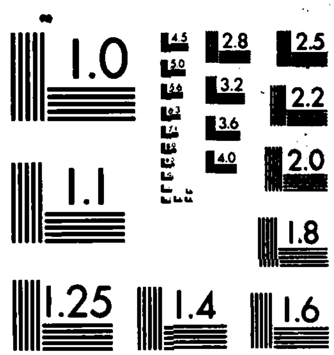
AD-A165 967 ON THE DEVELOPMENT OF AN OPERATIONAL CONCEPT FOR THE MARINE CORPS EXPEDIT (U) MARINE CORPS DEVELOPMENT AND EDUCATION COMMAND QUANTICO VA 17 DEC 85

1/3

UNCLASSIFIED F/G 1/5 NL




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

(12)

AD-A165 967

DTIC FILE COPY

# FINAL REPORT

## On the Development of an Operational Concept for the Marine Corps Expeditionary Airfield (AEF) System 1985-1995



United States Marine Corps
Development and Education Command
Quantico, Virginia 22134-5001



86 3 10 053

DEPARTMENT OF THE NAVY
HEADQUARTERS UNITED STATES MARINE CORPS
WASHINGTON, D.C. 20380

IN REPLY REFER TO
11000
RD/ASL-42/OS6558302t
55-83-02

17 DEC 1985

From: Commandant of the Marine Corps

Subj: DEVELOPMENT OF AN OPERATIONAL CONCEPT FOR THE MARINE CORPS EXPEDITIONARY AIRFIELD (EAF) SYSTEM 1985-1995 STUDY (SCN: 55-83-02)

1. The purpose of the subject study was to examine and analyze the operational requirements of the EAF system and to identify such changes in organization, concept, equipment, and system support requirements as may be necessary to ensure the validity of the concept through the mid-range period (1985-1995).

2. The study attained the objectives, uncovered additional issues that need to be resolved, and has generated thinking and planning for future improvements based on new materials and technology to overcome current deficiencies. The following significant problems highlighted by the study stem from the large size of the Marine Corps Mid-Range Objectives Plan (MMROP) Marine Amphibious Force (MAF) Aviation Combat Element (ACE) (634 aircraft):

a. Adequate logistical support.

b. Ability of the Expeditionary Airfield (EAF) System to accommodate the ACE.

c. Transportability of the materials and equipment required for forward support.

It should be noted that the directed study base (MMROP MAF ACE) is significantly larger than a typical MAF ACE, which has approximately 400 aircraft. Therefore, this study should not be used for programming support for an EAF since it may seriously overstate the current actual requirements.

3. The conclusions and recommendations will be the basis for future improvements to and developments in the EAF system.

4. A copy of this letter will be affixed inside the front cover of each copy of the subject study report prior to its distribution.

F. X. Chambers Jr.

F. X. CHAMBERS, JR.
Colonel U. S. Marine Corps
Acting Deputy Chief of Staff for RD&S

Subj: DEVELOPMENT OF AN OPERATIONAL CONCEPT FOR THE MARINE CORPS EXPEDITIONARY AIRFIELD (EAF) SYSTEM 1985-1995 STUDY (SCN: 55-83-Ø2)

Distribution:

| | |
|---|---|
| DTIC | (12) |
| DLSIE | (2) |
| CNA | (2) |
| CMC (A) | (15) |
| (P) | (3) |
| (M) | (1) |
| (L) | (5) |
| (RP) | (3) |
| (RES) | (2) |
| (RD) | (2) |
| (T) | (1) |
| COMNAVAIRSYSCOM (CODE 5512M) | (5) |
| CG FMFPac | (3) |
| CG FMFLant | (3) |
| CG, MCDEC | (5) |
| CG 2d MAW | (3) |
| CG 1st MAW | (3) |
| CG 4th MAW | (3) |
| CG 3d MAW | (3) |
| COMNAVFACENGCOM | (2) |
| COMCABWEST EL TORO CA | (1) |
| CG MCAGCC 29 PALMS CA | (1) |
| COMCABEAST CHERRY PT NC | (1) |

Accession For
NTIS GRA&I ☒
DTIC TAB ☐
Unannounced ☐
Justification per ltr

By
Distribution/
Availability Codes

| Dist | Avail and/or Special |
|---|---|
| A-1 | |

## EXECUTIVE SUMMARY

### Statement of the Problem

A series of evolutionary changes has occurred in the Marine Corps Expeditionary Airfield (EAF) system since its inception as a formal operational requirement in 1958. Concurrently, various technological advances have been applied to EAF system components and support operations in an effort to enhance its operational capabilities. These changes have occurred previously in an ad hoc manner without a systematic approach to measure the EAF system as an entity against known requirements and to evaluate the system's capabilities and deficiencies against these requirements.

The purpose of the Development of an Operational Concept for the Marine Corps Expeditionary Airfield (EAF) System 1985-1995 study is to examine and analyze the operational requirements of the EAF system and to identify such changes in organization, concept, equipment, and system support requirements as may be necessary to ensure the validity of the concept through the mid-range period (1985-1995).

### Study Methodology

The study was accomplished by collecting and analyzing available data which bears on the EAF system and the military requirements that are its genesis. A baseline of EAF capabilities was developed in order to conduct a comparative analysis of a range of near and mid-term requirements and the changes needed to support those requirements. Finally, an analysis of major operational, logistic support, and organizational functions provided the data necessary to determine the degree to which the EAF system can meet its stated or derived requirement of supporting the notional Air Combat Element (ACE) contained in the Marine Corps Mid-Range Objectives Plan (MMROP) in the most demanding of the MARCOR scenarios. Both the EAF system concept and a broad range of issues associated with its employment in an expeditionary environment during the mid-range period were examined. The several major areas of concentration addressed in separate chapter headings include:

o The evolutionary development, threat to, dynamics involved and the potential risks associated with beddown of a 634 aircraft MMROP MAF ACE on an EAF system consisting of:

-- Two 900 foot Vertical Short Take-off Landing (VSTOL) facilities
-- One 8000 foot Strategic Expeditionary Landing Field (SELF)
-- Two 8000 foot bare bases

o The capabilities of appropriate systems and agencies to meet the EAF system support requirements

o The impact on and contributions to the EAF system of tangential areas of interest including:

-- EAF Support Equipment
-- Air Traffic Control Systems
-- The 4th Marine Aircraft Wing
-- The Introduction of New Aircraft
-- Ground Defense of Multiple EAF Sites

o Opportunities for enhancing the capability of the EAF system and its components to support the ACE of any size Marine Air Ground Task Force (MAGTF) through modification of its organizational structure and the exploitation of new technologies.

Certain assumptions and study guidance were provided by the Headquarters, Marine Corps Study Advisory Committee that significantly affected the study conclusions. Those of major impact included the following decisions:

o Each of the two 8000 foot bare bases included in the EAF system configuration used to beddown the MMROP MAF ACE were to be presumed to consist of 8000 feet of hard surfaced runway, 140, 160 square yards of surfaced parking area, and no other support facilities.

o Theatre airfields, road sites, and other unimproved parking areas were to be excluded from consideration as permanent or semi-permanent beddown sites for aircraft.

o The use of non-standard parking criteria was authorized to compute the beddown area required for fixed wing aircraft since standard NAVFAC P-80 parking criteria would have resulted in an inordinate sized parking area at each EAF and bare base site.

## Significant Results and Conclusions

The sheer size, 634 aircraft, of the MMROP MAF ACE proved to be the most significant problem encountered in the conduct of the study. It tends to dominate most major aspects of the study and generates several significant logistic support problems. The EAF system was determined to be capable of accommodating the MMROP MAF ACE with two significant modifications. The first is the need for the addition of 130,000 AM-2 mats to the current EAF system allocated each MAW, and the second is the need to deviate from using standard aircraft parking criteria for fixed wing aircraft to a dense pack beddown mode at the large EAF configurations.

There are, of course, several penalties accruing from a dense pack mode of parking high cost ACE resources. In a high threat environment, characterized by an enhanced enemy ground and air ordnance attack capability, the inability to revet individual aircraft, and the concommitant limitations on adequately camouflaging facilities, subject the ACE to potential catastrophic loss or damage to dense packed aircraft from single round impact. This high potential risk is of such concern, that the Study Team urges that alternative beddown modes be vigorously investigated and developed to include: dispersing the ACE's rotary wing aircraft to unimproved surfaces; increasing the size of or dispersing parking aprons; or, preferably, using theatre airfields (within 200 NM of the AOA) for beddown of high performance fixed wing aircraft.

With some augmentation assets and modification to employment concepts, the MAF combat service support capability can support the deployment of a total EAF system ashore and logistically sustain the MMROP MAF ACE in an AOA. The significant issues involved in this area of concern were determined to be the following:

o The MAF bulk fuel storage capacity exceeds the 7,730,000 gallon 10 day requirement of the MMROP MAF ACE. Mobile refueler assets currently in the inventory and programmed for the future can deliver in excess of the ACE daily JP fuel requirement to the EAF system, if a suitable road net exists in the AOA and the mobile refueling capability is not interrupted. Wide separation of EAF's and bare bases from the primary fuel source will require alternate, extended distance bulk fuel transfer systems to be installed. This alternate transfer system can be achieved by modifying the current AAFS equipment and short distance fuel transfer concept to include use of high capacity booster pumps, fuel storage tanks employed in tandem, larger capacity storage tanks, and a capability to deploy a rigid petroleum pipeline system to transfer fuel a cumulative distance of 60 miles or more to multiple EAF's and bare bases.

o The construction of forty-two 250 short ton capacity Class V(A) bomb dumps distributed among the five configuration EAF system needed to beddown the MMROP MAF ACE does not pose a significant engineer support problem. However, the adequacy of the MMROP MAF ACE aviation ordnance T/O and Class V(A) throughput procedures to support several widely dispersed airfield sites simultaneously should be examined in the near future.

o An estimated 139,000 man-hours of engineer construction/installation effort is necessary to deploy the EAF system (consisting of two VSTOL facilities, one Strategic Expeditionary Landing Field (SELF), and two 8000 foot bare bases) required to beddown the MMROP MAF ACE. Early rehabilitation/expansion of any existing bare base is essential to achieving an early operational capability for the ACE ashore. Sequence of construction should follow bare base rehabilitation, VSTOL facility or 1800 foot VSTOL airbase construction and, last, SELF deployment to maximize use of engineer resources. The MAF deliberate construction engineer forces, augmented by three wartime strength Naval Mobile Construction Battalion (NMCBs), are adequate to accomplish this task. No other external engineer support resources would be required.

o Adequate firefighting equipment assets are being procured to support the EAF system. Additional quantities of crash and rescue vehicles are needed to achieve required emergency response times at each EAF configuration. The deficient area remains the Foreign Object Damage (FOD) and snow/ice removal equipment capability. Larger capacity, more efficient FOD vehicles are needed. The non-existent capability to remove heavy snowfall and ice from a variety of EAF surfaces, especially AM-2 matting, requires priority attention in view of the severe climatic conditions that will be encountered in the various AOA's to which the EAF system may be deployed.

o The single Marine Air Traffic Control Squadron (MATCS) available to the MMROP MAF ACE is currently configured to support only three of the five EAF sites simultaneously. This deficiency can be resolved, however, by reinforcement of the MATCS with a minimum number of personnel and equipment assets and introduction of the new air traffic control systems that are scheduled for the near term.

o A number of options are available for use of the 4th Marine Aircraft Wing's (4th MAW) limited EAF personnel and component resources on mobilization. The most valuable option appears to be: 1) integrate EAF personnel with active MAW's; 2) assign a part of the EAF components to the two CONUS based EAF sites to reconstitute an EAF training asset; 3) place any remaining EAF components into contingency assets.

o New aircraft programmed to enter the Marine Corps inventory can be accommodated without any modification to the EAF system.

o The EAF system ground defense requirements will increase in a widely dispersed mode of EAF siting in an AOA. Extended distance separation of all Marine Air Ground Task Force (MAGTF) elements will place new demands on the EAF/bare base commander to develop a ground defense capability from a share of the ACE resources allocated to each airfield. One source of an EAF ground defense force is the law enforcement/security elements allocated to each Marine Aircraft Wing (MAW). If task organized and equipped with adequate mobility, weapons, and command and control resources, these MAW law enforcement/security elements can serve as the nucleus of a ground defense force at each EAF/ bare base and would be capable of coping with a ground attack by hostile forces of squad to platoon size strength. The entire issue of Rear Area Security, however, to include defense of multiple EAF's, is deserving of further study.

o The EAF system's responsiveness can be enhanced by the consolidation of EAF personnel and component resources in the Marine Wing Support Group (MWSG) of each MAW where maintenance, supply and the engineer/utility support required by the EAF system is available. Economies of personnel and equipment can be achieved by such consolidation, while the responsiveness of well trained personnel and adequately maintained EAF components to deploy with any size MAGTF will be enhanced.

o New technologies are being investigated to improve EAF component capabilities and reduce their weight and cube and the time required to install them in an expeditionary environment. A concomitant effort is being directed towards developing alternative surfacing materials and surfacing techniques. Items such as fiberglass reinforced polyester (FRP), AMSS, FIBERMAT, FLOTRAK, and the medium girder bridge structured "ski jump" ramp, hold the promise of reducing the engineer construction effort in EAF system site preparation; reducing the currently significant cube and weight of materials, and expediting the operational availability of the ACE ashore in contingency operations.

The study confirms that the EAF system is a flexible, essential support capability for ensuring the ACE can project itself ashore to contribute its significant combat power to attainment of the MAGTF objective; particularly in AOA's where airfields do not exist or bare bases are so severely damaged, timely rehabilitation is not possible.

Though adequate in its separate configurations to the mission of supporting an ACE of less than MAW size, the EAF system has a defined number of component, support equipment, organizational, and logistic support requirement limitations that can and should be corrected to enhance this unique Marine Corps operational capability to support the MMROP MAF ACE.

## TABLE OF CONTENTS

TABLE OF CONTENTS

(continued)

TABLE OF CONTENTS
(continued)

## TABLE OF CONTENTS
(continued)

## TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS

(continued)

## TABLE OF CONTENTS
(continued)

## LIST OF TABLES

## LIST OF TABLES
(Continued)

## LIST OF FIGURES

# CHAPTER I

## INTRODUCTION

1.1 Purpose. The purpose of the "Development of an Operational Concept for the Marine Corps Expeditionary Airfield (EAF) System 1985-1995," study is to examine and analyze the operating requirements of the EAF system and to identify such changes in organizational concept, equipment and system support requirements as may be necessary to ensure the validity of the concept through the mid-range period (1985-1995).

Both the EAF system concept and a broad range of issues associated with its employment in an expeditionary environment were examined. The several major areas of concentration are presented in separate chapters for ease of reference, completeness and continuity of thought.

