Configuration Item Verification Review (CIVR), and radars 3007 and 3008 were shipped to Fort Riley, Kansas, for use in Phase I of the Intensified Confirmatory Troop Test (ICTT). Phases II and III of the ICTT were to be conducted at Fort Bliss in conjunction with training of the first FAAR platoon. The DA decision to deploy the FAAR system would be based on the results of the ICTT program to be completed in the summer of 1972.[28]

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[27] DOD Appns for 1973, Hearings Before Subcom of the Com on Appns, House of Representatives, 92d Congress, 2d Session, Part F - Proc, pp. 102, 105-106, 108. HDF.

[28] (1) Hist Rept, CHAP SIMO, FY 72, pp. 4-5. HDF. (2) TECOM Hist Sum, FY 73, p. 31.

(U) In June 1972, the IPT units initially provided the ET/ST agencies were replaced by two systems which had been updated to correct a number of deficiencies and shortcomings. Tests of the later samples were completed in August 1972. Modifications were then made to correct the remaining deficiencies and the Air Defense Board evaluated the units during October 1972.[29] Meanwhile, the first three FAAR platoons were activated (one on 21 August, one on 18 September, and one on 16 October 1972), and the ICTT program was completed.[30]

(C) The IPT report, issued in October 1972, indicated that the FAAR system demonstrated the ability to detect low flying targets in high clutter environments and to provide the required alert of approaching targets. Engineering changes to correct all but two of the operational problems observed in the production system were evaluated and found to be adequate. The maintenance test package reflecting the equipment configuration being delivered from production would require revisions to accommodate the changes incorporated in the latest test sample. The FAAR system met 110 of 145 test requirements. Sixteen deficiencies and 29 shortcomings were reported; however, after analysis and appropriate reclassification, three deficiencies and eight shortcomings remained. The deficiencies were as follows:

1. (U) During normal operation at elevated shelter temperatures (95°F.), operation of the IFF receiver, IFF transmitter, and radar control lamps indicated that the system was malfunctioning. This problem was traced to the AN/TPX-50 (IFF) self-check circuitry; however, no corrective action was found.

2. (C) The continuous keying of the AN/VRC-46 transmitter (1.5-second intervals) induced early failure of the transmitter keying relay which was the major contributor to the low (192-hour) mean-time-between-failure. The expected MTBF for the AN/VRC-46 was 1,000 hours. An engineering change to eliminate the problem was programmed for installation in a test system in November 1972.

3. (U) The system could not be adequately maintained with the maintenance test package provided with the system tested. The technical manuals had numerous errors, and procedures required for system maintenance were missing. A spare parts package was not provided for the test. The technical manuals were completely revised and were in the process of being validated.

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[29] *Ibid.*, pp. 31-32.

[30] Hist Rept, ADSIMO, FY 73, p. 1. HDF.

(U) The Army Test & Evaluation Command recommended that the remaining deficiencies and as many of the shortcomings as feasible be corrected, and that the engineering changes incorporated in the latest test system be installed in the FAAR system. Upon completion of these actions, the FAAR system would meet the requirements for field use.[31]

Type Classification

(U) On 9 November 1972, a Pre-Production Validation IPR was conducted to review and evaluate the FAAR system for classification as standard, initiation of full-scale production, and release for deployment. Considering the latest test results, members of the review team recommended that the FAAR system, less the AN/TSM-126 electronic shop, be approved for classification as standard, that follow-on production be authorized, and that the system be deployed. They felt that the electronic shop should be released by a separate action.

(U) At the FAAR Production Validation IPR, held at MICOM on 14 December 1972, the majority of the participants recommended that the system be deployed and that it be classified as standard. The CDC representative nonconcurred in this position, recommending that type classification be deferred. AMC recommended to DA that the majority position be followed.[32]

(U) On 5 February 1973, the Acting Chief of Research & Development type classified the FAAR system as Standard A and authorized the continued fielding of the system. (The first two platoons had been deployed in December 1972.) The decision regarding the second production buy was held in abeyance pending a review addressing risk, cost, scheduling, and urgency of the requirement. Also, limited production authority for 19 AN/TSM-126 electronic shops to support the IFF set was extended to 30 June 1973.[33] The standard FAAR system consisted of the following items.[34]

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[31] TECOM Hist Sum, FY 73, p. 32.

[32] Hist Rept, ADSIMO, FY 73, pp. 1-2. HDF.

[33] Ltr, Act CRD, DA, to Cdr, AMC, *et al.*, 5 Feb 73, subj: PV IPR for the FAAR Sys - USA Pos, 14 Dec 72. CMO Files.

[34] AMCTCM, unnumbered & undated, subj: FAAR Sys TCLAS Std. CMO Files.

1. Radar Set, AN/MPQ-49 (XO-1), mounted on the M561 Gama Goat vehicle and M101 trailer. (The interim AN/MPQ-49 [XO-2], mounted on the M35A2 vehicle, was not fielded.)

2. Display Set, Target Alert Data (TADDS), AN/GSQ-137 (XO-2). This unit was originally referred to as the Rapid Alerting and Identification Display (RAID).

3. Test Set, Organizational Maintenance (OMTS), Radar, AN/MPM-59 (XO-1). This was a special portable test set for maintenance of the AN/MPQ-49 radar at the organizational level.

4. Test Set, Support Maintenance (SMTS), Radar, AN/MPM-57 (XO-2). This was a special test set contained in a shelter and transported by the M35A2 vehicle for use at direct support (DS) and general support (GS) levels. It was originally known as the Field Maintenance Test Set (FMTS).

5. Tool Kit, Radar, Organizational Maintenance.

6. Tool Kit, Radar, DS/GS Maintenance.

7. Radar Maintenance Shop Supplemental Equipment, DS/GS Maintenance.

Tropic and Arctic Tests

(U) The FAAR tropic test commenced on 15 June 1973, when the equipment was placed in storage at Fort Clayton, Panama Canal Zone. The operational phase of the test began in September, and was successfully completed in December 1973.

(U) Arctic test of the FAAR system was originally planned for January 1975; however, it was rescheduled for January 1976 because of funding problems.[35]

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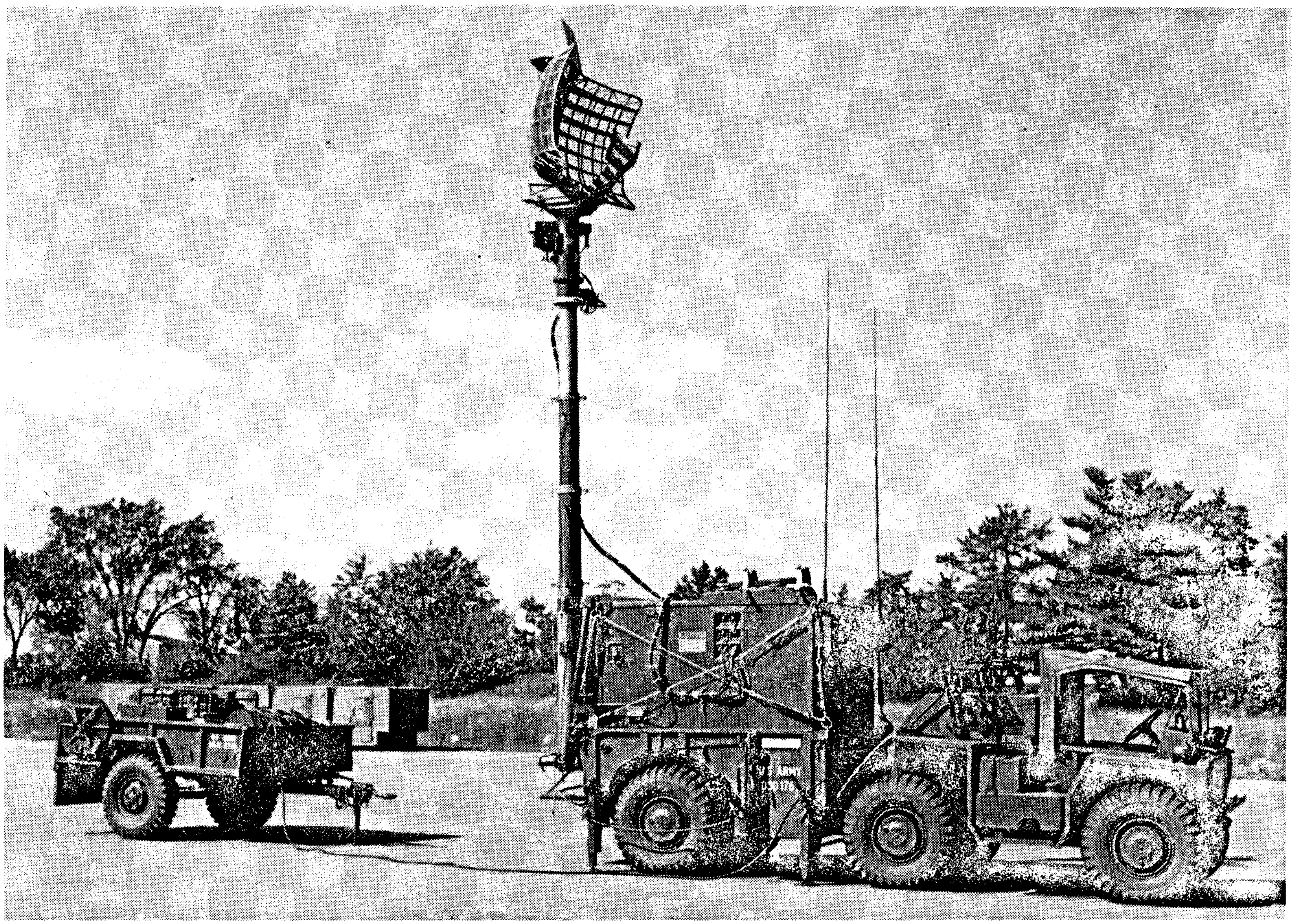
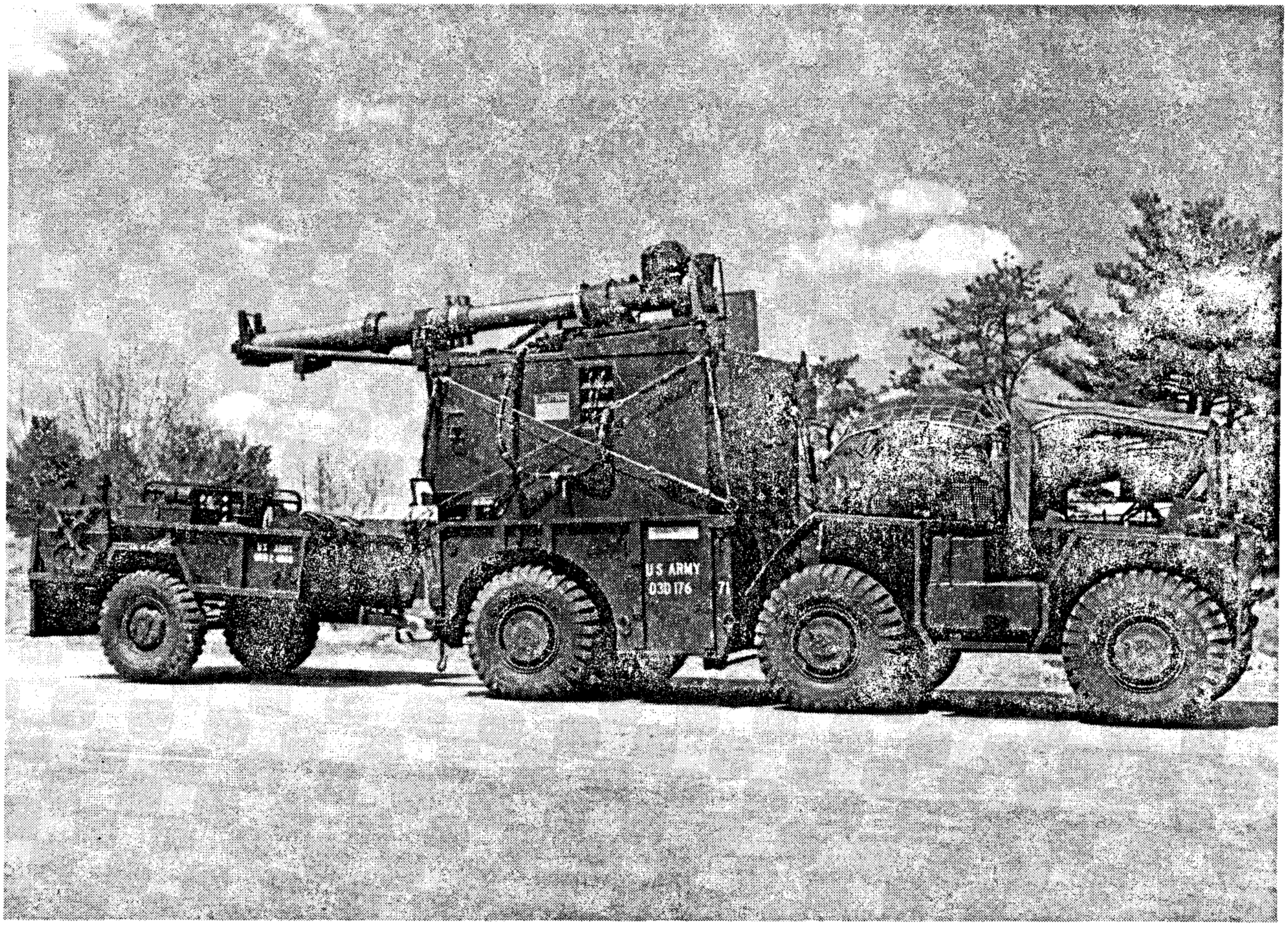
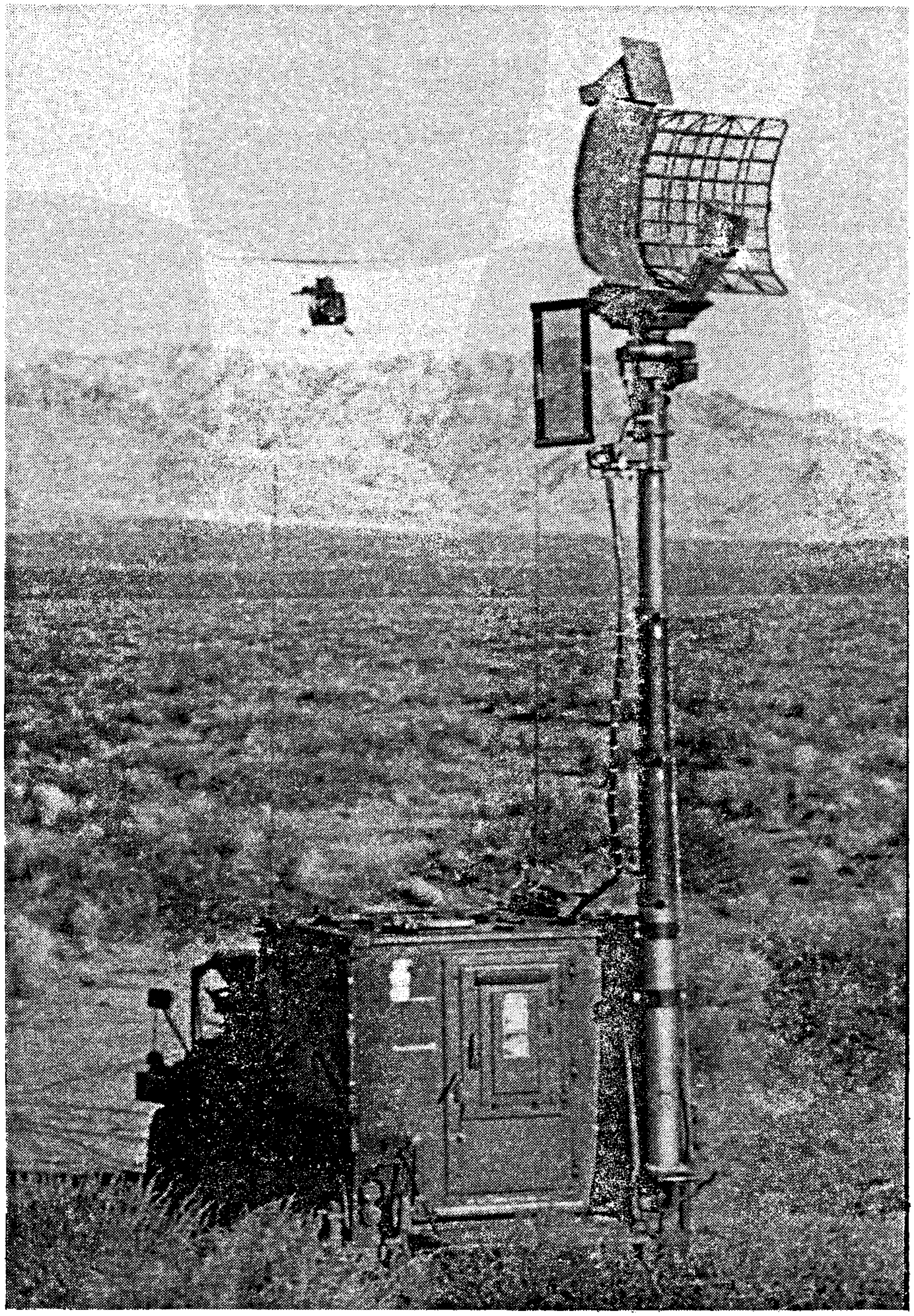
[35](1) Hist Rept, ADSIMO, FY 73, p. 3. (2) Hist Rept, SSMO, FY 74, p. 4. Both in HDF.



The Standard FAAR System Mounted on the M561 Gama Goat and M101 Trailer



The FAAR System in Travel Position



The FAAR System in Action

CHAPTER XI

(U) PRODUCTION SUMMARY (U)

First Buy

(U) Sanders Associates completed production and delivery of the first FAAR buy in May 1973. The major items produced under Contract C-0749 included 90 radar sets, 935 TADDS, 50 OMTS, and 21 SMTS. Teams from the Letterkenny Army Depot completed the Block I modifications on all tactically deployed FAAR units between July 1973 and April 1974. These modifications included the fixes necessary to eliminate deficiencies found during initial production testing.[1]

(U) Because of the technical problems and delays encountered in the transition from development to production and the numerous engineering changes necessary to correct design deficiencies, the contract cost of the initial buy increased from $14,196,750 to $27,576,889.[2] Other contracts with Sanders (for engineering services, pilot production, training, repair parts, modification kits, and system rework and retrofit) totaled $44.6 million. Sanders also received a $7 million engineering services contract for support of the second FAAR production by another contractor. (*See* Table 10.) The items of Government-furnished equipment and the supporting agencies having logistic responsibility therefor were as follows:[3]

<u>Tank-Automotive Command</u>
- M561 Vehicle (Gama Goat)
- M101A2 Trailer
- 5-KW Generator

<u>Mobility Equipment Command</u>
- Air Conditioners

<u>Electronics Command</u>
- S-250 Shelter
- AN/VRC-46 Radio
- AN/TPX-50 IFF
- CX-722 & CS-4723 Cables
- AM-1780/VRC Audio Amplifier
- C2298/VRC Intercom Control
- H-161 Headset
- LS-454 Loud Speaker

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[1](1) Hist Rept, ADSIMO, FY 73, p. 2. (2) Hist Rept, SSMO, FY 74, p. 4. Both in HDF. (3) FAAR Fact Book. CMO Files.