The sections incorporated in this Chapter address the mission of the EAF system, its historical development, related study efforts, the scope of the effort and study methodology employed, and the guidance/direction provided by the Headquarters, U.S. Marine Corps Study Advisory Committee (SAC). To set the stage for evaluation of the EAF system, Chapter II summarizes strategic considerations and the nature of the threat that will affect its employment. Chapter III describes the EAF system and its components as a lead-in to the analysis conducted in Chapter IV to determine the capabilities and deficiencies of the current EAF system to beddown the 634 aircraft MMROP MAF ACE. Chapters V through VIII focus on the combat service support requirements of the EAF system and the capabilities of the existing logistic support agencies and systems to provide that support. Chapter IX covers the air traffic control system needed to support multiple configuration EAF sites, while the impact on the EAF system of new aircraft entering the Marine Corps inventory is evaluated in Chapter X. A detailed discussion of the ground defense requirements that will be generated by widely separated multiple EAF's and bare bases is presented in Chapter XI. EAF system organizational, supply, and maintenance issues are examined in Chapter XII, and the EAF system contributions to be made by the 4th Marine Aircraft Wing are summarized in Chapter XIII. Finally, Chapter XIV discusses the conceptual and doctrinal issues drawn from the preceding chapters.

1.2 Mission of the EAF. Despite the lengthy period of time that the EAF and its predecessor, the Short Airfield for Tactical Support (SATS), have been operational they have not been assigned a clearly stated and commonly understood mission. For the purpose of this study that mission is simply "To provide Marine Aviation Combat Elements with the capability to operate ashore in those areas where sufficient operational airfields and facilities are not available."

## 1.3. Historical Development of the EAF.

1.3.1 Conceptual Evolution. The history of the expeditionary airfield system can be traced to the early years of World War II when a Marine Aircraft Group operated from a wooden planked runway using catapult and arresting equipment. Development ensued throughout the post-war years and, in 1956, the Commandant of the Marine Corps (CMC) formally established an operational requirement for the system. In 1958, the expeditionary airfield concept was approved, and the system was designated Short Airfield for Tactical Support (SATS). In 1965, Developmental Bulletin No. 1-65 further revised the concept. On 1 December 1978, CMC letter ASL-42-mog/13800 described a series of building block configurations which coincided with, and supported, the range of operational capabilities required by the ACE in support of the various task organized MAGTFs. The initial building block system allocated to each Marine Aircraft Wing (MAW) consisted of:

- o 6 72' x 72' vertical take-off and landing (VTOL) sites
- o 1 1800' vertical/short take-off and landing (VSTOL) airbase or
- o (3) 600' vertical/short take-off and landing (VSTOL) facilities
- o 1 5200' Expeditionary Airfield (EAF)
- o 1 8000' Strategic Expeditionary Landing Field (SELF) (Available to selected MAW from contingency assets)

NOTE: System provided for either one 1800' foot airbase or three 600' VSTOL facilities.

Since that time, notably in 1980 and 1982, the Commandant of the Marine Corps has been pursuing several changes to the system configuration.

In September 1980, CMC provided for the incorporation of two bare bases in the EAF system within each MAW. For planning purposes, each bare base is envisioned to consist of an 8000 foot long permanent runway without any support capabilities or services. It is also envisioned that these bases will be available to MAGTFs deployed to any area of operations world-wide.

In July 1982, the CMC determined that the 600 foot length VSTOL facility was not in consonance with the normal ground roll requirement of the AV-8B without use of the Medium Girder Bridge (MGB) Ski Jump. The required ground roll, under specified conditions, was determined to be 900 feet with a normal combat load. As a result, CMC recommended to the Naval Air Systems Command (NAVAIR) that the EAF system be modified to provide for two 900 foot VSTOL facilities per MAW vice three 600 foot facilities.

In the same 1982 correspondence, the Marine Corps' increased reliance on the Military Airlift Command (MAC) for transport and logistic support, using C-141, C-5A, and wide body aircraft within the Civil Reserve Air Fleet (CRAF), formed the basis for proposing that each MAW be provided the capability to expand the 5200 foot EAF into a SELF without dismantling the EAF. This is to be accomplished by the development of conversion kits utilizing the AM-2 matting presently held in contingency assets.

Figure 1-1 depicts the current system and reflects the various changes summarized above. It also indicates that the majority of changes are still in the planning stage.

1.3.2 <u>Technological Advances</u>. Concurrent with the EAF's conceptual evolution and the acquisition of equipment to support operations under this concept, advances in technology have also taken place. The increased weight and speed of new aircraft have led to the development of a new landing surface material. The improved take-off performance of the newer aircraft and lengthening of the runway to 5200 feet have obviated the need for catapult equipment. The mirror landing system has been replaced by a Fresnel Lens Optical Landing System

## Current EAF System Configuration

| EAF Facility | Number Per MAW |
|---|---|
| VTOL Site (72' x 72') | 6 |
| VTOL Site (96' x 96') | (8) 1/ |
| VSTOL Facility | (3) 2/ |
| VSTOL Airbase (1800') | 1 |
| Expeditionary Airfield (EAF) (5200') | (1) 3/ |
| Strategic Expeditionary Landing Field (SELF) (8000') | 1 3/ |
| Bare Base (8000') | 2 4/ |

NOTES:

1/ 96' x 96' sites are not currently standard within the system. Matting assets will be provided to each MAW to provide the capability to construct 96' x 96' sites on an as-required basis.

2/ Current system provides for three 600' VSTOL Facilities to be constructed from assets of the VSTOL Airbase (1800') facility. This will be changed to two 900' facilities to accommodate take-off requirements of AV-8B.

3/ EAF will be converted to a SELF through means of a conversion kit. Kit is in design stage.

4/ For planning purposes, consists only of a minimum of 8000' permanent type runway. If necessary, parking aprons, taxiways, and maintenance areas will be constructed from AM-2 matting.

FIGURE 1-1

(FLOLS). Arresting equipment and lighting and marking devices have similary been undergoing improvement. In the main, these changes have been brought about as a result of changing system/operational needs and have been accommodated by utilizing existing technology. Little attention has been focused upon areas of new technology which are emerging and the potential which that technology has for vastly improving the EAF's operational capabilities.

1.4 Related Study Efforts. Having recognized the limited attention accorded the EAF system over the years, the Naval Air Systems Command (NAVAIR) recently chartered two studies which have, inter alia, the objective of enhancing the acquisition, maintenance, and supply systems in support of the EAF.

In the initial effort, "EAF Maintenance and Supply Support Analysis," the EAF components were subjected to a vigorous analysis of maintenance procedures and the levels at which this maintenance was being performed. The contingency utilization of the equipment facilitated implementation of the concept of reliability centered maintenance (RCM) which has as its basic premise, "If an equipment is RFI and operable, don't inspect it." Concurrent with the maintenance analysis, a supply analysis was conducted to validate the accessibility of spare parts support at the appropriate level of repair and to determine if adequate quantities were available to satisfy anticipated usage. While not the principal purpose of the above analysis, organizational aspects of the EAF community were also subjected to review.

The second effort, "10-year EAF Systems Profile", provides commanders, planners, and managers with a comprehensive program management plan which will identify system capabiiities and deficiencies, guide research, development and product improvement, and facilitate acquisition and budgetary planning. It identifies deficiencies within the existing system, other requirements, the actions required to reconfigure or rehabilitate present components, and those required to program for new equipment which might result from emerging technology. Finally, it contains a recommended acquisition profile for two components, i.e., the M-21 arresting gear and the AM-2 matting which require priority efforts toward research, development, and acquisition.

1.5 Objective and Scope of this Study Effort. The objective of this study, as cited in the Statement of Work (SOW), is "To identify changes/modifications that are required to accomplish the most effective EAF system to support the requirements of a task organized Aviation Combat Element (ACE) in support of the mission of a MAGTF (Marine Air-Ground Task Force)."

The scope of work requires the Study Team to, "Analyze operating requirements of the EAF system and recommend changes/modifications to current operational concepts and the organizational structure containing EAF units to include the Tables of Organization and Equipment (TO&E), existing parent organization to which EAF personnel and equipment are assigned, support requirements and sources of support both internal and external to the parent organization, and maintenance support requirements of the EAF System and parent organization."

1.6 The Study Approach. A thorough research of the current literature which bears on the EAF and the military requirements that are its genesis has been conducted. Full use has been made of the reference material provided by the Contracting Officer's Technical Representative (COTR). The literature research has been supplemented by comprehensive discussions with appropriate experts at Headquarters, U.S. Marine Corps (HQMC); NAVAIR; the Naval Air Engineering Center (NAEC), Lakehurst, New Jersey; the Naval Construction Battalion Center, Port Hueneme, California; and operating force personnel thoroughly experienced in the operations of the EAF.

A baseline of EAF capabilities was established in order to conduct a comparative analysis of a range of alternatives which, in turn, permitted the identification of near and mid-term requirements and the changes required to meet those requirements.

Finally, an analysis of major operational, logistic, and organizational functions provided the data necessary to determine the degree to which the EAF system can meet its stated or derived requirement of supporting the notional ACE set forth in the Marine Corps Mid-Range Objectives Plan (MMROP) in the most demanding of the MARCORS scenarios.

1.7 Study Guidance, Development and Assumptions. Throughout the conduct of the study, a range of problem areas and assumptions was identified that required the clarification, guidance, or direction of the SAC to resolve. As an example, the initial focus on conceptual analysis has had to be deemphasized. The study team's attentions and analysis had to be redirected instead to identifying shortfalls between current and future requirements and projected capabilities, and to developing data and rationale to support future Marine Corps progamming efforts to overcome the shortfall.

The guidance received from the SAC and the potential impact thereof on the conduct and outcome of the study are summarized in the following paragraphs and discussed in additional detail throughout this report.

1.8 EAF System Configuration. The SOW directs that the EAF system set forth by the CMC in 1978 form the basis of analysis by the Study Team. However, as discussed earlier, the system has undergone a series of evolutionary changes and the present system, shown in Figure 1-1, has been substituted at the direction of the SAC. As indicated by the footnotes in Figure 1-1, a number of changes are still in the planning stage, e.g. employment of the 96' by 96' Forward Operating Sites, employment of the 900' vice 600' VSTOL Facilities, and final design of the kit to convert the EAF to the SELF. These changes have limited impact on the conduct or probable outcome of the study. However, the concept of planning for the use of bare bases added a new dimension which could significantly affected the study.

1.9 Bare Bases. CMC letter 13890 of 30 September 1980 to Commander, Naval Air Systems Command, provides for the incorporation of two bare bases within the EAF system authorized each MAW. The inclusion of the bare bases (assuming their actual availability) could represent the most efficient use of EAF resources. They could obviate the need for a substantial quantity of matting and thus markedly reduce strategic and tactical lift requirements. Of equal importance, they could significantly reduce the time and effort required to prepare the site and install like-sized facilities using AM-2 matting.

The results of an analysis of the availability of permanent type runways, i.e. bare bases within selected Marine Corps Mid-Range Threat Scenarios and Target List Studies, is reflected in Table 1-1. That analysis established that there is an abundance of such fields. The abundance of adequate bare bases in those areas of the world wherein Marine Corps forces are most likely to be committed

## BARE BASES

### Table 1 - Military Airfields (Over 8,000 Feet)

| MARCOR Scenario | Inside AOA |
|---|---|
| 1A | 10 |
| 2A | 64 |
| 4 | 34 |
| 5 | 20 |

### Table 2 - Civil Airfields

| MARCOR Scenario | Inside AOA | |
|---|---|---|
| | 1250-8000 Ft. | Over 8000 Ft. |
| 1A | 6 | 138 |
| 2A | 18 | 34 |
| 4 | 6 | 11 |
| 5 | 21 | 84 |

TABLE 1-1

raises the question as to whether there is a requirement for each MAW to possess the capability to install a full range of EAF facilities, particularly the larger configurations, e.g., the EAF and/or the SELF.

It was determined by the SAC that the requirement for a full system per MAW be retained to provide for "worst case" planning in order to be consistent with ongoing or programmed Marine Corps studies and to provide a clear, documented accounting of the potential shortfalls between the capabilities of the current system and the most demanding operational requirements.

The Marine Corps, in conjunction with NAVAIR, is in the process of evaluating the EAF component requirements necessary to exploit any 900 foot, 1800 foot and 8000 foot bare base configuration that may be available in an expeditionary environment. Initial efforts will concentrate on the development or procurement of the following bare base lighting packages:

- A service change for brackets and adapters that would allow the current runway edge and threshold lights to be mounted on dirt, macadam, or concrete surfaces.
- Development of a lightweight, battery-operated or optional hard wire powered, radio controlled lighting system for the 900 foot and 1800 foot bare base configurations.
- Procurement of an 8000 foot bare base lighting system.

In addition to development of lighting packages, allowance quantities under appropriate field installation packages have been established for the following EAF components to support enhancement of an 8000 foot bare base:

- Four Rapid Runway Repair Kits
- Two M-21 Aircraft Recovery Systems plus one additional arrester and retrieve engine
- One 8000 foot EAF lighting kit
- One EAF communication system

In the course of the MMROP MAF ACE beddown analysis, the SAC and Study Team initially agreed to concentrate on the inclusion of two 8000 foot bare bases in the MMROP ACE beddown computations and that each bare base would have the same capabilities as the SELF. Subsequently, however, the SAC concluded that the SELF and the 8000 foot bare bases would be individually configured to support the tactical beddown of the ACE. Accordingly, the SAC directed that, for study purposes, each bare base should be assumed to resemble the SELF only in terms of an 8000 foot runway and 140,160 square yards of surfaced parking areas.

1.10 Theatre Airfields. The term "theatre airfields" used in various MARCORS scenarios is not defined in appropriate publications. The SAC has concurred in the following definition: "A fully operational facility in friendly territory, and within 200 nautical miles of the AOA, free of air defense requirements, with all essential support systems, e.g. lighting, fuel, communications." An analysis similar to that conducted regarding the existence of bare bases was also accomplished to identify the existing theatre airfields. Again, as shown in Table 1-2, there is an abundance of such airfields and their potential employment is recognized both within the various MARCORS Scenarios and by the appropriate planners within HQMC. However, their availability is not predictable within the context of this study and the use of such airfields has not been incorporated in the Study Team's considerations. But, as discussed in Chapter IV, the use of theatre airfields to supplement EAF facilities should be pursued as a separate issue, most appropriately by means of an intelligence analysis.

1.11 Use of Captured/Friendly Airfields and Roads. The specific provision within the SOW that captured, repaired, and friendly airfields and roads will be utilized before new EAF facilities are constructed has been clarified by the SAC. Roads may be used as temporary sites for Visual Flight Rules (VFR) operations of helicopters and the AV-8B aircraft. The 900 foot and 1800 foot bare base lighting packages discussed in paragraph 1.9 above, when developed, will be available at these sites to permit night VFR operations for both helicopters and AV-8B aircraft. It is not anticipated, however, that Instrument Flight Rules (IFR) operations will be conducted nor will aircraft be bedded down on a permanent or semi-permanent bases at these road sites.