[2]*See* above, p. 158.

[3]AMCTCM, unnumbered & undtd, subj: FAAR Sys TCLAS Std. CMO Files.

TABLE 10—(U) Major FAAR Contracts With Sanders Associates

CONTRACT NUMBER	DATE	COMMODITY OR SERVICE	TOTAL VALUE
RDTE			
DA-01-021-AMC-15008	May 66	Initial Dev + 1 EM, 4 Prots, & Test Sets	$ 5,457,638
DA-AH01-67-C-0039	Aug 66	Special Study, ECM Threat	46,601
DA-AH01-69-C-1136	Feb 69	Continued FAAR R&D	997,450
			$ 6,501,689
PEMA			
DA-AH01-68-C-1930	Apr 68	Adv Pdn Engrg + 2 Systems & Pilot Line	$ 3,752,117
DA-AH01-69-C-0275	Aug 68	Instr/Key Pers Tng Courses	69,150
DA-AH01-69-C-0749	Nov 68	Initial FAAR Pdn & Test Equipment	27,576,889
DA-AH01-69-C-0977	Dec 68	FAAR Technical Manuals	511,577
DA-AH01-69-A-0017	Jan 69	Repair Parts (Long Leadtime Spares)	1,565,386
DA-AH01-69-A-0039	Jan 69	Repair and Modifications	18,127
DA-AH01-69-C-1241	Feb 69	Engrg Services to Support Production	2,857,996
DA-AH01-69-C-1262	Feb 69	Additional Spares	14,210
DA-AH01-69-C-1333	Mar 69	Sp Acceptance Insp Equipment (SAIE)	928,447
DA-AH01-70-A-0041	Jan 70	FAAR Repair/Retrofit (Fab of Mod Kits)	148,340
DA-AH01-70-C-0876	Mar 70	FAAR Engineering Services FY 1970	483,184
DA-AH01-70-C-0996	Apr 70	FAAR Pilot Pdn Engineering (PPE)	1,329,653
DA-AH01-70-C-0997	Apr 70	FAAR Production Engineering Services	7,101,523
DA-AH01-71-A-0022	Jan 71	Repair and Rebuild	127,521
DA-AH01-71-C-0973	Apr 71	Engineering Services FY 1971	2,229,654
DA-AH01-71-C-1492	Jun 71	Instr/Key Pers Training Courses	153,169
DA-AH01-72-C-0259	Oct 71	Engineering Services	10,523,489
DA-AH01-72-A-0001	Oct 71	Repair Parts/Spares	5,655,958
DA-AH01-72-A-0012	Feb 72	Rep Parts for Mod Kit (Rework/Retrofit)	1,727,985
DA-AH01-73-A-0004	Oct 72	Repair Parts	5,286,541
DA-AH01-74-A-0003	Sep 73	Fabrication of Modification Kits	40,615
DA-AH01-74-A-0001	Oct 73	Repair Parts	84,876
DA-AH01-74-C-0934	Jun 74	Engrg Services in Spt of 2d FAAR Pdn	7,080,072
			$79,266,479

SOURCE: MICOM Contract Listings, 1 Jul 72 - 1 Jan 74, & CMO Contract Files.

Second Buy

(U) As stated earlier, the FAAR system was classified as standard on 5 February 1973, but the decision regarding the second production buy was held in abeyance pending a review of the risk, cost, scheduling, and urgency of the requirement.[4] While recognizing the urgent need for an alerting radar to support the CHAPARRAL/VULCAN battalions, the Army Vice Chief of Staff felt that such need could not justify the procurement of an item that continued to have reliability and maintainability problems, especially when the user questioned the utility of one of its components (the TADDS). Therefore, before contracting for the second buy, the Army would have to have positive assurance that the total system could satisfactorily perform its prescribed mission, that the maintainability and reliability were acceptable to the user, and that the contractor could meet quality control, cost, and delivery requirements. Moreover, it was essential that sufficient testing be completed to insure suitability of the system from the user's standpoint. When these requirements were met, they were to be verified by a formal IPR and presented to DA for approval of the second production release.[5]

Program Cost Estimates

(U) In August 1972, the Commander of AMC informed MICOM that the second FAAR procurement would be competitive unless the urgency of the requirement was such that a sole source buy from Sanders was necessary.[6] Initial planning and budget estimates had been predicated on sole source procurement with deliveries from the second buy butting the first buy deliveries. At the behest of AMC, MICOM, in January 1973, issued a revised study of FAAR cost estimates associated with two alternate quantities of hardware procured sole source from Sanders and competitively from a new producer. The study included two options with each alternate quantity; viz., Option 1 - with a production gap and Option 2 - without a production gap. Alternate A covered the total program quantity, while Alternate B covered the total program with TADDS units for REDEYE sections only. Consideration

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[4]*See* above, p. 165.

[5]Ltr, GEN Bruce Palmer, Jr., VCSA, to GEN Henry A. Miley, Jr., 4(?) Jul 72, n.s. Atchd as incl to Ltr, CG, AMC, to CG, MICOM, 1 Aug 72, subj: FAAR Second Buy. CMO Files.

[6]*Ibid.*

of the alternate quantities was necessary because of funding constraints. The breakout of funds in the April 1972 Army Materiel Plan showed $25.1 million for hardware, $700,000 for proofing and testing, $900,000 for Government engineering, and $3.6 million for contractor engineering. Not included in this breakout was an additional $2 million which had been provided, bringing the total program to $32.3 million. The cost estimates (in millions) were as follows.[7]

	Alternate A		Alternate B	
Quantities	Opt 1	Opt 2	Opt 1	Opt 2
Radar	86	86	86	86
TADDS	1,621	1,621	568	568
SMTS	13	13	13	13
OMTS	30	30	30	30
COMPETITIVE				
Total Hardware Price	$24.27	$23.89	$20.02	$19.64
Contr Engrg Services	7.72	6.63	7.05	5.43
In-House Support & GFE	3.59	3.11	3.27	2.78
Total Program	$35.58	$33.63	$30.34	$27.85
SOLE SOURCE				
Total Hardware Price	$26.99	$26.93	$21.71	$21.64
Contr Engrg Services	5.39	4.93	3.99	3.48
In-House Support & GFE	2.25	2.14	1.94	1.83
Total Program	$34.63	$34.00	$27.64	$26.95

Production Decision Review

(U) On 14 February 1973, the FAAR Production Decision Review was held at AMC Headquarters, with participants from AMC, CDC, CONARC, MICOM, and the Logistics, Doctrine, Systems, & Readiness Agency (LDSRA). Since hardware from the first production would equip the training base and high priority unit deployments, the user stated that there was no urgency associated with the second procurement which should compel the Army to accept an unusual or excessive risk. It was agreed that the required materiel for equipping CHAPARRAL/VULCAN battalions and REDEYE sections (Alternate B) could be procured within available funding and fielded on a schedule consistent with the urgency of the program

[7] (1) MICOM Rept, 4 Jan 73, subj: FAAR Cost Study. (2) Ltr, COL Donald H. Steenburn, Mgr, ADSI, to Cdr, AMC, 15 Dec 72, subj: Cost Alternatives to the FY 72 FAAR Program. Both in CMO Files.

at a reasonable level of risk. The risks involved had been substantially reduced by modifications to correct the deficiencies identified during initial production tests. These modifications, together with updated support requirements, would be subjected to tests before delivery to the field. In addition, field experience with deployed hardware would be available before the start of second production. The review committee recommended that DA provide AMC with an early decision regarding second procurement of the FAAR system. During negotiations, hardware quantities would be adjusted to coincide with available funds.[8]

(C) Seven months later, in September 1973, MICOM received orders to proceed with actions leading to award of the second buy production contract in April 1974. DCSLOG released FY 1973 funds in the amount of $28 million for hardware procurement; however, before award of the contract, the results of a special Operational Test & Evaluation (OTE) were to be submitted for review by the Deputy Director (Test & Evaluation), Office of the Secretary of Defense. Other constraints to be satisfied before award of the contract included assurance that the Block I modifications corrected the problems they were designed to remedy and that the mean-time-between-failure and reliability achieved the values predicted at the December 1972 IPR. The items to be procured included 86 radars, 568 TADDS, 10 SMTS, and 25 OMTS. The number of TADDS units did not include REDEYE team requirements; however, if costs from the requests for quotation permitted, the full quantity of 1,621 was to be procured.[9]

(FOUO) The delay in guidance from higher headquarters led to an escalation in estimated program costs. The cost study of 4 January 1973 had been based upon a contract award date of June 1973, whereas the DA guidance called for an award date of April 1974. This 10-month delay increased the estimated cost for Alternate B Option 2 (competitive) by $4,609,000, from $27,850,000 to $32,457,000. An additional 9-month stretchout in completion of production deliveries created another potential funding shortage of $3,389,000, increasing the total program cost by $7,998,000,

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[8] FAAR Pdn Decn Review, 14 Feb 73. Atchd to TT, Cdr, AMC, to Cdr, MICOM, 8 Feb 73, subj: FAAR Pdn Decn Review, 14 Feb 73, 0830 Hrs. CMO Files.

[9] (1) TT, Cdr, AMC, to Cdr, MICOM, 14 Sep 73, subj: FAAR Second Proc. (2) Ltr, DCSLOG, DA, to Cdr, AMC, 24 Sep 73, subj: FAAR Proc, w 1st Ind, Cdr, AMC, to Cdr, MICOM, 1 Oct 73. (3) Ltr, DCSLOG, DA, to Cdr, AMC, 1 Oct 73, subj: FY 72 & 73 Msl Proc Programs. All in CMO Files.

from $27,850,000 to $35,846,000. Added to this cost estimate was $248,000 for the procurement of 62 battery chargers to be placed in the SMTS to recharge TADDS batteries. The need for this item had been emphasized during the December 1972 IPR.

(U) Yet another problem resulting from the delayed program release and contract award concerned the FAAR engineering services contract with Sanders, which was scheduled to expire on 30 December 1973. To maintain program continuity and to cover part of the 10-month delay, MICOM exercised an option for an additional 5 months of effort for $1,344,810. This extended the performance period through 30 May 1974.[10]

Special Operational Test & Evaluation

(U) The requirement for additional operational tests and evaluation of the FAAR before commitment of funds for the second buy stemmed from the fact that the system had not been tested in a realistic environment. To satisfy this requirement, a two-phase test was conducted to demonstrate system performance with respect to multiple high performance aircraft, helicopters flying nap-of-the-earth, and sophisticated electronic countermeasures (ECM).

(U) Phase I was conducted by Headquarters, Modern Army Selected System Test, Evaluation, & Review (MASSTER) at Fort Hood, Texas, and monitored by the Army Operational Test & Evaluation Agency (OTEA). This test, in November and December 1973, allowed for suitable terrain, sufficient high performance aircraft from a nearby Air Force base, helicopter and ECM resources, unrestricted flight profiles and attack directions, and an operational FAAR platoon organic to a VULCAN battalion. The Phase I test, however, was uninstrumented. To obtain a more complete understanding of the FAAR's operational effectiveness, an instrumented phase was conducted in conjunction with tests of the CHAPARRAL at Fort Lewis, Washington, during February 1974. Testing at that location offered, in addition to instrumentation, a different terrain, operation with CHAPARRAL fire units, and wide variations in weather and visibility. But these advantages were partially offset by restrictions in flight profiles and direction of attack, power limitations on ECM, and limitations in the number and types

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[10] MFR, G. R. Bailey & S. O. Burns, CHAP/FAAR Div, SSMO, 15 Oct 73, subj: FAAR Program Funding. Atchd as incl to DF, Chf, CHAP/FAAR Div, SSMO, 16 Oct 73, subj: Req for Validation of FAAR Second Buy Cost Increase. CMO Files.

of high performance aircraft.[11]

(U) Representatives of MICOM and OTEA presented the results of the evaluation to the Director of Defense Research & Engineering (DDRE) on 5 April 1974. DDRE then approved the second FAAR procurement.[12] Although other constraints placed on procurement action had not been fully satisfied, DCSLOG informed AMC that the need for the FAAR system had been reexamined and that it was urgently needed to meet operational requirements. He therefore requested that the contract award be expedited and that the earliest possible delivery of hardware be effected to support the deployed CHAPARRAL/VULCAN battalions and REDEYE teams.[13]

Contract Negotiation

(FOUO) Meanwhile, the planned award date for the hardware contract had slipped nearly 2 months because of amendments to the request for proposal (RFP) in the form of drawing additions, corrections, deletions, and/or changes; the magnitude and complexity of the technical data package; and the time required for offerors to obtain vendor quotations. The RFP was issued on 25 October 1973. Under the original plan, the proposals were to be received by 28 December 1973, evaluations and negotiations were to be completed by 15 February 1974, and the contract was to be awarded on 5 April 1974. For reasons noted above, the scheduled award date was slipped to 24 May 1974.[14] However, negotiations were completed in time for award of the hardware contract on 13 May.

(FOUO) Five firms submitted proposals for competitive procurement of the FAAR: Sanders Associates; Sperry Gyroscope Division of Sperry Rand, Inc.; Applied Devices, Inc.; Dynell Electronics Corporation; and Frequency Laboratories.[15] On 13 May

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[11]FAAR Fact Book, pp. 2-3. CMO Files.

[12]Hist Rept, SSMO, FY 74, p. 4. HDF.

[13]Ltr, DCSLOG, DA, to Cdr, AMC, 19 Apr 74, subj: FAAR. CMO Files.

[14](1) 1st Ind, Cdr, AMC, to Cdr, MICOM, 29 Apr 74, on Ltr, DCSLOG to Cdr, AMC, 19 Apr 74, subj: FAAR. (2) Ltr, Cdr, MICOM, to Cdr, AMC, 3 Dec 73, subj: FAAR Proc. (3) Daily Journal Item, D/P&P, 12 Dec 73, subj: FAAR Competitive Proc. All in CMO Files.

[15]Intvw, M. T. Cagle w Jay Snyder, D/P&P, 7 Apr 75.

1974, MICOM awarded the Sperry Gyroscope Division of Sperry Rand a FAAR production contract (DA-AH01-74-C-0779) for $18,214,622, which included both major items and concurrent repair parts. Through competition and the combining of buys, repair parts, which included some 241 line items, were procured for about 40 percent of the programmed dollars.[16] Subsequent modifications to the contract increased its value to $18,245,575 as of 27 March 1975. The major items procured and the delivery schedule were as follows.[17]

Item	Qty	Delivery Schedule
FAAR	86	Sep 75 - Oct 76
TADDS	1,621	Sep 75 - Apr 77
OMTS	25	Sep 75 - Aug 76
SMTS	10	Sep 75 - May 76

(U) As a general rule, the engineering services contract is awarded to the production contractor. In this case, however, it went to Sanders Associates. In June 1974, Sanders received a $7,080,072 contract (DA-AH01-74-C-0934) for follow-on engineering services support of the second FAAR production buy. This contract would support the FAAR program through completion of production deliveries in the fourth quarter of FY 1977.[18]

(U) No further production of the FAAR system was planned for Army use, but there were several foreign military sales cases in process. In February 1975, 4 FAAR's, 36 TADDS units, 504 CHAPARRAL missiles, and 37 fire units were sold to Morocco for a total of $81.1 million. Brazil and Iran were also considering purchase of the FAAR system.[19]

Army Inventory Status

(U) With delivery of the second buy, the total Army inventory would consist of 176 FAAR's, 2,556 TADDS's, 75 OMTS's, and 31

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[16](1) Hist Rept, SSMO, FY 74, p. 4. (2) Hist Rept, D/Mat Mgt, FY 74, p. 18. (3) Hist Rept, D/P&P, FY 74, p. 9. All in HDF. (4) *NOTE:* The author was not allowed access to the Evaluation Board Report.

[17]Contr C-0779, 13 May 74. CMO Files.

[18](1) Contr C-0934, Jun 74. (2) Fact Sheet, Mgr, SSMO, 3 Dec 73, subj: FAAR Program Sta. Both in CMO Files.

[19]FAAR Fact Book. CMO Files.

SMTS's. Distribution of the first buy is shown in Table 11. The planned distribution of the second buy radars and TADDS units was as follows.

Location	Radars	TADDS
CONUS*	70	1,087
Germany	0	272
Korea	8	139
Hawaii	8	123
	86	1,621

*Includes activation of the 5th, 7th, & 24th Divisions.

(U) The REDEYE requirements for the TADDS, which totaled 1,744, were to have been filled from the second buy; however, 265 advance units were issued from depot stock to REDEYE teams in Europe. The remaining 670 TADDS from the first buy were deployed in support of CHAPARRAL/VULCAN battalions. Of the 1,621 TADDS units under contract, 583 would be allocated to CHAPARRAL/VULCAN battalions and 1,038 to REDEYE teams, leaving the latter 441 units short of established requirements.[20]

[20] FAAR Fact Book. CMO Files.

TABLE 11—(U) FAAR System First Buy Distribution (U)

LOCATION	RADARS	TADDS	OMTS	SMTS
Tactical Equipment				
USAREUR - Germany	52	685*	19	7
Fort Bragg, N.C.	8	60	3	1
Fort Hood, Texas	8	60	3	1
	68	805	25	9
Non-Tactical Equipment				
Fort Bliss - Tng Base	10	54	8	1
Redstone Arsenal	1	2	1	1
Ft Huachuca, Arizona	4**	16	4	4
563 Ord Co, Germany	0	0	2	2
Sanders Associates	2	5	1	1
Sperry Gyroscope	1	2	1	0
FAAR/CHAPARRAL Tests	0	3	1	0
Maintenance Floats	2	27	3	0
Letterkenny Army Depot	2	21	4	3
	90	935	50	21

*Includes 265 from depot stocks to REDEYE teams.
**Washouts.

SOURCE: FAAR Fact Book. CMO Files.

CHAPTER XII

(U) FAAR COST SUMMARY

(U) During the FY 1965-73 period, the Army invested a total of $99,497,342 in development and production of the FAAR system. Following is a breakdown of the investment by appropriation and fiscal year (in millions of dollars).