## THEATRE AIRFIELDS

### Table 1 - Military Airfields
(Over 8,000 Feet)

| MARCOR Scenario | Outside AOA |
|---|---|
| 1A | 50 |
| 2A | 10 |
| 4 | 11 |
| 5 | 90 |

### Table 2 - Civil Airfields

| MARCOR Scenario | Outside AOA | |
|---|---|---|
| | 1250-8000 Ft. | Over 8000 Ft. |
| 1A | 12 | 343 |
| 2A | 18 | 38 |
| 4 | 9 | 36 |
| 5 | 49 | 192 |

TABLE 1-2

Captured, repaired, and friendly airfields fall into one of two categories, i.e., theatre airfields or bare bases. As discussed above, the availability of theatre airfields is a highly subjective issue and one which requires a separate, comprehensive analysis. The EAF system now incorporates two bare bases and while it might be reasonable to assume that additional fields would be available, the limit of two will be adhered to for study purposes.

1.12 Composition of the Aviation Combat Element (ACE). The Statement of Work (SOW) directs that the representative ACE for planning set forth in Tables VII-9 through VII-11 of the Marine Corps Mid-Range Objectives Plan (MMROP) dated 29 April 1983 be evaluated by the Study Team. That ACE, depicted in Table 1-3, consists of 270 fixed wing aircraft and 364 helicopters, for a total of 634 aircraft. That total far exceeds the number now found in the active MAW or in any contingency plan. In fact, it equates to two-thirds of the intermediate mid-range programming force shown in Table VI-1-26 of the MMROP.

It was clear from the outset that the number of aircraft in the MMROP ACE could not be bedded down on the existing EAF facilities without a major expansion of the system and a potentially substantial increase in the support required. As a result, the Study Team proposed that a range of smaller ACE's also be analyzed to arrive at more realistic estimates of the capabilities of the current EAF system to support an ACE comparable to those cited in the Marine Corps Scenarios and those that would be deployed under current contingency plans. The Study Team was directed, however, to limit the analysis to the MMROP MAF ACE to again insure consistency with other studies and to identify potential shortfalls in required assets.

1.13 Beddown Criteria. Early evaluation of the beddown requirements of the MMROP MAF ACE clearly indicated that use of standard beddown criteria contained in the Facility Planning Criteria for Navy and Marine Corps Shore Installations (NAVFAC P-80) could only result in a massive expansion of AM-2 matting requirements and related construction efforts to accommodate the 634 aircraft in that ACE.

Careful analysis determined that safety factors dictate that the helicopters must be parked according to the standard criteria in NAVFAC P-80. In the case

## MMROP MAF AVIATION COMBAT ELEMENT (ACE) 1/

| Aircraft Type | Squadrons | Number A/C | Total A/C |
|---|---|---|---|
| **Rotary Wing** | | | |
| AH-1 | 3 | 24 | 72 |
| UH-1 | 1 | 24 | 24 |
| CH-46E | 13 | 12 | 156 |
| CH-53 A/D | 5 | 16 | 80 |
| CH-53E | 2 | 16 | 32 |
| Total Rotary Wing | 24 | | 364 |
| **Fixed Wing** | | | |
| F-4/F-18 | 6 | 12 | 72 |
| AV-8B | 5 | 20 | 100 |
| A-6E | 4 | 10 | 40 |
| EA-6B | 1 | 15 | 15 |
| RF-4B | DET | 7 | 7 |
| KC-130 | 2 | 12 | 24 |
| OV-10 | 1 | 12 | 12 |
| Total Fixed Wing | 19 + DET | | 270 |
| GRAND TOTAL | 43 + DET | | 634 |

NOTE: 1/ Source: Figures VII-9 through VII-11, MMROP dated 29 April 1983

TABLE 1-3

of the fixed wing aircraft, the safety factor has been compromised, to some extent, by the acceptance of substitute criteria which permit 3 feet wing-tip to wing-tip clearance on both parking aprons and taxilanes. Additional considerations, e.g. maintenance, revetting of aircraft, camouflage limitations, and the increased risks of single round damage to densely packed aircraft are discussed in Chapter IV.

1.14 Logistic Support Matters. The study approach to this area was restricted to an analysis of the level of effort required to install the EAF system and to enhance the two bare bases to the degree necessary to accommodate the beddown of the total MMROP MAF ACE.

The issue of throughput procedures and techniques for Class III(A) and V(A), though important, were determined to be outside the scope of the study, however, planning factors for the MMROP MAF ACE were provided to the Study Team and incorporated in development of logistic support facility construction requirements described in later chapters. In addition, the Study Team did analyze the Class III(A) aviation fuel transfer problem in view of the new demands for Class III(A) support a widely dispersed EAF System would place on, inter alia, the Amphibious Assault Bulk Fuel System (AAFS) and other refueling assets.

Other logistic support issues, discussed with the SAC but not completely developed for inclusion within this study effort, concern: the issue of amphibious lift requirements for the significant square, cube, and weight of equipment and materiel associated with a total EAF System; and, the range of EAF components that merit consideration for inclusion in the inventory of material positioned on Maritime Prepositioned Shipping (MPS).

1.15 EAF System Defense. The SOW required that the Study Team develop alternate postures, and recommend the preferred posture, of ground defense for an EAF located in various environments. Subsequently, the SAC directed that this requirement be addressed only in brief, conceptual terms.

# CHAPTER II

## STRATEGIC CONSIDERATIONS

2.1 General. Marine Corps Mid-Range Threat Scenarios and Target List Study (MARCORS 1A through 5), the Marine Corps Mid-Range Objectives Plan for Fiscal Years 1985-1994 (MMROP, FY85-94), the Marine Corps Mobilization Plan (MPLAN), selected contingency plans, and other classified documents were reviewed to determine the strategic considerations that might impact on the requirements for and employment of the EAF system. The reviews included analysis of the type of operations wherein an EAF might be employed, the environmental extremes which might be encountered, and the nature of potential adversaries and others who may confront the MMROP MAF. The conclusions drawn from the review are reflected throughout the report; however, sanitized summaries of the salient points are set forth in the following paragraphs.

2.2 Strategic Security Interests. It is clear from study of the strategic security interests of the United States, and the defense objectives derived from those interests, that amphibious forces must be prepared to force a beachhead anywhere on the world's littoral. Areas of critical interest are the Northeast Atlantic, the GIUK Gap, Southern Europe, Central and South America, Southeast Asia, the Far East (Korea), South Asia, the Middle East, and Northern Africa. Certainly, a case can be made that other areas are of equal strategic importance. However, the foregoing areas serve to establish the outer limits of the environment which might be encountered, the range of capabilities potential enemies might possess, and the range of capabilites that the amphibious forces and, in particular, the landing forces must possess to overcome the threat.

Operations in the GIUK Gap or on the littoral of the North Atlantic will most certainly be conducted in sub-Arctic weather the year round and in conditions of extreme cold in the winter months. In this environment, not only will operations be exceedingly difficult, but logistic support, to include maintenance efforts, can be expected to become an extremely demanding task.

At the other end of the operational and environmental spectrum lies the Middle East and North Africa where desert operations, with problems and challenges involving extreme heat, dust, and a lack of sufficient water supply, will prevail. The desert operations will be further complicated by rugged mountains which are both difficult and dangerous for surface traffic, and which increase an already heavy logistic burden associated with the establishment of the EAF ashore and the conduct of air operations. Between the two climatological extremes, the potential areas of operations are primarily temperate in climate, but geographic features such as mountains, swamps, and other unstable soil conditions, unsuitable for installation of EAF systems without extensive engineering effort, must be anticipated and plans made accordingly.

## 2.3 Nature of The Threat.

2.3.1 Opposing Forces. The threat analysis is keyed to MARCORS scenarios 1A through 5 which range in coverage from a major conflict in Europe to a mechanized force engaged in Northeast Asia, to independently initiated, small unit harrassing attacks by terrorist organizations, partisan sympathizers, or indigenous militia forces in Southeast Asia. However, in order to establish a reasonable "worst case" analysis, the study concentrated on MARCORS scenario 1A which envisions the employment of a MAF against a Soviet Motorized Division supported by that slice of Soviet aviation normally associated with such a division.

The Soviet division possesses an obvious advantage over the Marine Division in mobility, fire power, and shock action, and the ability to deploy rapidly in mass along a broad front. It presents a most formidable challenge to the MAF, particularly with regard to the potential need for the MAF to defend a full array of expeditionary airfields. A comparison of the relative personnel strengths and selected weapons possessed by the opposing forces (classified data) establish that there is a substantial disparity that favors the Soviet division.

The aviation force available to the Soviet division consists of a proportional share of the Soviet Air Army reinforced by assets from the Long Range Air Army and Soviet Naval Aviation. The proportional share identified for analysis (classified) assumes that the Soviet division will engage in a main effort, which is the case in scenario 1A. The considerable enemy air effort, in terms of type and number of sorties that may be generated, is supplemented by an awesome array of air defense capabilities. The considerable threat confronting the MAF, and especially the EAF system, clearly suggests the initial requirement for a full range of combat and combat support forces to include forces afloat and, where possible, friendly air support operating from theatre airfields.

2.4 Theatre Airfields/Bare Bases. The various scenarios provide for the use of theatre airfields outside the AOA and bare bases uncovered within the AOA. While planning for use of such airfields is certainly sound, there are several limiting factors that should be considered in contingency planning:

- Access to friendly or allied airfields may be denied U.S. forces.
- Suitable bare bases may not exist in the area of operations or may not be uncovered on a timely basis.
- Theatre airfields and bare bases may be the target of enemy denial operations.

Access to friendly nation and/or airfields of our allies has been denied to U.S. forces with sufficient frequency in the recent past to confirm the need for the Marine Corps to maintain a viable EAF capability in a high state of readiness.

Although an analysis of the potential AOAs in the MARCORS scenarios indicates the existence of a relatively large number of bare bases, there are areas of the world wherein such bases will not exist. Additionally, in those areas where they do exist, their availability will be dependent upon their being uncovered on a timely basis and/or upon the success of the enemy's efforts to deny their use. The potential for the Soviet and Soviet bloc forces to conduct effective denial operations is strong enough and the influence of these actions on the employment of the EAF sufficient enough to merit discussion.

2.5 Denial Operations. As discussed in FM 31-10, "Denial Operations and Barriers," areas or objects having tactical or strategic value to an opposing force are prime candidates for denial operations. Operational airfields and bare bases, vital to the conduct of MAGTF operations, especially in wartime, can be reasonably assumed to rank high in a priority list of targets to be attacked and made inoperative for a predetermined optimum denial period.

The denial of airfields and bare bases by cratering, toxic chemical or nuclear contamination, mining, and even occupation by airborne or amphibious assault forces can disrupt operational and logistic support of the MAGTF unless compensatory capabilities are available.

2.5.1 Types of Denial Operations. As noted previously, denial operations can take a variety of forms. Such operations are strategic in concept, and vary widely in scope. At one extreme is a scorched earth policy in which an entire region is made useless to the enemy. At the other extreme is a small-scale operation in which the use of a specific area or facility is temporarily denied to the enemy. The scope of most denial operations normally lies somewhere between the two extremes. The exception may occur in those instances where terrain is traded for time in the face of an overpowering enemy offensive capability, as occured in 1942 when the Germans closed on Moscow.

Enemy denial operations, involving deliberate destruction of airfields or bare bases with atomic demolition munitions, could render the installation unusable in terms of nuclear contamination and the time, materiel, and effort needed to repair massively cratered runways. In such a situation the MAGTF would have to install the EAF system configuration needed to support the size ACE deployed.

Those denial operations involving the use of toxic chemical contamination, mining of the installation or approaches to it, or occupation of the site by enemy forces without deliberate massive destruction of runways and structures by atomic demolition munitions, can be categorized as limited scope operations. Damage to existing facilities would be temporary in nature, and appropriate counterforce or rehabilitation measures, including use of some EAF system components, could remove the impediments to use of the facility by the MAGTF. Such interdicted air installations could be made operational for fixed wing aircraft to a degree and within a time frame that would obviate the need to install a complete EAF system.

The cratering of runways and destruction of facilities at matted airfields or bare bases with conventional munitions would delay deployment of air assets ashore. However, airfield rehabilitation for use by fixed wing assets is not an insurmountable task, particularly if EAF system components are employed.

The essential point, however, is that the EAF system and its components provide a MAGTF with the means to effect rapid, temporary rehabilitation of air facilities damaged by enemy denial actions short of nuclear demolition.

2.6 Summary. National strategic security interests, and the defense objectives derived therefrom, dictate a continuing requirement for amphibious forces prepared for and capable of forcing a beachhead anywhere on the world's littoral.

The existing threat ranges from a major conflict against Soviet or Warsaw bloc nations in Europe or Northeast Asia to independent actions of a lesser scope worldwide.

While use of theatre airfields or bare bases must be planned for, the limitations on their use as a result of diplomatic/political decision or denial operations reinforce the need for the MAGTF to possess a full range of EAF capabilities, including rapid runway repair, to ensure that landing force aviation can be established ashore in the early stages of an operation.

# CHAPTER III

## SYSTEM REQUIREMENTS AND DESCRIPTION

3.1 General. To provide a point of departure for the analysis presented in subsequent Chapters, it is first necessary to define the functional requirements of the EAF inherent in its mission statement and selected factors bearing on them. Next, the six different airfield configurations that comprise the total system are described followed by a brief explanation of the five major components of the system.

3.2 System Functional Requirements. General functional requirements inherent in the EAF's mission statement are that the system must:

- Provide a range of rapidly emplaceable launch/landing surfaces.
- Accommodate all aircraft types/sizes (rotary wing, VTOL, VSTOL, fixed wing fighter and attack, and strategic lift) either through normal or arrested landing as appropriate.
- Be operable under all meteorological conditions on a twenty-four hour basis.
- Be operable in a variety of climatological environments.
- Support the operational tempo of variously configured ACEs on a sustained basis.

Additional factors bearing upon the functional requirements are:

- Because of the weight and cube involved in deployment of the EAF, its employment may be constrained by the availability of strategic and/or tactical lift.
- To facilitate installation and field maintenance, the components of the system must be relatively unsophisticated.

3.3 System Configurations. As stated in the introductory chapter, in 1978 the CMC set forth the initial configuration of the modern EAF building block concept. The current configuration of the individual building blocks are illustrated in Figure 3-1. As previously stated, several changes to the original system have been approved, however, the detailed descriptions and configurations are still in the planning stage. The following descriptions will, where appropriate, recognize the changes although it is not possible at this point in time to set forth a full array of details.

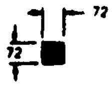
3.3.1 Forward Operating Site. A 72' by 72' pad of AM-2 matting which can normally be installed rapidly providing sufficient cleared, level ground is available and the approaches are free of obstructions. Each site can accommodate one helicopter or one VSTOL aircraft and may be provided with a Helicopter Expedient Refueling System (HERS) and limited ordnance support. In discussions with representatives of HQMC (Code ASL) it was determined that each MAW will be allocated sufficient additional AM-2 matting to permit the installation of eight 96' X 96' VTOL sites to accommodate unusual situations. However, the 72' X 72' site will continue to be the primary size site and will be reflected in all planning documents.