FY	RDTE	PEMA	TOTAL
1965	1.660		1.660
1966	.440		.440
1967	2.025		2.025
1968	1.497		1.497
1969	1.618	42.783	44.401
1970	.430	13.799	14.229
1971	1.036	1.844	2.880
1972	.512	29.280	29.792
1973	.286	2.287	2.573
	9.504	89.993	99.497

(U) The RDTE cost of $9,504,000 for the 1965-73 period nearly doubled the original estimate of $5,945,000 for the period through FY 1971. Of the RDTE funds authorized, $8,605,000 was allocated to and dispensed by MICOM, most of it going to Sanders Associates, the prime R&D contractor (*see* Table 12).

(U) Included in the PEMA investment was $1,108,630 for the Block I modification program in FY 1973. The cost of the first production buy was $58,426,194, while the second buy totaled $30,458,518.[1]

[1] (1) RDTE Program Cost Sum, compiled by Nancy Smalley, CMO, Feb 75. (2) PEMA Cost Sum of FAAR Sys as of 31 Mar 75, compiled by Johnny C. King, Budget Div, Compt.

TABLE 12 (U) Actual FAAR RDTE Cost*

AGENCY	FY 65	FY 66	FY 67	FY 68	FY 69	FY 70	FY 71	FY 72	FY 73	TOTAL
MICOM										
Proj Mgt/Spt	.160	.064	.018	.061	.239	.193	.021	.026	.041	.823
Sanders Assocs	1.500	.287	1.889	.951	1.051	.118	.630	.186	.090	6.702
HDL			.075	.045	.170	.002				.292
TECOM			.016	.023	.036	.012	.125			.212
TACOM				.087	.010	.010				.107
Miscellaneous		.089	.027	.092	.019	.047	.140		.055	.469
TOTAL MICOM:	1.660	.440	2.025	1.259	1.525	.382	.916	.212	.186	8.605
PMO						.042		.200		.242
TECOM				.238	.093	.006	.120	.100	.100	.657
TOTAL:	1.660	.440	2.025	1.497	1.618	.430	1.036	.512	.286	9.504

*In millions of dollars.

SOURCE: RDTE Program Cost Sum, Compiled by Nancy Smalley, CMO, Feb 75.

CHAPTER XIII

(U) DEPLOYMENT (U)

(U) The first two FAAR units reached the field in December 1972, some 3 years after initial deployment of the CHAPARRAL/ VULCAN systems. By the end of August 1973, nine FAAR units had been trained and deployed as shown in Table 13. Additional units would be deployed upon delivery of the production systems under contract.

(U) As stated earlier, the Block I modification program on tactically deployed FAAR systems began in July 1973 and was completed in April 1974. These modifications corrected the deficiencies and shortcomings found during initial production tests, but they were overtaken by other equipment deficiencies and logistic support and materiel readiness problems.

Early Logistic Support Problems

(U) In May 1973, with overseas deployment of the fourth FAAR unit, the Senior Staff Technical Representative (SSTR) in Europe reported numerous discrepancies in materiel shipments to that theatre. He noted, for example, that the field maintenance van had been shipped with defective key components and without log books and shipping or packing lists.[1] The source of the problem was traced to the poor quality of new materiel coming directly from the manufacturer, the lack of adequate product acceptance inspections and surveillance over contractor operations, and shipment of the materiel by the depot without benefit of a visual or functional check. These and other logistic support problems were soon overcome by corrective actions instituted through the coordinated efforts of responsible MICOM elements and the Letterkenny Army Depot.[2]

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[1] DF, D/Maint to Mgr, ADSIMO, 9 May 73, subj: FAAR Shpmts to Europe. HDF.

[2] (1) DF, Mgr, ADSIMO, to D/Maint, 22 May 73, subj: FAAR Shpmts to Europe. (2) Ltr, D/Prod Assurance to Cdr, LEAD, 11 Jun 73, subj: Quality of FAAR Shpmts to Europe. (3) Ltr, Cdr, LEAD, to MG E. I. Donley, Cdr, MICOM, 25 Jun 73, n.s. (4) Ltr, Cdr, MICOM, to COL H. C. Newell, Cdr, LEAD, 16 Jul 73, n.s. All in HDF.

[redacted]

TABLE 13—(~~C~~ u) FAAR Tactical Deployments (U)

UNIT DESIGNATION	ASSIGNMENT/LOCATION	ACTIVATED	DEPLOYED	RADARS	TADDS	OMTS	SMTS
1st Bn/68th Arty 27th Maint Bn	1st Cav Div, Ft Hood	21 Aug 72	Dec 72	8	60	3	1
1st Bn/59th Arty 91st Ord Det	5th Corps, Germany	18 Sep 72	Dec 72	8	60	3	1
3rd Bn/67th Arty 218th Ord Det	7th Corps, Germany	16 Oct 72	Jan 73	8	60	3	1
6th Bn/56th Arty 224th Ord Det	32nd AADCOM, Germany	13 Nov 72	Feb 73	6	60	2	1
3rd Bn/4th Arty 763 Ord Det	82nd Abn Div, Ft Bragg	8 Jan 73	Apr 73	8	60	3	1
2nd Bn/60th Arty 92nd Ord Det	32nd AADCOM, Germany	5 Feb 73	May 73	6	60	2	1
3rd Bn/61st Arty 509th Ord Det	5th Corps, Germany	5 Mar 73	Jun 73	8	60	3	1
2nd Bn/59th Arty 280th Ord Det	7th Corps, Germany	2 Apr 73	Jul 73	8	60	3	1
2nd Bn/67th Arty 172nd Ord Det	32nd AADCOM, Germany	30 Mar 73	Aug 73	8	60	3	1

SOURCE: FAAR Fact Book, CMO Files.

[redacted]

Criticism of the Gama Goat-FAAR Combination

(U) The correction of operational deficiencies in the tactical FAAR system proved to be a much more difficult, expensive, and time consuming task. Of prime concern were continuing overload and mobility problems with the M561 Gama Goat vehicle. Early in the development program, the M101 trailer was added to relieve the weight problem, but the system was still overweight. Engineering and service tests of the PPE units, completed in September 1971, disclosed that the vehicle failed to meet mobility reliability requirements for the FAAR to keep pace with the supported air defense units. Design changes in the transmission, suspension, and axle shafts were retrofitted to the vehicles supplied for initial production units.[3] Yet, the field units in Europe continued to express dissatisfaction with the Gama Goat-FAAR combination.

(U) In July 1973, the Commander, U. S. Army Europe (USAREUR) reported a number of problems with the system, some of which had been addressed in the engineering and service test reports. The The Gama Goat, he complained, was overloaded and the combination had a high center of gravity, making the system unstable and preventing access to some desirable areas in the rugged terrain of the forward area defense sector. The maximum safe speed on hard-surfaced roads was 15-20 miles per hour, which would not permit the FAAR to keep pace with a normal air defense march unit. In addition, space for on-vehicle equipment, crew, and crew equipment was extremely limited, forcing one crewman to ride in the FAAR shelter. This was most undesirable because of the instability of the vehicle-FAAR combination.[4]

(U) In an effort to solve the overload problem, TACOM developed a vehicle suspension kit consisting of coil springs, air lift spring bag, supporting pad, and improved ball joints. The modification kits were installed on all M561 vehicles during FY 1974.[5] The users, however, still were not satisfied with the vehicle. According to a General Accounting Office (GAO) report, they felt that the Gama Goat lacked durability, that it was difficult and exhausting to drive, and that it "was oversophisticated and a piece of junk." Drivers of the vehicle claimed

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[3] *See* above, pp. 136-37, 162.

[4] TT, Cdr, AMC, to Cdr, MICOM, 13 Jul 73, subj: FAAR Bfg to CG AMC. HDF.

[5] Hist Rept, SIMO, FY 74, p. 4. HDF.

that the truck was difficult to steer up hills and that it handled poorly in light snow, slipped in shallow mud, and could not cross tundra. They complained that the truck had a tendency to pop out of gear, and, unless they were careful while shifting, the axle or propeller shaft universal joints would break.[6]

(U) In September 1974, TACOM completed programmed production of the M561 Gama Goat and undertook a product improvement program.[7] Sufficient M561 vehicles were available for the second production buy of the FAAR; however, the systems being sold to foreign countries would be mounted on the M35A2 vehicle.[8] This vehicle, it will be recalled, had been used as an interim prime mover for the FAAR pending availability of the Gama Goat.

Operational Readiness Problems

(U) As a result of growing concern about the unsatisfactory operational readiness of the FAAR system, MICOM sent a technical assistance team to Europe, on 27 September 1974, to install modifications, get as many equipments operational as possible, determine the causes of readiness problems, and make recommendations for their solution. The team members spent 34 days in Germany, during which time they visited the 563d Ordnance Company and seven CHAPARRAL/VULCAN air defense battalions and their respective direct support units.

(U) At the time of the team's departure, 48 radars were modified and electronically operational and 5 were still awaiting requisitioned parts. Four of the nine SMTS's were modified and fully operational, and five had commercial equipments out for calibration. In many instances, the team found that the units were reporting more radars operational than was actually the case. Many of the radars reported operational were not within their specifications. These radars could track high-flying large aircraft, but could not track low-flying aircraft in ground clutter. One Gama Goat vehicle was inoperative at one battalion site and vehicle trouble had prevented delivery of the FAAR to another site.

(U) One of the primary contributors to the unsatisfactory

[6] GAO rept quoted in Jack Anderson column, The *Huntsville Times*, 14 Jan 75, p. 9.

[7] FONECON, M. T. Cagle w Robert L. Swint, TACOM, 10 Apr 75.

[8] Intvw, M. T. Cagle w Roy M. Ezell, CMO, 31 Mar 75.

operational readiness status of the FAAR system was the lack of adequate personnel training in the operation and maintenance of the radar. The operators and organizational maintenance personnel reported that they received 3 weeks of training on the FAAR at Fort Bliss, but most of it was on march order and emplacement procedures. The direct and general support maintenance personnel had received a 5-week course at the U. S. Army Intelligence School at Fort Huachuca, Arizona, but the majority of that training was on the TPX-50 IFF unit. About 65 percent of the FAAR personnel in Europe were school trained; however, the non-trained personnel were often superior to those with training. Another factor was that the FAAR troops did not understand the tactical and operational use of the radar. Very few knew anything about the TADDS unit and there was no evidence that they had been deployed with a firing unit. Battalion commanders readily admitted that no integrated training had been conducted. The team recommended that a technical assistance training package be furnished to assist each commander in providing additional training for his troops, particularly in the area of operator and organizational maintenance personnel.

(U) Also contributing to the FAAR operational readiness problem were design deficiencies in the system. The team reported a total of 13 deficiencies requiring correction, two of them involving serious safety hazards. One of the latter problems stemmed from water leaking into the shelter through the roof and floor. The presence of water and high voltage inside the shelter created a hazardous condition. The other safety problem involved the spring tension on the winch cable (one of the Block I modifications), which failed on most of the radars, causing the cable (wire rope) to fray. If the wire rope should break—as did occur at one site during the team's visit—the mast and antenna would fall, creating a serious hazard to both personnel and equipment. This problem was apparently the result of improperly tempered spring steel. The remaining deficiencies involved individual components which required redesign to reduce the failure rate and improve performance. The team recommended that immediate action be taken under the engineering services contract to solve the moisture and wire rope problems, and that the other design deficiencies be corrected through a product improvement program and Block II modifications. Other problems and corrective actions addressed by the team involved supply support, technical manuals, and the calibration repair cycle for the SMTS.[9]

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[9]Trip Rept, Roy M. Ezell, 12 Nov 74, re: FAAR Tech Assistance Team Visit to USAREUR - Germany, 27 Sep - 31 Oct 74. CMO Files.

(U) As of April 1975, engineering change proposals were in process to eliminate the safety hazards, and MICOM engineers were working on other problems reported by the technical assistance team. Work was also in progress on problems reported in Equipment Improvement Reports from other user locations.[10]

(U) In summary, the FAAR system was in the field and having more than its share of problems, many of which could be traced to poor engineering design and a lack of adequate personnel training. With the possible exception of the LACROSSE weapon system, the Gama Goat-FAAR combination was probably the most unpopular, derided piece of equipment ever fielded by the U. S. Army. Nevertheless, it was fulfilling a vital role in support of the CHAPARRAL/VULCAN fire units and REDEYE teams.

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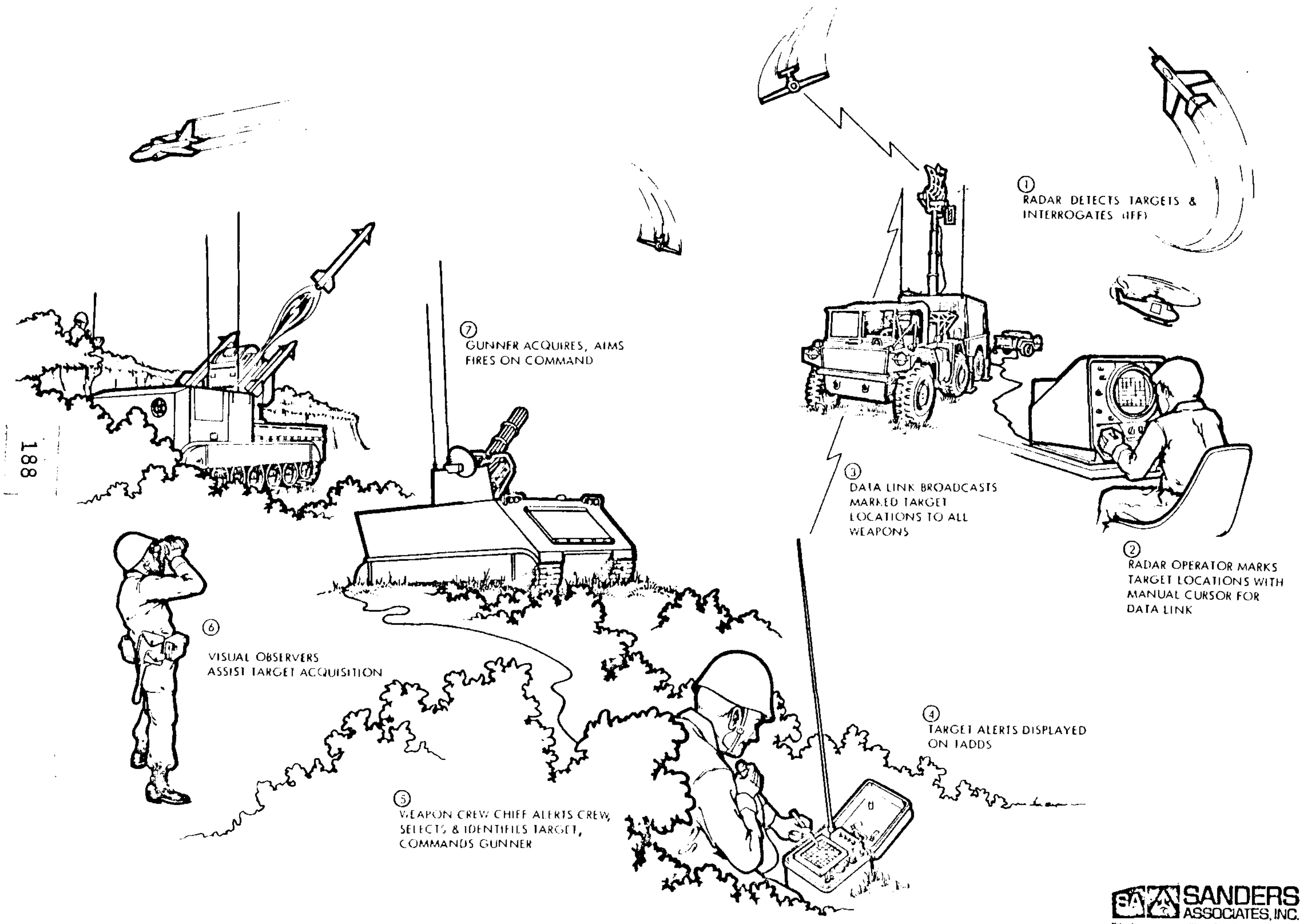
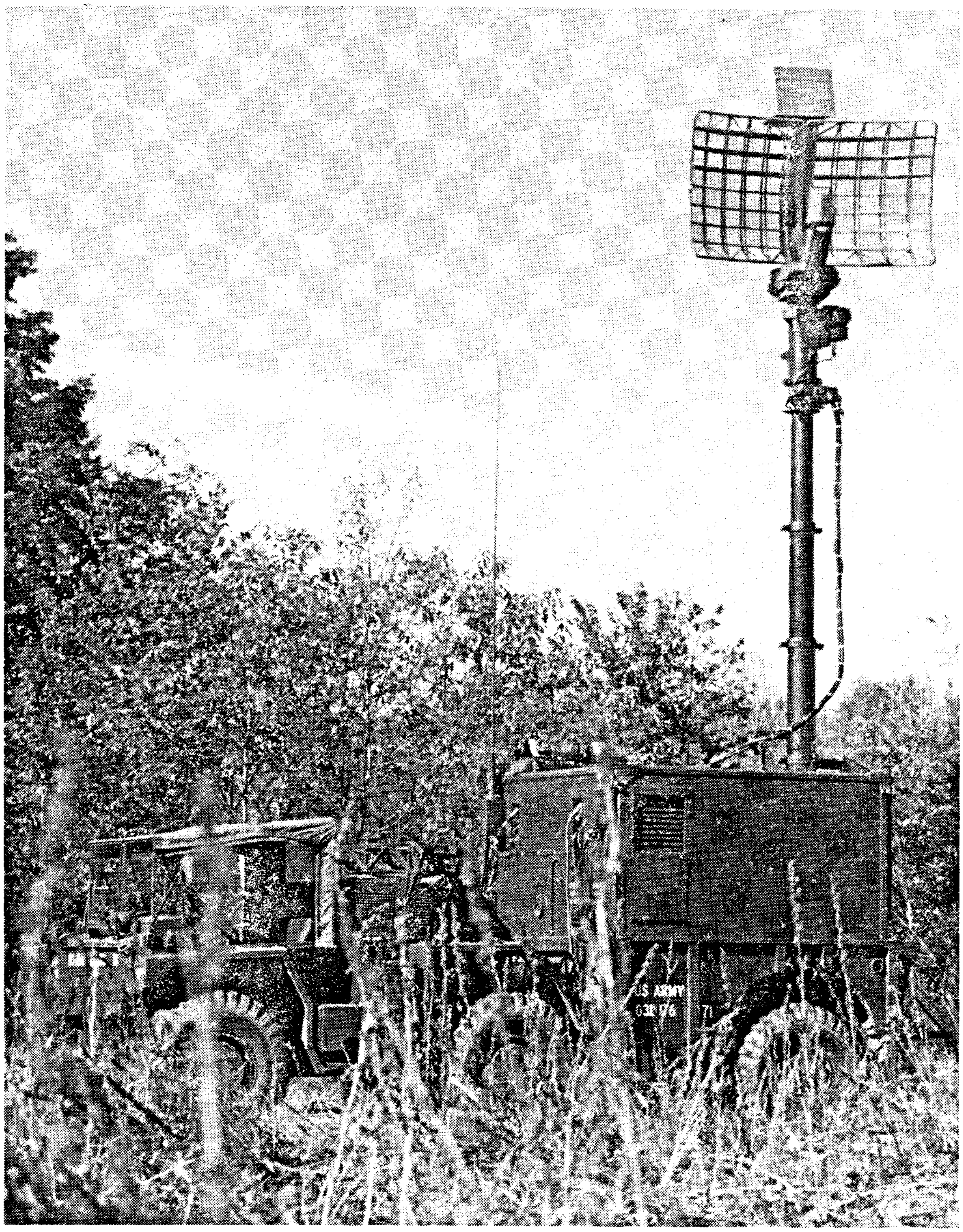
[10] Intvw, M. T. Cagle w Charles H. Kirchner, 14 Apr 75.