Currently, NAEC, Lakehurst, NJ is pursuing a two phase VTOL site lighting package development program. In Phase I current lighting systems (i.e., Heliport and GALE lighting systems) will be modified with adapters and brackets of sufficient strength to withstand the AV-8B generated heat blast to provide a capability for day/night helicopter and day AV-8B operations. In Phase II, a lighting system based on portable electro-illuminescent technology will be developed to permit night operations for both helicopter and AV-8B aircraft from VTOL sites.

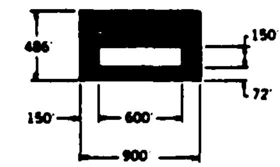
3.3.2 VSTOL Facility. Under the original building block concept, the forward operating site was normally expanded into a 600' VSTOL Facility. The runway length in the future will be increased to 900' to provide for the additional take-off requirements of the AV-8B under selected operating conditions. The facilities are normally constructed from the assets of the VSTOL Airbase (1800') and the increased runway length of the facility (i.e. 900 feet), will decrease the number of facilities that can be constructed from three to two.

## FIELD CONFIGURATIONS

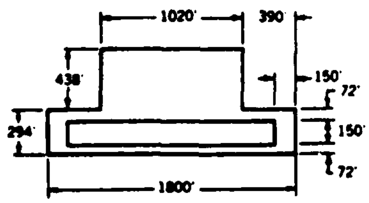
January 3, 1983




① VTOL




② VSTOL FACILITY



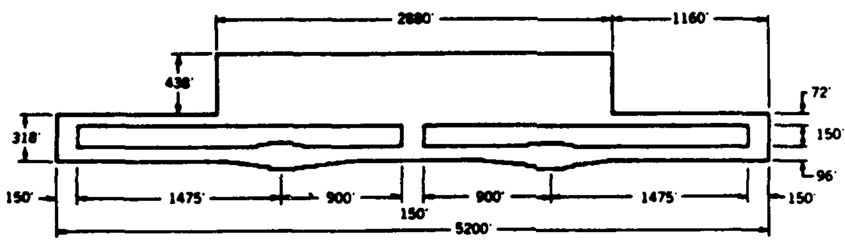

③ VSTOL AIRBASE

| MATTING SUMMARY | | | | | | | |
|---|---|---|---|---|---|---|---|
| FIELD CONFIGURATION | | PER FIELD | PER WING | | FMF TOTAL | | |
| | | SQ.FT | FIELD QUAN | SQ.FT | FIELD QUAN | SQ. FT. | |
| ① | VTOL 72 FT | 5,184 | 6 | 31,104 | 18 | 93,312 | 1/ |
| ② | VSTOL FACILITY 900 FT | 347,400 | 2 * | * | 6 * | * | |
| ③ | VSTOL AIRBASE 1800 FT | 750,960 | 1 | 750,960 | 3 | 2,252,880 | |
| ④ | EAF 5200 FT | 2,257,980 | 1 | 2,257,980 | 3 | 6,773,940 | |
| ⑤ | SELF 8000 FT | 3,163,980 | 1** | 906,000 | 3** | 2,718,000 | |
| | TOTAL | | | 3,946,044 | | 11,838,132 | |

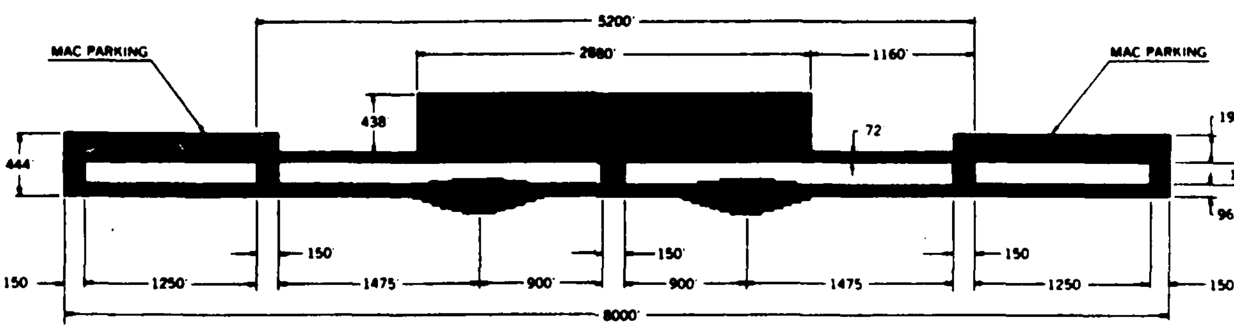
* MAKE FROM VSTOL AIRBASE ASSETS

** CONVERSION FROM 5200 FT ONLY

Note: 1/ Total matting will be increased by 73,728 square feet per MAW to provide the capability to construct eight 96' x 96' pads as required.




④ EXPEDITIONARY AIRFIELD (EAF)




⑤ STRATEGIC EXPEDITIONARY LANDING FIELD (SELF)

FIGURE 3-1

These facilities are capable of supporting helicopter, VTOL and VSTOL aircraft and may be equipped with a Fresnel Lens Optical Landing System (FLOLS); a control tower; communications system; a Tactical Airfield Fuel Dispensing System (TAFDS); ordnance and weather support; limited aircraft parking and maintenance areas; and the AN/TPN-30 of the Marine Remote Area Approach and Landing System (MRAALS). Modifications to VSTOL facility lighting systems and those systems under development will permit their installation at any available 900 foot bare bases in an AOA in lieu of, or prior to, construction of a VSTOL facility.

3.3.3 VSTOL Airbase. The third phase of the building block concept, the VSTOL Airbase, features an 1800 foot runway and an expanded support and maintenance capability that can normally support at least one VSTOL attack aircraft squadron and twenty-four helicopters. The support services available include those provided for the VSTOL Facility, and an all-weather traffic control capability. The VSTOL airbase lighting system components are being modified for use at any 1800 foot bare base that may be available in an AOA.

3.3.4 Expeditionary Airfield (EAF). The VSTOL Airbase can be expanded into an Expeditionary Airfield (EAF) with a 5200' x 96' runway. As presently configured, the EAF is capable of supporting six squadrons of light to medium fighter/attack aircraft in addition to a complement of reconnaissance aircraft and helicopters; a total of 88 aircraft. The EAF normally employs two FLOLS, two sets of M-21 arresting gear for the recovery of aircraft, as well as field lighting and a communication system. In addition to the support services provided to the VSTOL Airbase, the EAF is equipped with a Marine Air Traffic Control Detachment, an expanded maintenance/supply unit, and an airfield operations unit. The installation of the EAF provides the commander ashore with the capability to ensure that independent, sustained combat operations can be pursued upon termination of the amphibious operation and the departure of major portions of naval forces from the objective area.

3.3.5 Strategic Expeditionary Landing Field (SELF). The largest of the expeditionary airfields, the SELF, provides an 8000 x 96 foot runway capable of supporting 96 tactical, transport, and inter theatre (e.g., C-5) aircraft. Support activities, such as fueling, ordnance, maintenance, material handling, and air traffic control can be expected to increase consistent with the expanded role of the facility. The present concept requires the construction of a new installation, however, as cited in the first Chapter, CMC has proposed that a conversion kit be developed that will permit the rapid expansion of the 5200' EAF to a SELF.

3.3.6. Bare Base. As stated earlier, in September 1980, CMC provided for the incorporation of two bare bases within the EAF system authorized each MAW. As will be discussed in greater detail in later chapters, other than prescribing the runway length as 8000', there is no detailed description of the bare base in the 1980 correspondence or in any subsequent correspondence on the subject. Discussions with representatives of the SAC disclosed that NAVAIR and the Naval Air Engineering Center (NAEC), Lakehurst, New Jersey are in the process of defining the configuration, desired operational capabilities, and the EAF components and other support required in order to provide a standard configuration.

For planning, however, it has been assumed that the bare bases do not possess those logistic support services, e.g., lighting, and fuel dispensing systems required by the ACE.

For purpose of this study, the SAC has established that each bare base will possess 140,160 square yards of parking area. The SAC also concluded that the precise configuration of the bare bases along with those of the EAF and the SELF will be determined by the Study Team employing the detailed base loading plan provided by the SAC; that is, the configuration of the EAF facilities in terms of parking aprons, taxilanes, and taxiways will be derived through the process of bedding down the number and type of aircraft assigned to each facility.

3.4 The Components. Having defined the functional requirements of the EAF system, and described the various EAF configurations, it is appropriate to briefly discuss the five major components of the system (AM-2 matting and earth anchors, M-21 Aircraft Recovery System, lighting and marking systems, Fresnel Lens Optical Landing System (FLOLS), and the Short Range Communications System). The several parts of each component, the packages which are assembled to constitute complete components, and auxiliary packages such as the Tool Trailer, Package F-24 are not discussed. Detailed logistic information on each component can be found in NAVAIR 51-35-7, Technical Manual, Logistics Data Initial Staging Area to Field Installation, Expeditionary Airfields.

3.4.1 <u>AM-2 Airfield Landing Mat and Accessories</u>. AM-2 matting and related components are used to provide the emplaceable landing, take-off, taxiway, and parking surfaces for all of the EAF system building blocks. Weighing six pounds per square foot, a standard mat panel is an extrusion of high strength aluminum alloy 12 feet x 2 feet x 1 1/2 inches. Half panels are 6 feet x 2 feet. Panels are placed in a brickwork pattern; each panel being interconnected by a locking bar to form a covering of virtually any shape or size. Spacer mats are available to correct runway installation spacing problems. Matting is capable of sustaining 1,600 cycles of aircraft operations with a 27,000 pound single wheel load and a 400 pound per square inch (PSI) tire inflation pressure when the subgrade has a California Bearing Ratio (CBR) of 4.0 or greater.

Heavy-duty mats are provided for use on the runway sections where the arresting cable is situated. These panels are 1 1/2 feet wide and 6 feet long. The top and bottom surfaces, as well as the internal channels, are approximately three times thicker than the regular matting to prevent cable-induced damage to the upper surface during arrestment.

Blast deflectors which may consist of mat sections positioned at approximately a 60° angle to the horizontal, are installed along the edges of the taxiways and parking areas to deflect jet engine blast and rotor wash. They also help to minimize the amount of dust/FOD stirred up.

A number of accessories are available to increase the utility of the matting. Starter keylocks are narrow mats which are used in the center of the strip. Panel laying may then proceed simultaneously in both directions from the starter keylock, decreasing the panel placement time.

Ninety-degree connectors are used to join areas of matting which are placed at right angles to each other, such as between the taxiways, the runway, and parking areas.

Aircraft tie-downs are installed directly on the AM-2 matting surface.

Centerline lighting of the runway is accomplished by emplacing 10-1/2 inch matting inserts containing the lighting units at various intervals along the length of the runway.

The LEA-20 Earth Anchors and cruciform stakes secure matting sections to the ground. The anchors are imbedded in the earth from six to twelve feet deep. The anchor is driven into the soil until only a few inches remain above the ground surface. An electrically exploded cartridge is then inserted and lowered to the bottom of the anchor tube, and actuated to produce the following results:

- o Ejection of the driving point.
- o Flaring and splitting of the lower end of the anchor into prongs or tines.
- o Creation of a camouflet (spherical cavity) in the earth between 12 and 15 inches in diameter, depending upon the type of soil involved.

Grout is funneled into the camouflet and an anchor foot assembly inserted. The grout requires a minimum of one hour to set up. Once set, the equipment being secured may be mounted on the exposed end of the anchor.

Earth anchors have not been reuseable, though removable earth anchors are being developed by NAEC.

Table 3-1 depicts the square footage, weight, and cube of the matting required by each building block in the 1978 system and the time normally required to install the matting on a prepared surface.

3.4.2 <u>M-21 Aircraft Recovery System</u>. The M-21 Aircraft Recovery System is employed on the Expeditionary Airfield, SELF, and the bare bases to provide a short field landing capability for high performance aircraft or where a conventional rollout is impractical. The unit consists of two arrester engines, two diesel retrieve engines, a cross deck pendant, nylon tapes wound on reels, and LEA-20 anchoring devices. The arresting engine is a hydrodynamic unit utilizing the vortex principle of energy absorption. It consists of reel

| MATTING SUMMARY<br>1978 EAF SYSTEM | | | | | |
|---|---|---|---|---|---|
| BUILDING BLOCK CONFIGURATION | QTY. PER AIRCRAFT WING | INSTALLATION TIME (MAN HOURS) | TOTAL AREA (SQ. FT.) | GROSS WEIGHT (LBS.) | GROSS VOLUME (CU. FT.) |
| VTOL Pad 72 x 72 | 6 | 96 | 31,104 | 228,000 | 6,864 |
| VSTOL Facility (1) 600 feet | (2) 3 | 3,072 | 246,600 | 5,064,000 | 147,936 |
| VSTOL Airbase 1800 feet | 1 | 7,168 | 750,960 | 5,068,000 | 149,146 |
| Expeditionary Airfield (EAF) (5200 feet) | 1 | 20,640 | 2,267,580 | 15,144,000 | 447,394 |
| Strategic Expeditionary Landing Field (SELF) 8000 feet | (3) | 25,344 | 2,607,000 | 17,158,000 | 507,131 |
| AIRCRAFT WING TOTAL | | | 3,049,644 | 20,440,000 | 603,404 |
| GRAND TOTAL | | | 5,656,644 | 37,598,000 | 1,110,535 |

<u>NOTES</u>: (1) These facilities are constructed from airbase assets. Area, cube, and weight are not cumulative in MAW total.

(2) Eventual change to two 900 foot VTOL facilities anticipated.

(3) Only one in system. A war reserve asset. Matting may be used to construct kits to convert the three EAF's to three SELF's.

TABLE 3-1

and tape mechanism with throttle and an energy absorber. The braking force of the energy absorber is derived from the vortex motion of ethylene glycol fluid contained in a cavity beneath the tape reel. A built-in mechanical brake system maintains deck tension. The design energy of the system is in excess of 56,000,000 foot-pounds. The nylon tape is eleven inches wide and runs out approximately 765 feet.

A cooling system is available for dissipating the heat buildup in the absorber base fluid when the arresting gear experiences a particularly high usage rate, or when the ambient temperature is high.

After recovery, the retrieve engines drive the reel in the opposite direction rewinding the tape. This positions the deck pendant in its pretensioned battery position.

The arrester engines are secured to the earth's surface by earth anchors and cruciform stakes preventing movement during arrestment and retrieval.

One complete M-21 Aircraft Recovery System weighs 54,738 pounds and occupies 2,600 cubic feet. The installation time required is 348 man hours.