ENGAGEMENT CYCLE OF STANDARD FAAR



SANDERS ASSOCIATES, INC.
DEFENSE SYSTEMS DIVISION



The FAAR Stands Watch

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PART THREE

CONCLUSION

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CHAPTER XIV

(U) IN RETROSPECT

The problems, failures, and mistakes in judgement in the CHAPARRAL and FAAR programs have become legend with the passage of time and the seasoning of cold assessment. What originally appeared to be a fairly routine task of providing a quick-fix, interim CHAPARRAL/FAAR capability by January 1968 turned into a nightmare of funding shortages, performance deficiencies, changes in military requirements, cost overruns, and schedule delays. The task at the commodity command level was further complicated by the fragmented management structure, manpower deficiencies, and a lack of timely guidance from higher echelons.

The CHAPARRAL was originally conceived for interim use pending availability of the MAULER weapon system, whose development had fallen behind schedule because of technical problems. It was to be a rather unsophisticated assemblage of off-the-shelf hardware requiring minimum changes in order to provide an operational capability by January 1968. The system was intended for deployment to Europe only, and was to remain in the field some 2 to 4 years, until the MAULER became available. The quick-fix, bolt-together concept, however, was invalidated the first year of development. Extensive component modifications were required and some system peculiar equipment had to be developed. As a result, the prototype system delivered in August 1965 bore little resemblance to the concept originally proposed, and system development costs increased.

With the cancellation of the MAULER project in November 1965, the military requirements for the CHAPARRAL were expanded, causing more changes in the design of major components and a further escalation in program costs. Instead of an interim system with a service life of 2 to 4 years, the CHAPARRAL was changed to a more complex system which would fully meet world-wide environmental conditions and have an estimated service life of some 10 years. Initially, it was assumed that the necessary improvements could be made and still meet the service availability date of January 1968; however, this optimistic assumption fell victim to delays in the decision making process at higher headquarters, piecemeal funding support, and technical and quality control problems. In the end, the CHAPARRAL operational availability date slipped a total of 22 months and the RDTE cost increased some 257 percent over the original estimate, from $17,500,000 to $62,481,000 through FY 1974. A large portion of the cost growth and schedule slippage was attributed to design changes engendered by the expanded military requirements, the scope of which exceeded expectations, and to problems and delays associated with the joint Army-Navy management-procurement concept. Another contributory factor was the "stop-start" funding philosophy which not only had a profound impact on the rate and quality of technical progress, but also contributed to the schedule slippages and the steady rise in development costs.

The Forward Area Alerting Radar (FAAR) was beset with many of the same problems as the CHAPARRAL, plus some notable ones of its own. It was originally envisioned as a modified off-the-shelf item to provide a suitable early warning and identification system within the same timeframe as the interim CHAPARRAL. As in the case of the CHAPARRAL, however, the quick-fix concept failed to meet technical requirements. With the change in military requirements calling for world-wide deployment and an expanded service life of 8 to 10 years, the estimated RDTE cost rose from an austere level of $2,110,000 to $5,945,000 for the FY 1965-71 period.

Sanders Associates began development of the FAAR in May 1966. Three and a half years later, in November 1969, the CHAPARRAL system was deployed without an early warning and identification capability, as the FAAR program floundered in a maze of technical, managerial, financial, and contractual difficulties. The FAAR system, developed at a total cost of $9.5 million through FY 1973, finally reached the field in December 1972 amid growing user concern about latent deficiencies and a general lack of operational readiness. Most of the cost growth, equipment deficiencies, and schedule delays could be traced to a poor engineering design, poor contractor performance, management deficiencies both within the Army and the contractor's plant, premature production release of the system over objections of the Army Missile Command, the subsequent 21-month production hold, and the equally premature decision to resume production in April 1971. The deficiencies in equipment initially deployed were corrected by Block I modifications completed in April 1974. Subsequent deficiencies and logistic support and materiel readiness problems were eventually eliminated through a product improvement program and Block II modifications, together with improved personnel training in system operation and maintenance.

TABLE 14—(U) CHAPARRAL/FAAR Cost Summary*
(in millions of dollars)

FY	CHAPARRAL			FAAR			CHAPARRAL/FAAR		
	RDTE	PEMA	TOTAL	RDTE	PEMA	TOTAL	RDTE	PEMA	TOTAL
1965	5.160	--	5.160	1.660	--	1.660	6.820	--	6.820
1966	19.486	26.030	45.516	.440	--	.440	19.926	26.030	45.956
1967	17.125	63.081	80.206	2.025	--	2.025	19.150	63.081	82.231
1968	7.251	8.000	15.251	1.497	--	1.497	8.748	8.000	16.748
1969	5.456	71.645	77.101	1.618	42.783	44.401	7.074	114.428	121.502
1970	2.492	69.833	72.325	.430	13.799	14.229	2.922	83.632	86.554
1971	.605	47.382	47.987	1.036	1.844	2.880	1.641	49.226	50.867
1972	1.193	15.635	16.828	.512	29.280	29.792	1.705	44.915	46.620
1973	.375	5.391	5.766	.286	2.287	2.573	.661	7.678	8.339
1974	3.338	.460	3.798	--	--	--	3.338	.460	3.798
	62.481	307.457	369.938	9.504	89.993	99.497	71.985	397.450	469.435

**See* pp. 125, 180.

CHAPTER XV

(U) FORWARD AREA AIR DEFENSE OF TODAY AND TOMORROW

Today, the Army's arsenal of forward area, low altitude air defense weapons essentially consists of those systems selected to fill the void left by termination of the MAULER program in 1965. The CHAPARRAL/VULCAN and self-propelled HAWK battalions reached the field in late 1969, joining the REDEYE teams which had been deployed some 2 years earlier. The Forward Area Alerting Radar, deployed in December 1972, greatly enhanced the operational effectiveness of the CHAPARRAL/VULCAN fire units and REDEYE teams by providing them early warning and target identification information.

On the drawing boards was a new generation of low altitude air defense weapons to cope with the threat into the 1980's. The planned future generation consisted of the SHORAD (ROLAND II) system for defense of the rear-area, high-value targets; the Improved CHAPARRAL for defense of the division area or forward combat zone; the shoulder-fired STINGER missile which would replace the REDEYE; and the SAM-D weapon system which would supplant the HAWK and NIKE HERCULES systems.

GLOSSARY OF ABBREVIATIONS

- A -

AAA---------- Army Audit Agency
Acptn-------- Acceptance
ACSFOR------ Assistant Chief of Staff for Force Development
AD---------- Air Defense
ADSIMO------ Air Defense Special Items Management Office
AIT--------- Advanced Individual Training
AMC--------- Army Materiel Command
AMCTCM------ Army Materiel Command Technical Committee Meeting
AMP--------- Army Materiel Plan
AMSAA------- Army Materiel Systems Analysis Agency
APE--------- Advance Production Engineering
APM--------- Assistant Project Manager
App--------- Appendix
Appn-------- Appropriation
Appr-------- Approve
Apprl------- Approval
ASA(I&L)---- Assistant Secretary of the Army (Installations and Logistics)
ASAP-------- Army Scientific Advisory Panel
Asg(mt)----- Assign, Assignment
ASP--------- Annual Service Practice
Atchd------- Attached
ATT--------- Army Training Test
AUT--------- Advanced Unit Training

- B -

Bd---------- Board
BF---------- Blast Fragmentation
Bfg--------- Briefing
BOA--------- Basic Ordering Agreement
BOB--------- Bureau of the Budget
Br---------- Branch
BUT--------- Basic Unit Training
Bx---------- Box

- C -

C&DP-------- Comptroller and Director of Programs
CAR--------- Configuration Audit Review
CDC--------- Combat Developments Command
Cdr--------- Commander
CG---------- Commanding General
Ch---------- Change
CHAP-------- CHAPARRAL
Chf--------- Chief
CIVR-------- Configuration Item Verification Review

Clas-------- Classification
Cmdty------- Commodity
CMO--------- CHAPARRAL Management Office
Cmt--------- Comment
COA--------- Comptroller of the Army
Com--------- Committee
Comb-------- Combine
Comd-------- Command
Compl------- Completion
Compt------- Comptroller
CONARC------ Continental Army Command
Contr------- Contract, Contractor
CONUS------- Continental United States
Coord------- Coordination
COSTECH----- Cost & Technical Information (Report)
CRD--------- Chief of Research & Development
CTP--------- Coordinated Test Program
C/V--------- CHAPARRAL/VULCAN
CVADS------- CHAPARRAL/VULCAN Air Defense System