3.4.3 Lighting and Marking System. The all weather, round-the-clock operation functional requirement is achieved by the installation of an airfield marking and lighting system. Major components of the system include:

- An electrical distribution vault
- Two types of constant current voltage regulators (4Kw and 15Kw)
- Distribution cabling of high intensity approach lights (white)
- Approach light with strobe lights
- High intensity bi-directional runway lights (white)
- Low intensity taxiway lights (blue)
- Circling guidance lights
- Runway threshold lights (red or green)
- Runway centerline lights (flush mounted within specific sections of AM-2 matting)
- A rotating airfield beacon (green/white)

- o Obstruction lights (red)
- o Lighted wind indicators
- o Runway status lights
- o Flood lights

Although development is underway on a lighting/reference system for use on the VTOL sites, none are in use at this time. With the exception of the sites and the VSTOL Facility, the remaining building blocks of the system have all of the elements of the lighting and marking system listed above in common. When service changes to adapters and brackets have been made, the lighting and marking system and its components listed above, except for runway centerline lights, will be available for installation on 900 foot and 1800 foot bare bases. Table 3-2 displays the weight, cube and time required to install the lighting system for each building block configuration:

Lighting and Marking System Installation Requirements

| Field Configuration | Weight (lbs) | Volume (cu ft.) | Installation Time (Man Hours) |
|---|---|---|---|
| VSTOL Facility | 42,200 | 3,297 | 388 |
| VSTOL Airbase | 75,700 | 5,787 | 912 |
| EAF | 114,750 | 8,825 | 1,610 |
| SELF | 150,000 | 10,656 | 1,760 |

TABLE 3-2

3.4.4 Fresnel Lens Optical Landing System (FLOLS MK 8 MOD 0). The portable shore-based Fresnel Lens Optical Landing System (FLOLS), is a trailer mounted electro-optical landing aid for use on VSTOL Airbases, EAF's, SELF's, and bare base facilities. The FLOLS is comprised of a 1/4 ton two-wheeled trailer upon which are mounted a frame assembly, cell frame assembly, cell assemblies, junction box, spare parts box, reel assembly, separate wave-off assembly, a source light failure indicator assembly, leveling jack assemblies, and a hook-to-eye roll drive assembly. Other accessories include a sighting mirror assembly and a remote pickle switch. A pilot whose aircraft is approaching a runway equipped with a FLOLS can visually establish and maintain the proper glide angle for landing. The system produces a horizontal bar of light that appears in a fresnel lens cell, and the position of the light bar with respect to a set of fixed, horizontal datum lights indicates to the pilot whether he is above, below or centered on the correct glide slope. The bar of light is formed by the combined actions of the source lights, fresnel lenses, and lenticular lenses. The light bar appears above the horizontal datum lights if the glide slope is too steep and below them if the glide slope is too shallow. When aligned evenly with the datum lights, the aircraft approach glide slope is correct for a proper landing.

Normally, two FLOLS units are installed at each of the EAF building block installations previously indicated. Packaged, the individual units have a gross cube of 900 cubic feet and weight of 4,500 pounds. Installation time for a single unit is 18 man hours.

3.4.5 Short Range Communications System. The EAF Short Range Communications System provides a means of rapid, nonsecure voice communications to assist launch and recovery personnel in conducting safe, efficient aircraft operations. The system consists of twelve 2.5 watt commercial type portable VHF FM radios with carrying cases and covers, eight headsets and adapter cables, rechargable batteries, and two battery chargers (a single unit charger and a six unit charger).

Communication system sets are available for all EAF building blocks except the VTOL pad. Each has a gross weight of 90 pounds and occupies six cubic feet.

3.4.6 Ski Jump Ramp. In addition to the components cited in the preceding sections, another innovative EAF development is under consideration. Headquarters, U.S. Marine Corps, NAVAIRSYSCOM, and selected field organizations have validated the feasibility of the "ski jump" ramp. Developed by the British, the "ski jump" consists of a medium girder bridge structured ramp which can be married to an EAF matted runway surface of variable length. The ramp allows aircraft to become airborne after a minimal take-off run and allows for increases in payloads which is particularly important for the AV-8's. The feasibility of utilizing the system with F/A-18's is also under consideration.

3.5 Summary. The components of the EAF are generally satisfactory and all currently meet their functional requirements; however, there is room for improvement. The matting component, for example, requires an extraordinary amount of strategic and tactical lift. Reduction in its cube and weight would significantly assist in alleviating that problem. The M21 arresting system, while performing very well, is heavy, time consuming to install, and relatively slow in operation. The field lighting system was designed to meet Federal Aviation Agency (FAA) specifications for major commercial airfields and is probably more complex than is required by the expeditionary airfield system in a combat environment. Modern technology, applied to improving these components and employment of the "ski jump" ramp, could substantially reduce the logistic burden of the EAF system and make it simpler and more responsive to the needs of the Aviation Combat Element of the MAGTF.

## CHAPTER IV

## BEDDING DOWN THE ACE

4.1 Setting the Stage. This Chapter outlines the results of the analysis conducted to determine the capabilities and deficiences of the 1978 and current EAF systems to accommodate the beddown of the 634 aircraft within the MMROP MAF ACE. It identifies the aircraft base loading plan suitable to the Marine Corps, discusses the criteria used in evaluating alternative solutions to bedding down the MMROP ACE, identifies the need to significantly expand the size of the current facilities to accommodate the ACE, cites the additional resources required to install the expanded system, and summarizes the potential risks associated with accepting the beddown concept employed.

4.2 Beddown on the 1978 System. The EAF system allocated to each MAW in 1978 had the capability of bedding down a total of 241 aircraft. Although not stated in any applicable documents, it has been determined by evaluation of the data, that the 1978 base loading plan was predicated on the standard criteria for parking aircraft set forth in the "Facility Planning Criteria for Navy and Marine Corps Shore Installations, (NAVFAC) P-80." That criteria, in terms of square yards of parking area required, is contained in Tables 113-20B of NAVFAC P-80 and is depicted in Table 4-1. Table 4-2 shows the 1978 EAF system base loading concept.

PARKING AREA CRITERIA

| Aircraft | Square Yards Per Aircraft | |
|---|---|---|
| | 45° Parking | 90° Parking |
| F-4 | 1065 | 1860 |
| F/A-18F | 1080 | 1920 |
| A-6 | 1460 | 1700 |
| AV-8B | 800 | 1280 |
| UH-1 | - | 1195 |
| AH-1 | - | 1195 |
| CH-46 | - | 1533 |
| CH-53D | - | 2784 |
| CH-53E | - | 3398 |

TABLE 4-1

## BEDDOWN - 1978 EAF CONCEPT

(Base loading as contained in CMC ltr 13800
of 1 Dec 1978 to COMNAVAIRSYSCOM)

| SIX VTOL SITES 72' X 72' | VSTOL AIRBASE (1800') or, 3 VSTOL Facilities (600') | EAF (52000") | SELF (8000') |
|---|---|---|---|
| 1AV-8B or HLCPTR on sites and 2 in Hides | 12 AV-8B<br>12 CH-46<br>4 CH-53<br>6 AH-1<br>2 UH-1 | SQDN / A/C / #<br>3 / F-4 or F/A-18 / 36<br>2 / A-4/AV8B / 40<br>1 / A-6 / 12<br>(or a combination of fixed/rotary wing) | SQDN / A/C / #<br>3 / F-4 or F/A-18 / 36<br>2 / A-4/AV-8B / 40<br>1 / A-6 / 12<br>DET / KC-130 / 8<br>C-5, C-141 or DC-8 / 3 |
| 18 A/C | 36 A/C | 88 A/C | 99 A/C |

SUMMARY

| | |
|---|---|
| Rotary Wing | 24 |
| Fixed wing | 214 |
| Total ACE | 238 |
| Strategic Lift | 3 |
| Grand Total | 241 |

TABLE 4-2

Using standard parking criteria, a shortfall of 393 aircraft would exist if an effort were made to beddown the MMROP ACE on the 1978 configuration. Evaluation of the capability of the 1978 system to accommodate that ACE using various combinations of standard and non-standard parking criteria reduced the shortfall to some extent; however, none of the alternatives considered provided a capability to beddown more than fifty percent of the ACE. Further evaluations were considered of limited value - even for comparative purposes - and the study effort was directed towards evaluating the capabilites of the current system.

4.3 Beddown on the Current EAF System. As a first step in such an evaluation, it was necessary to determine an appropriate configuration for the two bare bases. As stated in Chapter I, for planning purposes, they were to be considered as being 8000 feet of permanent, hard surface runway and 140,160 square yards of parking area, but without additional support services. Initially, it was agreed upon by the SAC and the Study Team that, for study purposes, the configuration of each bare base would be identical to that of the modified SELF, i.e., the EAF expanded to a SELF by means of a conversion kit. In effect, this placed a constraint on the evaluation in that the configuration of the various facilites were "inviolate", i.e., they could not be expanded to accommodate excess aircraft. Other factors/ limitations bearing on the analyses are:

- o Because the potential hazards of extremely close operations appeared to outweigh any space saving advantages, the parking criteria for both fixed and rotary wing aircraft, contained in NAVFAC P-80 and outlined in paragraph 4.2 above, were used initially except that the width of the taxilanes was reduced to 72 feet from 150 feet.
- o Although it was recognized that VTOL sites and/or collocated hides are not normally used to beddown aircraft, 18 AV-8B's were so dispersed in an effort to utilize all available options.
- o The evaluation centered on bedding down all aircraft on AM-2 matted surfaces and not resorting to off-ramp parking.

Despite the parking criteria used, the "modified" current system, (i.e., wherein the two bare bases are identical in configuration to the SELF), could only accommodate 270 aircraft, leaving a shortfall of 364. See Table 4-3.

BEDDOWN OF MMROP MAF ACE ON CURRENT EAF SYSTEM

| VSTOL SITES/HIDES | VSTOL AIRBASE | SELF (EAF CONVERSION) | | | BARE BASE #1 | | | BARE BASE #2 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 18 AV-8B (Total) | 4 CH-53E | SQDN | A/C | # | SQDN | A/C | # | SQDN | A/C | # |
| | 12 CH-46E | | | | | | | | | |
| | 4 AH-1 | 2 | F-4 | 24 | 2 | F-4 | 24 | 2 | F-4 | 24 |
| | 2 UH-1 | 1 | AV-8 | 20 | 2 | AV-8 | 40 | DET | RF-4B | 7 |
| | | 2 | A-6 | 20 | 1 | A-6 | 10 | 1+ | AV-8B | 22 |
| | | DET | KC-130 | 8 | DET | | 8 | 1 | EA-6B | 15 |
| | | | | | | | | DET | KC-130 | 8 |
| 18 | 22 | | | 72 | | | 82 | | | 76 |
| | | Plus 3 Stategic Lift A/C | | | | | | Total Beddown | | 270 |

MMROP ACE = 634 Aircraft

Aircraft Bedded Down = 270

Shortfall in Beddown Capacity = 364

SHORTFALL BY TYPE

| TYPE A/C | SQD | A/C |
|---|---|---|
| A-6E | 1 | 10 |
| OV-10 | 1 | 12 |
| CH-53A/D | 5 | 80 |
| CH-53E | 2(-) | 28 |
| CH-46E | 12 | 144 |
| UH-1N | 1(-) | 22 |
| AH-1 | 3(-) | 68 |
| | TOTAL | 364 |

TABLE 4-3

It was now clear that if standard parking criteria were used, it would be necessary to expand the size of the individual facilities, unless the helicopters were parked off-ramp, with all the attendant difficulties of such parking.

4.4 Beddown on Expanded Current System Using Standard Parking Criteria. The next analysis centered on ascertaining the extent of expansion that the current system would have to undergo to beddown the complete MMROP ACE using standard NAVFAC P-80 criteria. In this and following analyses, the expansion was limited to the three major facilities, i.e., the SELF and the two bare bases. The 1800 foot VSTOL Airbase or the two 900 foot VSTOL Facilities were not reconfigured or expanded in this or the following options on the premise that increased density forward in the AOA would be tactically unsound, and that any reasonable increases in ramp space at the smaller configurations would only marginally improve total beddown capabilities.

As depicted in Table 4-4, it would require an additional 285,614 AM-2 matting panels (2'X12') to expand the SELF and to provide adequate parking aprons on the bare bases to beddown the ACE. It would also require a substantial increase in the lighting and marking system; however, the specifics of that requirement have not been identified. The assets currently allocated to the SELF, which is stored as a contingency asset, are not sufficient to convert the three EAFs (one per MAW) to the SELF configurations even without increasing the size of the parking area.

4.5 Beddown on the Expanded Current System Using Selected Non-Standard Criteria. The preceding option was unacceptable to the SAC both in terms of the dollar costs and in light of the fact that the standard criteria set forth in NAVFAC P-80 is primarily applicable to permanent shore based facilities and not expeditionary airfields. As a result, the SAC directed that an analysis be conducted using selected non-standard parking criteria.

BEDDOWN ON EXPANDED CURRENT SYSTEM USING STANDARD PARKING CRITERIA

| SITE | PARKING APRON REQUIRED SQUARE YARDS | PARKING APRON AVAILABLE SQUARE YARDS | APRON SHORTFALL SQUARE YARDS | ADDITIONAL MATTING REQUIRED (2'x12' PANELS) |
|---|---|---|---|---|
| FAC-1 | 31,644 | 33,600 | — | — |
| FAC-2 | 31,644 | 33,600 | — | — |
| SELF | 241,868 | 140,160 | 101,708 | 38,141 |
| BB1 | 371,705 | 140,160 | 231,545 | 86,829 |
| BB2 | 568,546 | 140,160 | 428,325 | 160,644 |
| | | | | 285,614 MATS |

NOTES: 1. The computation includes 25% of all helos down for maintenance and parked in folded blade configuration.

2. Includes 150' vice 72' peripheral taxilane.

TABLE 4-4

As in earlier evaluations, the criteria used for helicopters were those established in NAVFAC P-80 with the exception of helicopters with blades folded. The parking criteria used are in Table 4-5.

ROTARY WING PARKING CRITERIA

| Aircraft | Rotors Extended (Square Yards) | Rotors Folded (Square Yards) |
|---|---|---|
| UH-1 | 1195 | 90 |
| AH-1 | 1195 | 90 |
| CH-46E | 1533 | 140 1/ |
| CH-53D | 2784 | 140 1/ |
| CH-53E | 3398 | 140 |

NOTE: 1/ When these aircraft are in rotor folded configuration the actual requirement is close enough to 140 square yards to warrant use of this figure.

TABLE 4-5

The fixed wing aircraft were dense packed using the following combination of standard and nonstandard criteria:

- Aircraft parked at 45° angle
- Wings folded on all parked aircraft with foldable wings
- Wing-tip to wing-tip separation for both parking and taxiing would be 3 feet
- Width of taxilanes would be based on turning radius and 3 feet wingtip separation
- Peripheral taxilanes (72' wide) would be based upon the largest rotary wing aircraft - CH-53E with parked aircraft to rotor separation equal to one-half of 1.5 times rotor diameter, and with the helicopter outboard wheel 3 feet from the edge of the taxilane. (This equates to NAVFAC P-80 data with parked aircraft on one side of the turning helicopter)

Use of the first three criteria reduces by 60% the parking space required for individual fixed wing aircraft using standard criteria. Table 4-6 contains a summary of the results of the analysis.