- D -

D/---------- Directorate for
DA---------- Department of the Army
D&F--------- Determination and Finding
DB---------- Daily Bulletin
DCASD------- Defense Contract Administration Services District
DCG--------- Deputy Commanding General
DCG/ADS----- Deputy Commanding General for Air Defense Systems
DCSLOG------ Deputy Chief of Staff for Logistics
DDRE-------- Director of Defense Research & Engineering
Decn-------- Decision
Def--------- Defense
Dep--------- Deputy
Dev--------- Development
DF---------- Disposition Form
DIDO-------- Directional Doppler
Distr------- Distribution
Div--------- Division
D/Maint----- Directorate for Maintenance
D/Mat Mgt--- Directorate for Materiel Management
Dmstn------- Demonstration
DOD--------- Department of Defense
D/P&P------- Directorate for Procurement & Production
D/PT&FD----- Directorate for Personnel Training & Force Development
Drte-------- Directorate
DS---------- Direct Support
DSARC------- Defense Systems Acquisition Review Countil
Dsg(n)------ Designate, Designation

- E -

EA---------- Engineering Analysis
ECM--------- Electronic Countermeasure
ECOM-------- Electronics Command
ECP--------- Engineering Change Proposal
ED/MPT------ Engineering Design/Military Potential Test
EDT--------- Engineering Design Test
EMFU-------- Engineering Model Fire Unit
Engr-------- Engineer
Engrg------- Engineering
Equip------- Equipment
ERR--------- Engineering Release Record
Est--------- Estimate
Estb-------- Establishment
ET---------- Engineering Test
ET/ST------- Engineering Test/Service Test
Eval-------- Evaluation

- F -

FAAR-------- Forward Area Alerting Radar
Fab--------- Fabrication
Fgn--------- Foreign
Fld--------- Field
Flt--------- Flight
FMS--------- Foreign Military Sales
FMTS-------- Field Maintenance Test Set
FORSCOM----- Forces Command
Ft---------- Fort
Func-------- Function
Fwd--------- Forward

- G -

GAO--------- General Accounting Office
GCG--------- Guidance Control Group
Gen--------- General
GETA-------- General Equipment Test Activity
GFE--------- Government-Furnished Equipment
GM---------- Guided Missile
GO---------- General Order
Govt-------- Government
Gp---------- Group
GS---------- General Support

- H -

HDF--------- Historical Division File
HDL--------- Harry Diamond Laboratories
HHB--------- Headquarters & Headquarters Battery

Hist-------- History, Historical
HQ---------- Headquarters

- I -

IADS-------- Interim Air Defense Systems
ICTT-------- Intensified Confirmatory Troop Test
IFAADS------ Interim Field Army Air Defense System
IFF--------- Identification, Friend or Foe
Incl-------- Inclosure
Ind--------- Indorsement
Info-------- Information
Insp-------- Inspection
Intcp------- Intercept
Intvw------- Interview
IPR--------- In-Process Review
IPT--------- Initial Production Test
IR---------- Infrared
IRSTS------- Infrared Search Track Set

- J -

Just-------- Justification

- K -

km---------- Kilometer

- L -

LA---------- Low Altitude
LCSIMO------ Land Combat Special Items Management Office
LCTS-------- Launch and Control Test Set
LDSRA------- Logistics, Doctrine, Systems & Readiness Agency
LEAD-------- Letterkenny Army Depot
LO---------- Letter Order
Loc--------- Location
LOFAADS----- Low Altitude Forward Area Air Defense System
LP---------- Limited Production
LP-T-------- Limited Production - Test
LP-U-------- Limited Production - Urgent
Ltr--------- Letter

- M -

Maint------- Maintenance
MASSTER----- Modern Army Selected System Test, Evaluation, and Review
Mat--------- Material, Materiel
Memo-------- Memorandum
MFR--------- Memorandum for Record
Mgr--------- Manager

Mgt--------- Management
MICOM------- Army Missile Command
Mil--------- Military
Mins-------- Minutes
MIPR-------- Military Interdepartmental Purchase Request
Mk---------- Mark
mm.--------- Millimeter
MOS--------- Military Occupational Specialty
Mpr--------- Manpower
MPT--------- Military Potential Test
Msg--------- Message
Msl--------- Missile
Msn--------- Mission
MTBF-------- Mean-Time-Between-Failure
Mtg--------- Meeting
Mtr--------- Motor
MTTR-------- Mean-Time-To-Repair

- N -

NASC-------- Naval Air Systems Command
NATO-------- North Atlantic Treaty Organization
NCO--------- Non-Commissioned Officer
NET--------- New Equipment Training
NOTS-------- Naval Ordnance Test Station
n.s.-------- No Subject
NWC--------- Naval Weapons Center

- O -

OACSFOR----- Office, Assistant Chief of Staff for Force Development
Oblg(n)----- Obligate, Obligation
OCRD-------- Office, Chief of Research & Development
Ofc--------- Office
Off--------- Officer
OMSS-------- Organizational Maintenance Shop Set
OMTS-------- Organizational Maintenance Test Set
Opt--------- Option
Org--------- Organization
OSD--------- Office, Secretary of Defense
OT---------- Operational Test
OTE--------- Operational Test & Evaluation
OTEA-------- Operational Test & Evaluation Agency

- P -

Part-------- Participation
Pd---------- Period
Pdn--------- Production
PEMA-------- Procurement of Equipment & Missiles, Army

Perf--------	Performance
Pers--------	Personnel
PIP---------	Product Improvement Program
PIT---------	Performance Improvement Test
PM----------	Project Manager
PM_2P--------	Project Management Master Plan
PMP---------	Project Master Plan
PMSO--------	Project Manager Staff Office
POM---------	Preparation for Overseas Movement
Pos---------	Position
PPE---------	Pilot Production Engineering
Ppsd--------	Proposed
Ppsl--------	Proposal
PPT---------	Pre-Production Test
Prelim------	Preliminary
Presn-------	Presentation
Proc--------	Procurement
Prod--------	Product
Prog--------	Progress
Proj--------	Project
Prov--------	Provisional
Pt----------	Part
Pub---------	Publication
PV----------	Production Validation

- Q -

QMR---------	Qualitative Materiel Requirement
Qtr---------	Quarter
Qty---------	Quantity

- R -

RAID--------	Rapid Alerting Identification Display
RAID/RF-----	Rapid Alerting Identification Display/Radio Frequency
R&D---------	Research and Development
RDE---------	Research, Development, & Engineering
RDTE--------	Research, Development, Test, & Evaluation
Recm(n)-----	Recommend, Recommendation
Rep---------	Repair
Rept--------	Report
Req---------	Request
Resp--------	Responsibility
RF----------	Radio Frequency
RFP---------	Request for Proposal
Rg----------	Range
RHA---------	Records Holding Area
Rkt---------	Rocket
Rqrmt-------	Requirement

RSIC-------- Redstone Scientific Information Center

- S -

SA---------- Secretary of the Army
SAIE-------- Special Acceptance Inspection Equipment
SAM-D------- Surface-to-Air Missile - Development
S&A--------- Safety & Arming
Sbm--------- Submission
Scd--------- Schedule
SDR--------- Small Development Requirement
Sec--------- Section
SECDEF------ Secretary of Defense
SHORAD------ Short Range Air Defense
Shpmt------- Shipment
SHUCRP------ Select High Unit Cost Repair Parts
SIMO-------- Special Items Management Office
SMSS-------- Support Maintenance Shop Set
SMTS-------- Support Maintenance Test Set
SO---------- Special Order
Sp---------- Special
SP---------- Self-Propelled
Spt--------- Support
SS---------- Summary Sheet
SSMO-------- Special Items Management Office
SSTR-------- Senior Staff Technical Representative
ST---------- Service Test
Sta--------- Status
STAMO------- Stable Master Oscillator
Std--------- Standard
ST/IPT------ Service Test/Initial Production Test
Struc------- Structure
Subcom------ Subcommittee
Subj-------- Subject
Suc--------- Successful
Sum--------- Summary
Survl------- Surveillance
Svc--------- Service
Sys--------- System

- T -

TAA--------- Target Acquisition Aid
TABV-------- Theatre Air Base Vulnerability
Tac--------- Tactical
TACOM------- Tank-Automotive Command
TADDS------- Target Alerting Data Display System
TAMIRAD----- Tactical Mid-Range Air Defense
TCLAS------- Type Classification
TD---------- Table of Distribution

TDA---------	Table of Distribution & Allowances
TDD---------	Target Detecting Device
Tech--------	Technical
TECOM-------	Test & Evaluation Command
Termn-------	Termination
Tgt---------	Target
Tng---------	Training
Tnr---------	Trainer
TOE---------	Table of Organization & Equipment
TR----------	Technical Requirements
Trf---------	Transfer
Trns--------	Transition
TT----------	Teletype

- U -

Undtd-------	Undated
Unsuc-------	Unsuccessful
USA---------	United States Army
USAADCENFB--	United States Army Air Defense Center & Fort Bliss
USAADS------	United States Army Air Defense School
USAREUR-----	United States Army, Europe
USATECOM----	United States Army Test & Evaluation Command

- V -

V/C---------	VULCAN/CHAPARRAL
VC----------	Viet Cong
VCSA--------	Vice Chief of Staff
Veh---------	Vehicle
Vol---------	Volume

- W -

w-----------	With
WECOM-------	Army Weapons Command
Whd---------	Warhead
Wpn---------	Weapon
WSMR--------	White Sands Missile Range

- X -

Xmitl-------	Transmittal

INDEX