AIRCRAFT PARKING AREA REQUIREMENTS USING SELECTED NON-STANDARD CRITERIA

FIXED WING

| TYPE AIRCRAFT | STUDY DERIVED REQUIREMENTS (SQ. YARDS) | NAVFAC P-80 REQUIREMENTS (SQ. YARDS) |
|---|---|---|
| A-6 | 332 1/ | 1460 |
| OV-10 | 342 1/ | |
| AV-8B | 362 1/ | 800 |
| F-18 | 371 | 1080 |
| F-4 | 371 | 1065 |
| RF-4B | 438 1/ | |
| KC-130 | 3291 2/ | 4940 |

NOTES: 1/ A standard of 371 square yards was used for all fixed wing aircraft except KC-130 as being representative and conservative.

2/ KC-130 requirement based on turning radius of 85' (Diameter 170') is required. This calculated to 170' by 170' cell or a total of 3211 square feet.

TABLE 4-6

As can be seen in Table 4-6, the area required for the various type fixed wing aircraft ranges from 332 square yards for the A-6 to 371 square yards for the F-18 (with the exception of the KC-130). For computation purposes, a standard of 371 square yards was used for all fixed wing aircraft except the KC-130. The parking requirement for the KC-130 was based on its turning radius drawn from the KC-130 NATOPS Manual.

For the 75% of the helicopters parked with the rotors extended, the parking area required per aircraft ranges from 1195 square yards to 3398 square yards (see Table 4-6 above). For the 25% of the helicopters parked with rotors folded, a requirement of 140 square yards was used for the CH-53 and CH-46, and 90 square yards for the UH-1 and AH-1. The requirements in Table 4-5 were used in all computations.

At this point in the evaluation, a precise base loading plan, shown in Table 4-7, was developed. Although in earlier evaluations consideration was accorded to both the organizational and tactical aspects of bedding down aircraft, they were not viewed as a driving factor, i.e. the tactical location of the various MAGs and squadrons does not impact on those concepts, factors, etc., directed for study in the SOW to any significant degree.

In fact, although use of a precise base loading plan will influence the final configuration of each of the expanded facilities, it will have limited impact on the additional matting required, the additional construction effort required for site preparation or supporting services, e.g. ordnance dumps and fuel sites, or the total number of personnel required to operate the various facilities.

The value of the precise base loading plan resides in the fact that it is identical to the base loading plan to be used in a range of other Marine Corps studies and, therefore, provides a desirable consistency between separate but often related study efforts.

The combination of using the precise base loading plan and the beddown criteria, cited above, results in the requirement for 129,048 AM-2 matting panels in addition to those presently allocated to each MAW. The detailed computations are shown in Tables 4-8 and 4-9.

PRECISE BASE LOADING PLAN

| VSTOL FACILITY-1 | VSTOL FACILITY-1 | SELF | BARE BASE-1 | BARE BASE-2 |
|---|---|---|---|---|
| **Fixed Wing** | **Fixed Wing** | **MAG (VA/VF)** | **MAG (VA/VF)** | **MAG (VA/VF)** |
| SQDN / A/C / # | SQDN / A/C / # | SQDN / A/C / # | SQDN / A/C / # | SQDN / A/C / # |
| VMA AV-8B 20 | VMA AV-8B 20 | 3 VMA AV-8B 60<br>VMGR(-) KC-130 8<br>VMO OV-10 12 | 3 VMA FA-18 36<br>2 VMA A-6E 20<br>VMGR(-) KC-130 8<br>VMAQ EA-6B 15 | 3 VMA FA-18 36<br>2 VMA A-6E 20<br>VMGR(-) KC-130 8<br>VMFP RF-4B 7 |
| Total 20 | Total 20 | Total 80 | Total 79 | Total 71 |
| **SUPPORT SQDN** | **SUPPORT SQDN** | **SUPPORT SQDN** | **SUPPORT SQDN** | **SUPPORT SQDN** |
| H&MS(-)<br>MABS(-)<br>DET,MATCS<br>DET,MWSG | H&MS(-)<br>MABS(-)<br>DET,MATCS<br>DET,MWSG | H&MS DET,MWCS<br>MABS DET,MATCS<br>DET,MWSG<br>BTRY,LAAM BN<br>DET,FAAD BTRY | MAW,MWHS CI TEAM<br>SSCT SUPP<br>H&MS MABS<br>MWWU(-)<br>DET,MATCS DET,MWCS<br>BTRY,LAAM BN<br>DET,FAAD BTRY | H&MS MABS<br>MWWU(-) MACS<br>MATCS(-)<br>DET,MWSG<br>H&S BTRY,LAAM BN<br>(2) BTRY,LAAM BN<br>FAAD BTRY |
| **ROTARY WING** | **ROTARY WING** | **ROTARY WING** | **ROTARY WING** | **ROTARY WING** |
| HMA(-) AH-1T 12 | HMA(-) AH-1T 12 | 7 HMM CH-46E 84 | HMA AH-1T 24<br>HML UH-1N 24<br>2 HMH CH-53D 32<br>HMH CH-53E 16 | HMA AH-1T 24<br>6 HMM CH-46E 72<br>3 HMH CH-53D 48<br>HMH CH-53E 16 |
| Total 12 | Total 12 | Total 84 | Total 96 | Total 160 |
| | | | **SUPPORT SQDN** | **SUPPORT SQDN** |
| | | | H&MS WES(-)<br>MABS WTS(-)<br>H&S,MWSG | H&MS<br>MABS |
| GRAND TOTAL 32 | 32 | 164 | 175 | 231 |

TABLE 4-7

# MMROP MAF ACE BEDDOWN

## AIRCRAFT DISPOSITION

**VSTOL Facility #1 (900')**

| SQDN | A/C | # |
|---|---|---|
| 1 | AV-8B | 20 |
| DET | AH-1T | 12 |
| | TOTAL | 32 |

**VSTOL Facility #2 (900')**

| SQDN | A/C | # |
|---|---|---|
| 1 | AV-8B | 20 |
| DET | AH-1T | 12 |
| | TOTAL | 32 |

**SELF / BB-1 / BB-2**

| SELF SQDN | SELF A/C | SELF # | BB-1 SQDN | BB-1 A/C | BB-1 # | BB-2 SQDN | BB-2 A/C | BB-2 # |
|---|---|---|---|---|---|---|---|---|
| 3 | AV-8B | 60 | 3 | FA-18 | 36 | 3 | FA-18 | 36 |
| DET | KC-130 | 8 | 2 | A-6E | 20 | 2 | A-6E | 20 |
| 1 | OV-10 | 12 | DET | KC-130 | 8 | DET | KC-130 | 8 |
| | | | 1 | EA-6B | 15 | 1 | RF-4B | 7 |
| | TOTAL | 80 | | | 79 | | | 71 |
| | | | | **Rotary Wing** | | | | |
| 7 | CH-46 | 84 | 1 | AH-1T | 24 | 1 | AH-1T | 24 |
| | | | 1 | UH-IN | 24 | 6 | CH-46 | 72 |
| | | | 1 | CH-53E | 16 | 1 | CH-53E | 16 |
| | | | 2 | CH-53D | 32 | 3 | CH-53D | 48 |
| TOTAL | | 84 | | | 96 | | | 160 |
| GRAND TOTAL | | 164 | | | 175 | | | 231 |

## PARKING REQUIREMENT - SQ YD

| SELF | BB-1 Fixed Wing | BB-2 |
|---|---|---|
| 22,260 | 13,356 | 13,356 |
| 25,688 | 7,420 | 7,420 |
| 4,452 | 25,688 | 25,688 |
| | 5,565 | 2,597 |
| 52,400 | 52,029 | 49,061 |

**Rotary Wing**

| SELF | | BB-1 | | BB-2 | |
|---|---|---|---|---|---|
| 46(F) | 2,940 | AH(F) | 540 | AH(F) | 540 |
| S | 96,579 | S | 21,510 | S | 21,510 |
| | | UH(F) | 540 | 46(F) | 2,520 |
| | | S | 21,510 | S | 82,782 |
| | | 53E(F) | 560 | 53E(F) | 560 |
| | | S | 40,776 | S | 40,776 |
| | | 53D(F) | 1,120 | 53D(F) | 1,680 |
| | | S | 66,816 | S | 100,224 |
| TOT | 99,519 | | 153,372 | | 250,592 |
| | 151,919 | | 205,401 | | 299,653 |

S=Spread Rotors
F=Folded Rotors

## VSTOL FACILITY BEDDOWN DATA

AV-8B square cell = 371 sq. yards
AH-1 Rotor spread cell = 1,195 sq. yards

Use actual *facility beddown capacity from* configuration manual (AV-8B wing spread + 6')

Apron reqd. = 33,072 sq. yards
Apron avail. = 33,600 sq. yards
Shortfall = -0-

20 AV-8B = 7,420 sq. yards
12 AH-1T = 14,340 sq. yards
21 760 sq. yards
Taxilane = 11,312 sq. yards
TOTAL = 33,072 sq. yards

## SELF AND BAREBASE BEDDOWN DATA

All fixed wing cells = 371 sq. yds.
All KC - 130 cells = 3,211 sq. yds.
All folded CH-53/46 cells = 140 sq. yds.
All *folded* AH/UH-1 *cells* = 90 sq. yds.

All spread helo cells based on P-80:

CH-53E = 3,398 sq. yds.
CH-53D = 2,784 sq. yds.
CH-46E = 1,533 sq. yds.
AH/UH-1= 1,195 sq. yds.

To be conservative, no taxilane allowance is included in folded cells. That would nearly double cell size. Assume that all folded helicopters front on a taxilane or taxiway.

## SELF/BAREBASE TARMAC CALCULATIONS

Use 72'x72' peripheral taxilane on all aprons. This permits CH-53E use - 3' allowed for outside wheel and 1.5 rotor *radius from parked planes.*

| | | Additional Matting |
|---|---|---|
| **SELF (2880'x572')** | | |
| Apron gross | = 183,040 | |
| Avail gross | = 140,160 | |
| Shortfall | = 42,880 | = 16,080 |
| **BB-1 (3246'x668')** | | |
| Apron gross | = 240,925 | |
| Avail gross | = 140,160 | |
| Shortfall | = 100,765 | = 37,787 |
| **BB-2 (3532'x868')** | | |
| Apron gross | = 340,642 | |
| Avail gross | = 140,160 | |
| Shortfall | = 200,482 | = 75,181 |
| | TOTAL: | 129,048 |

TABLE 4-8

EAF/BAREBASE BEDDOWN REQUIREMENTS

| SITE | A/C | PARKING APRON REQUIRED (SQ YDS) | PARKING APRON AVAILABLE (SQ YDS) | SHORTFALL (SQ YDS) | APRON NET AREA (SQ YDS) | APRON GROSS AREA (SQ YDS) INCLUDING 72' TAXILANE | ADDITIONAL MATS REQUIRED |
|---|---|---|---|---|---|---|---|
| FAC-1 | 20 AV-8B<br>12 AH-IT<br>32 | 33,077 | 33,600 | -- | 742' x 264' | 886' x 336' | -- |
| FAC-2 | 20 AV-8B<br>12 AH-IT<br>32 | 37,077 | 33,600 | -- | 742' x 264' | 886' x 336' | -- |
| SELF | 60 AV-8B<br>8 KC-130<br>12 OV-10<br>84 CH-46E<br>164 | 183,040 | 140,160 | 42,880 | 2736' x 500' | 2880' x 572' | 16,080 |
| BB-1 | 36 FA-18<br>20 A-6E<br>8 KC-130<br>15 EA-6B<br>24 AH-IT<br>24 UH-IN<br>16 CH-53E<br>32 CH-53D<br>175 | 240,945 | 140,160 | 100,765 | 3102' x 596' | 3246' x 668' | 37,787 |
| BB-2 | 36 FA-18<br>20 A-6E<br>8 KC-130<br>7 RF-4B<br>24 AH-IT<br>72 CH-46<br>16 CH-53E<br>48 CH-53D<br>231 | 340,642 | 140,160 | 200,482 | 3388' x 796' | 3532' x 868' | 75,181 |
| TOTAL | 634 | | | | | | 129,048 MATS |

TABLE 4-9

As depicted, the SELF will require some 16,000 additional panels, Bare Base 1 some 38,000, and Bare Base 2 some 75,000 panels. Alternative surfacing materials to AM-2 matting are discussed in Chapter VII.

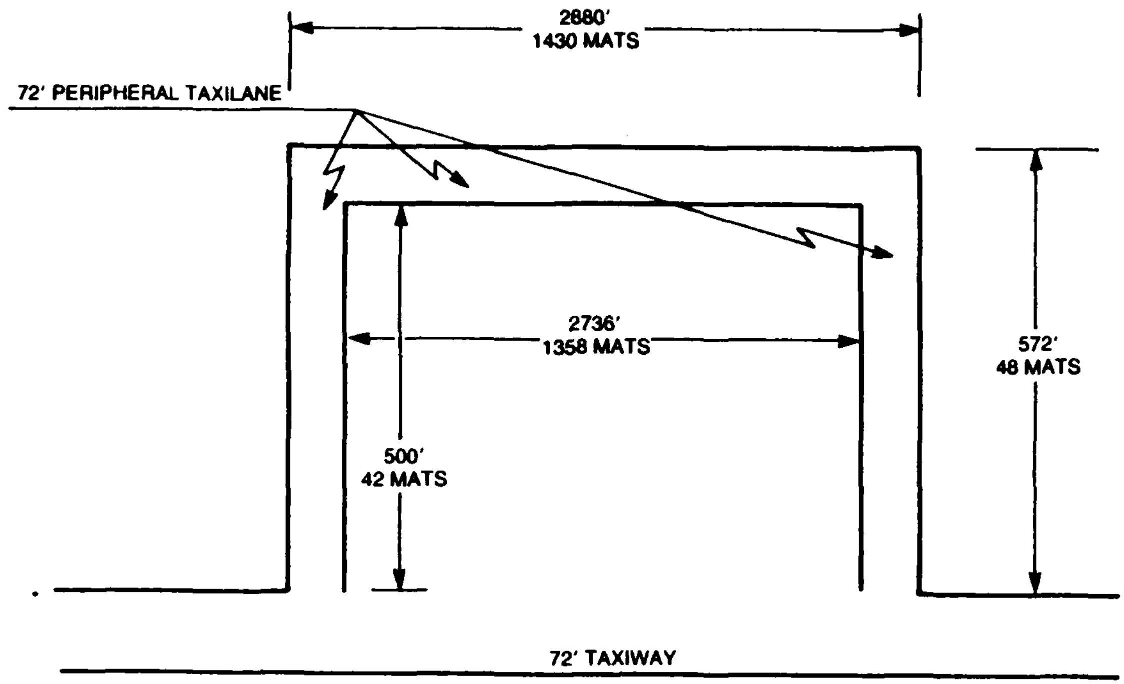
4.6 Design of the Expanded EAF Facilities. As noted above, the use of a precise base loading plan will influence the design of the expanded facilities. In turn, the final design of the parking areas will influence the redesign of the lighting and marking system required by the expanded parking areas. Those designs are properly the function of, and can best be accomplished by, the NAEC, Lakehurst, New Jersey.

The configuration of the parking areas developed by the Study Team to accommodate the base loading plan and a summary of selected calculations are shown in Figures 4-1 through 4-4. It should be clearly understood that these configurations are notional and have been developed for the express purpose of testing the precise base loading and beddown plans.

4.7 Potential Risk. A review of the criteria used to beddown the ACE established certain points and raised certain concerns. First, any beddown plan that attempts to locate the 634 aircraft on either hardstand or matted surfaces, and simultaneously attempts to limit the size and cost of the resultant expansion, must resort to use of non-standard parking criteria. If, in turn, that non-standard criteria results in dense packing of aircraft, i.e. parked with minimal separation and in the folded configuration and with difficult methods of egress from the parking area, it must be understood and accepted that potential risks will be present. These risks are discussed below.

4.7.1 Safety Factors. As mentioned in Chapter I, the resort to only 3 feet wing-tip clearance for fixed wing aircraft on parking aprons and taxilanes compromises safety which is already a concern of field commanders. The Commanding General, Fleet Marine Force, Pacific (CG, FMF PAC), expressed his concern in his message 041952, October 1983 to CMC. Adequate training of flight crews and ground personnel, careful movement of aircraft, and proper lighting can all assist in minimizing the potential difficulties during normal

# SELF PARKING AREA




PARKING AREA - 2736' × 500' - 1,368,000 SQ. FEET = 152,000 SQ. YARDS

TAXILANE - 2 (572 · 72') + 2736' × 72' - 279,360 SQ. FEET = 31,040 SQ. YARDS

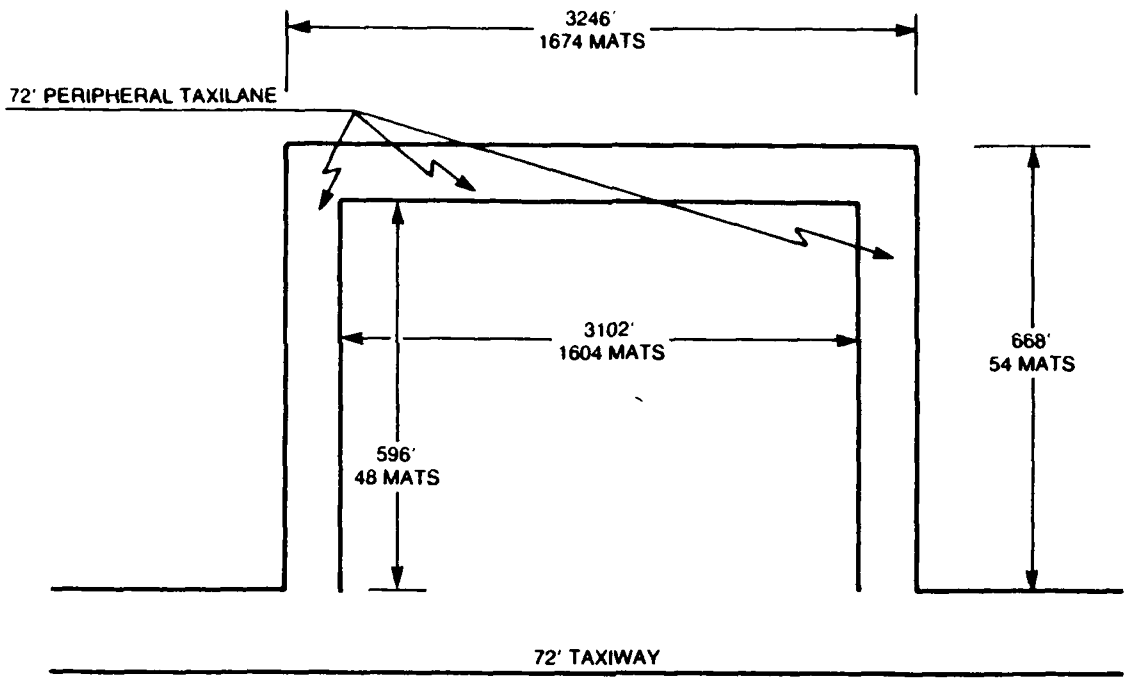
TOTAL AREA REQUIRED - 1,647,360 SQ. FEET - 183,040 SQ. YARDS

EAF (OR CONVERTED SELF) AREA AVAILABLE - 438' × 2880' - 1,261,440 SQ. FEET - 140,160 SQ. YARDS

TO MEET BEDDOWN REQUIREMENT ADD 72' TO WIDTH OF CURRENT EAF, OR CONVERTED SELF PARKING AREA

**FIGURE 4-1**

# BARE BASE-1 PARKING AREA




PARKING AREA = 3102' × 596' = 1,848,792 SQ. FEET = 205,421 SQ. YARDS

TAXILANE = 2 (668' × 72') + 3102' × 72' = 319,536 SQ. FEET = 35,504 SQ. YARDS

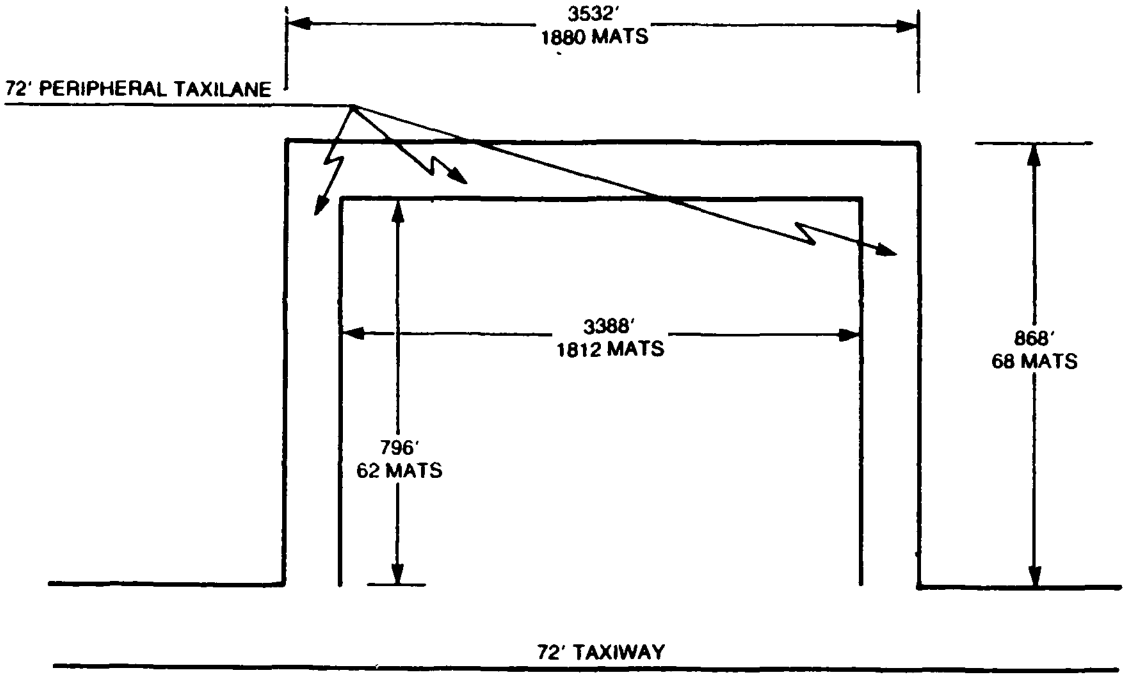
TOTAL AREA REQUIRED = 2,168,328 SQ. FEET = 240,925 SQ. YARDS

TOTAL AREA AVAILABLE = 1,261,440 SQ. FEET = 140,160 SQ. YARDS

ADDITIONAL AREA REQUIRED = 906,868 SQ. FEET = 100,763 SQ. YARDS

**FIGURE 4-2**

# BARE BASE-2 PARKING AREA




PARKING AREA 3388' × 796' = 2,696,848 SQ. FEET = 299,650 SQ. YARDS

TAXILANE = 2 (868' × 72') + 3388' × 72' = 368,928 SQ. FEET = 40,992 SQ. YARDS

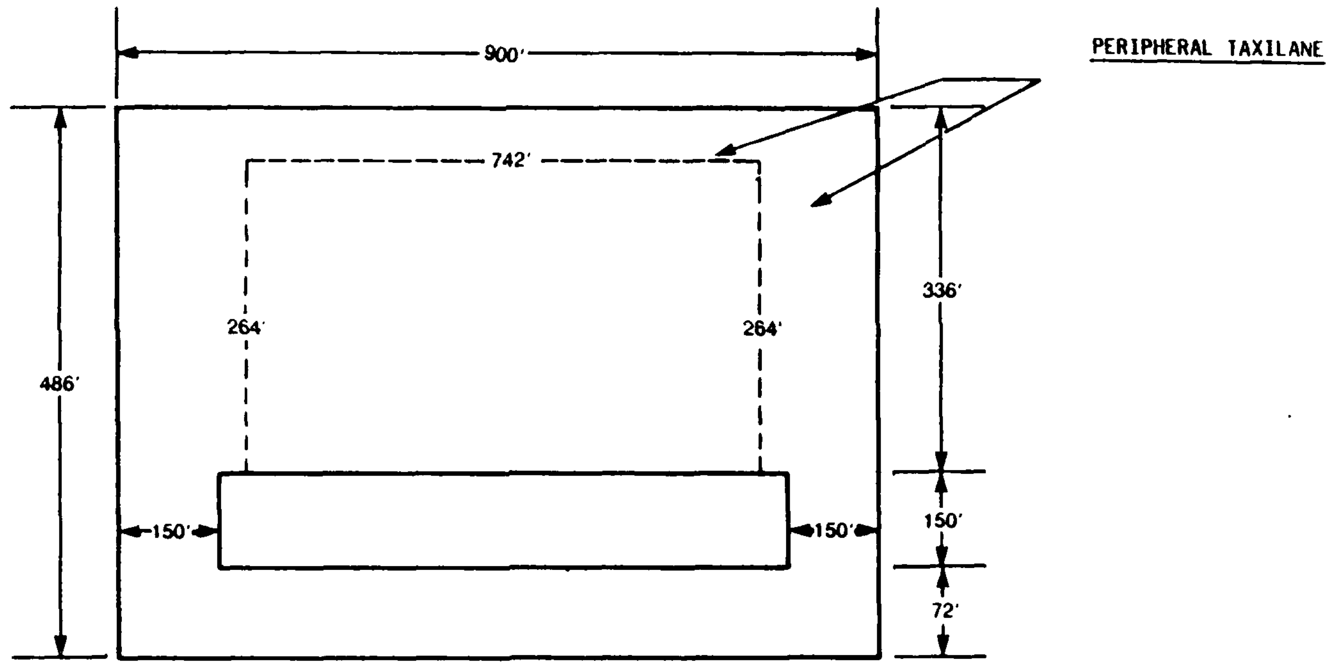
TOTAL AREA REQUIRED = 3,065,776 SQ. FEET = 340,642 SQ. YARDS

TOTAL AREA AVAILABLE = 1,261,440 SQ. FEET = 140,160 SQ. YARDS

ADDITIONAL AREA REQUIRED = 1,804,338 SQ. FEET = 200,482 SQ. YARDS

**FIGURE 4-3**

# VSTOL FACILITY PARKING AREA




PARKING AREA REQUIRED - 742' × 264' - 195,888 SQ. FEET - 21,765 SQ. YARDS

TAXILANE REQUIRED - 2 (336' × 72') + 742' × 72' - 101,808 SQ. FEET - 11,312 SQ. YARDS

TOTAL AREA REQUIRED - 297,696 SQ. FEET - 33,077 SQ. YARDS

TOTAL AREA AVAILABLE 302,400 SQ. FEET - 33,600 SQ. YARDS

FIGURE 4-4

operations. The problem will be compounded, however, during periods of intense operations and during periods wherein there is a need to relocate the aircraft rapidly in order to minimize potential damages/losses from accidents and enemy action.

4.7.2 Foreign Object Damage (FOD). Chapter VIII discusses the potential problems associated with FOD in detail. The intensity of those problems will be magnified by dense packing of fixed wing aircraft which will limit, if not eliminate, the opportunity/capability to conduct effective FOD sweep operations.

4.7.3 Revetting of Aircraft. Revetting of aircraft is virtually eliminated under the beddown concept employed, particularly in the case of the dense packed, fixed wing aircraft. Revetting can, of course, be accomplished if different beddown criteria are employed, if greater quantities of additional matting are procured in order to obtain increased dispersion of the aircraft, or if off-ramp parking of rotary wing aircraft is acceptable. If off-ramp parking were to be practiced, it could lead to either a reduction in the total matting required, or it could eliminate the concept of dense packing of the fixed wing aircraft. However, as discussed in paragraph 4.8.1 below, off-ramp parking could lead to maintenance, FOD, and arming difficulties.

4.7.4 Camouflage. The feasibility of adequately camouflaging aircraft is minimized if not eliminated under the beddown concept employed. Again, the need to improve methods of camouflaging airfields, equipment, and buildings as a means of reducing their susceptibility to enemy detection was cited in the CG, FMF PAC message identified in paragraph 4.7.1 above. This "deficiency", when combined with the inability to revet, dramatically increases the risk of inordinate losses resulting from an accident or enemy action.

4.7.5 Enemy Strike Damage. The combination of dense packing, the inability to revet, and the inability to camouflage adequately, increases the potential of excessive damages/losses to parked aircraft from enemy action, e.g., air-to-ground ordnance, artillery, and sapper attacks. This is an area which requires additional evaluation to include a trade-off analysis.

4.8 Alternatives. There appear to be two major alternatives to that of reconfiguring the facilities and increasing the parking aprons and, thus, the AM-2 matting requirements: parking the rotary wing aircraft on other than hardstand or matted surfaces, i.e. off-ramp, and planned use of theatre airfields.

4.8.1 Parking Rotary Wing Aircraft Off-Ramp. As indicated in Table 4-1, the helicopters with rotors unfolded require the largest amount of parking area per aircraft, i.e., from 1195 to 3398 square yards. Thus, they generate the greatest demand for matted surfaces. Although it would be feasible to park helicopters on unimproved surfaces, particularly in the early stages of an operation, continued use of such unsurfaced areas could present increased maintenance, FOD, and arming problems. Conversely, this method would permit greater dispersion of aircraft, the ability to revet, and the ability to camouflage thereby reducing the potential loss from accidents and/or enemy action.

4.8.2 Use of Theatre Airfields. A more acceptable solution may be the use of theatre airfields. Table 1-2 establishes that there is an abundance of such airfields within 200 nautical miles of the AOAs designated in the various MARCORS scenarios. As discussed in Chapter I, lacking any additional data or analysis, the availability of the theatre airfields must be considered suspect. In part, the data required to conduct such an analysis could not be made available to the Study Team as a result of its classification. It would appear that a comprehensive intelligence analysis needs to be conducted to determine the feasibility of planning for the use of theatre airfields to replace or supplement elements of the EAF system under specific conditions.

4.9 Summary. Chapter IV of the First Interim Report identified the composition (size) of the notional MMROP MAF ACE as the most significant problem confronting the Study Team. It is of such sheer size, 634 aircraft, that it tends to dominate most major aspects of the study. As discussed throughout this Chapter, it drives the requirement for major inventory increases in AM-2 matting and, as will be discussed in Chapter 7, generates several significant logistic support problems. It also leads to the need to dense pack fixed wing aircraft and to accepting the potential risks addressed above. Finally, and most importantly, it is the catalyst in redirecting the study effort from that of a conceptual analysis to one that has a programing objective and orientation. Having determined the ability of the EAF system to accommodate the MMROP MAF ACE and having identified the potential risks associated with that beddown effort, it is now necessary to validate the logistic requirements and capabilities to install, operate and sustain the EAF system. In selected cases it will first be necessary to determine what the logistic requirements of the ACE are, e.g., Class III (A) and Class V (A), as a prelude to evaluating the capability of the logistic system to support the ACE operating from EAF facilities. The succeeding chapters will discuss requirements, capabilities and deficiencies in the areas of Class III(A), Class V(A), engineer, and supporting equipment, e.g., crash and rescue equipment.

# CHAPTER V

## CLASS III AND CLASS III(A)

5.1 General. This Chapter addresses the Class III and Class III(A) requirements of the MAGTF, identifies the fuel storage, transfer, and dispensing systems available to support those requirements, and provides an array of alternative methods of deploying the systems. The concentration is on the requirements of the ACE, i.e., Class III(A).

It does not address the special petroleum products, oils, and other lubricants for both ground and aviation units. The requisite quantities of those supplies are insignificant when compared to the ground and aviation liquid fuel requirements, and, thus, they have a minimal impact on the issue at hand.

The various support requirements are discussed below.

5.2 Fuel Requirements. Data related to the fuel requirements consist of those developed by the appropriate agencies within HQMC and those developed by the Study Team. As outlined in the following paragraphs, the computations are relatively consistent.

5.2.1 HQMC Derived Fuel Requirements. Representatives of HQMC (CODE LME) indicated that Class III and Class III(A) support requirements of a notional MAF are derived from two sources. Class III planning factors are computed by the Logistic Management Information System (LMIS) model based on fuel consumption rates of all ground equipment resident in a MAF sized MAGTF. Class III(A) requirements are provided by HQMC (Code ASL). The Class III and Class III(A) planning factors are updated quarterly with the August 1983 summary reflected at Table 5-1.

Analysis of the LMIS summary reveals that the total notional MAF requirement for bulk Class III and III(A), less packaged and drummed petroleum, oils, and lubricants (POL), to be 61,790,000 gallons which represents 58 to 60 days of supply depending on the type fuel involved.

August 1983

Logistic Management Information System Report Summary 1/

Notional MAF

Mount Out Class III (Fuel) for MAGTF

| CATEGORY | ************55 GAL DRUMS************ DOS | DRUMS | GALLONS | CU FT | POUNDS | ************BULK************ DOS | GALLONS | BARRELS | POUNDS | ***DRY PACKAGES*** DOS | CU FT | POUNDS | ******TOTALS****** GALLONS | BARRELS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DIESEL | 0 | 0. | 0. | 0. | 0. | 58 | 12243038. | 291501. | 85578832. | | | | 12243038. | 291501. |
| MOGAS | 0 | 0. | 0. | 0. | 0. | 58 | 4656458. | 110868. | 28450944. | | | | 4656458. | 110868. |
| UP | 0 | 0. | 0. | 0. | 0. | 60 | 44644928 | 1062973. | 303585280. | | | | 44644928. | 1062973. |
| KEROSENE | 0 | 0. | 0. | 0. | 0. | 58 | 245560. | 5847. | 1677176. | | | | 245560. | 5847. |
| LUBE (IIIA) | 58 | 11669. | 630126. | 128359. | 5419037. | | | | | 58 | 0. | 0. | 630126. | 15003. |
| LUBE (IIIA) | 58 | 4025. | 217350. | 44275. | 1886513. | | | | | | | | 217350. | 5175. |
| CLASS IIIW (MARCORP) | 58 | 0. | 0. | 0. | 0. | | | | | 58 | 15586. | 475781. | 0. | 0. |
| TRIOXANE | | | | | | | | | | 45 | 17747. | 345716. | | |
| TOTAL | | 15694. | 847476. | 172634. | 7305550. | | 61789968. | 1471187. | 419291904. | | 33333. | 821497. | 62637424. | 1491365. |

*55 GALLON DRUMS HOLD 54 GALLONS FOR LUBE--53 GALLONS FOR OTHER FUELS
**1 BBL EQUALS 42 GALLONS
***MOUNT OUT GALLONS--(FUEL CONSUMER QUANTITY) X (GALLONS PER DAY) X (DOS)
****WEIGHT OF CONTAINER IS INCLUDED IN WEIGHT OF DRUM
*****TOTAL BBLS--DRUMS (GAL TO BBL EQUIV) + BULK(BBLS)

NOTE: 1/ PROVIDED BY HQMC (CODE LME)

TABLE 5-1

Of this quantity, 44,650,000 gallons, or 72% of the total Class III and III(A) supply, represents JP fuel to support the ACE.

Planners further estimate that a bulk fuel storage capacity of 12,000,000 gallons of Class III and III(A) is needed in an AOA to provide a fuel safety level necessary to sustain MAF operations during the projected 10 to 14 days turnaround shipping will require to deliver a Class III and III(A) resupply. Of that total, approximately 9,000,000 gallons are JP fuel.

5.2.2 Aviation Fuel Consumption Factors. Aviation fuel consumption factors were derived from NAVAIR Note C10340 dated 2 June 1983 for each type aircraft included in the MMROP ACE. These factors were then applied to the number and type of aircraft to be bedded down at each of the EAF configurations. The resulting computations determined the daily Class III(A) requirements at each site and a 10-day level of supply necessary to support the ACE element bedded down at each airfield. No attempt was made to compute increased daily fuel consumption generated by surges in daily sorties rates in response to the tactical situation. However, a 10-day supply of JP fuel, developed for each site, could be assumed to support a sortie rate surge. The daily JP fuel consumption rate and 10 days of supply level needed at each site is displayed at Table 5-2.

DAILY JP FUEL CONSUMPTION RATE/10 DAYS OF SUPPLY LEVEL

| Beddown Site | Daily JP Fuel Consumption (in gallons) | 10 Days of JP Fuel (in gallons) |
|---|---|---|
| Facility 1 | 31,156 | 311,560 |
| Facility 2 | 31,156 | 311,560 |
| SELF | 199,820 | 1,998,200 |
| BareBase 1 | 214,085 | 2,140,850 |
| BareBase 2 | 296,173 | 2,961,730 |
| Total Rounded | 773,000 gallons | 7,730,000 gallons |

TABLE 5-2

5.2.3 Comparison of Requirements. The JP fuel requirement for a 10-14 day period provided by HQMC (Code LME) was approximately 9,000,000 gallons or an average of 750,000 gallons per day (based on a 12 day median). The study requirement for a 10 day period, cited above, is 7,730,000 gallons or 773,000 gallons per day. As will be discussed in the paragraphs immediately following, sufficient bulk fuel storage and dispensing capacity exists to meet the greater requirement.

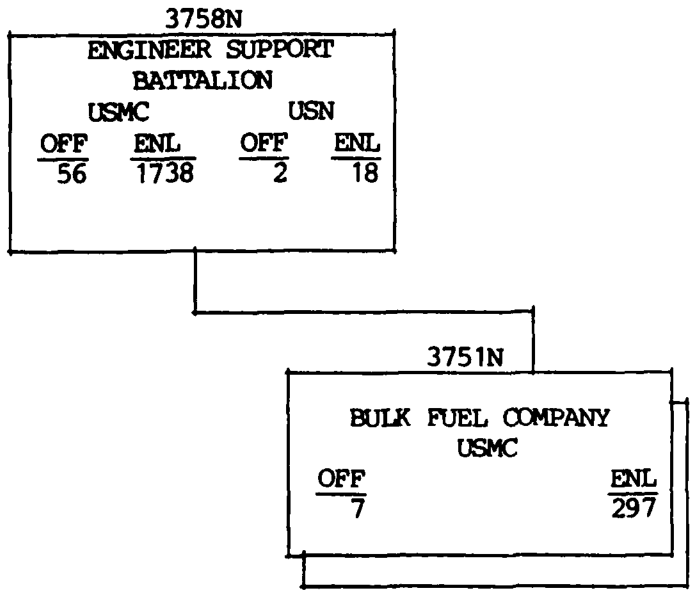
5.3 Fuel Storage and Dispensing Capabilities. The total bulk fuel storage and dispensing capability available to a MAF is provided through the composite assets of the Bulk Fuel Company, Engineer Support Battalion, Force Service Support Group (FSSG), equipped with the Amphibious Assault Fuel Systems (AAFS), and the Tactical Airfield Fuel Dispensing Systems (TAFDS) within the Wing Engineer Squadron (WES), Marine Wing Support Group (MWSG); plus the miscellaneous other storage and transfer assets, e.g., Helicopter Expedient Refueling System (HERS), refuelers, etc. within the MAF. An analysis of the composite capabilities of these assets to support the operational requirements of a 634 aircraft ACE establishes that the requisite fuel storage capability exists. The results of that analysis are set forth in the following paragraphs.

5.3.1 Amphibious Assault Fuel System (AAFS). In 1980, the bulk fuel storage and transfer capability of the MAF was expanded by the activation of a second Bulk Fuel Company within the FSSG. Figure 5-1 portrays the current organization.

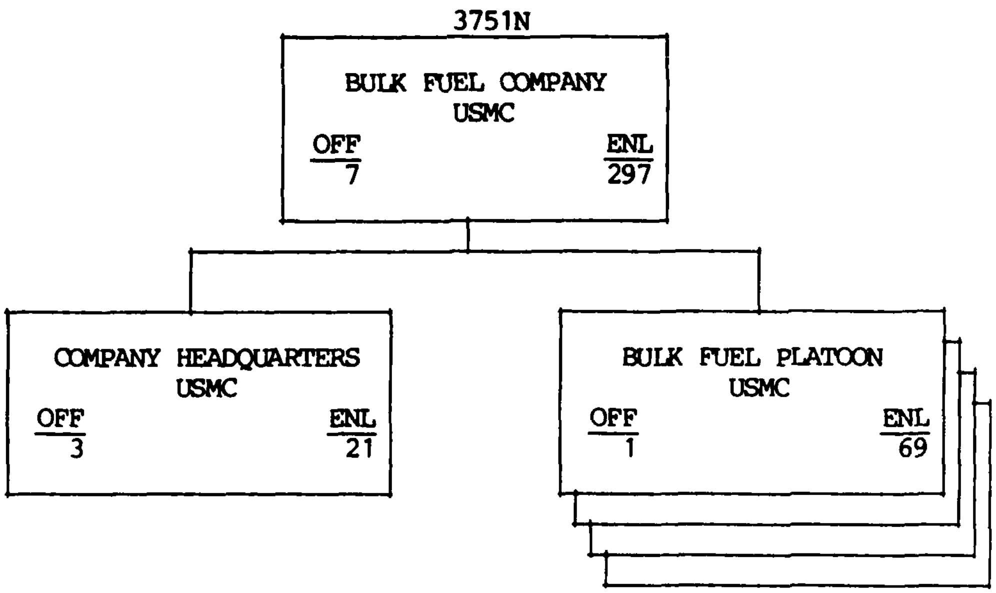
Each Bulk Fuel Company is equipped with 8 AAFS and each AAFS consists of thirty 20,000 gallon collapsible, impregnated fabric storage tanks. The tank storage capacity of each AAFS is rated at 600,000 gallons and each company at 4,800,000 gallons. In addition, each AAFS is equipped with six additional 20,000 gallon tanks with the necessary pumps, hoses, and adapters to establish a Beach Unloading and Booster Pump System for receiving and transferring fuel to Tank Farm Assemblies. These additional 48 tanks within each company increase the storage capacity by 960,000 gallons to a company total of 5,760,000 gallons. The total FSSG fuel storage and transfer capacity is, then, actually 11,520,000 gallons rather than 9,600,000 gallons.

## Table of Organization

Bulk Fuel Company,
Engineer Support Battalion, Force Service Support Group, FMF




Bulk Fuel Company, Engineer Support Battalion, FSSG, FMF




Note: A bulk fuel company consists of eight AAFS. Each bulk fuel platoon is capable of installing and operating two AAFS independently of the company.

FIGURE 5-1

5.3.2 Tactical Airfield Fuel Dispensing System (TAFDS). The second major component of the MAF Class III and III(A) bulk fuel storage capability is the TAFDS included in Table of Equipment 8714N, Wing Engineer Squadron (WES), Marine Wing Support Group (MWSG). The major components of this system are identical to those comprising the AAFS. The system is designed primarily to supply jet aircraft fuel at the EAF facilities.

There are twenty TAFDS within the WES, each TAFDS being equipped with six 20,000 gallon storage tanks. Thus, each TAFDS has a storage capacity of 120,000 gallons and the WES a total capacity of 2,400,000 gallons.

5.3.3 Additional MAF Assets. Additive to the two major bulk fuel storage components of the MAGTF are other fuel storage and dispensing systems included in various tables of equipment and designed to support special fuel distribution requirements. Among these systems are twenty 5,000 gallon capacity semi-trailer refuelers of the Transport Company, Motor Transport Battalion, FSSG (100,000 gal); the forty-two 5,000 gallon capacity semi-trailer refuelers of the Wing Transportation Squadron, MWSG (210,000 gal.), and three hundred twenty-four 500 gallon capacity collapsible tanks that constitute the 18 Helicopter Expedient Refueling Systems (HERS) of the Wing Engineer Squadron, MWSG (162,000 gal.). These systems collectively represent an additional 418,000 gallons of Class III and III(A) storage. The current total bulk fuel storage and transfer system of the MAF is computed to be in excess of 14,000,000 gallons of Class III and III(A). Table 5-3 summarizes the bulk fuel storage and dispensing systems currently available to support a MAF.

BULK FUEL STORAGE AND DISPENSING SYSTEM

| System | Number of Systems Available | Capacity (in gallons) | Location |
|---|---|---|---|
| AAFS | 16 | 9,600,000 | FSSG |
| TAFDS | 20 | 2,400,000 | MWSG |
| HERS | 18 | 162,000 | MWSG |
| Refuelers | 20 | 100,000 | FSSG |
| | 42 | 210,000 | MWSG |
| AAFS/BUA/BPA | 16 | 1,920,000 | AAFS |
| | Total | 14,392,000 gallons | |

TABLE 5-3

5.4 Comparison of Storage Assets with Requirements. Having established the total Class III(A) requirement, the bulk fuel storage and dispensing capability available to support the ACE can be evaluated.

USMC planners have projected that the Class III(A) requirement for the MMROP MAF ACE represents approximately 72% of the total bulk fuel assets included in MAGTF landing force Class III supplies. Accordingly, 72% of the 16 AAFS comprising the bulk fuel storage and transfer capability of the FSSG, or 11 AAFS, are available to combine with the 20 TAFDS resident in the WES, MWSG to provide the JP aviation fuel requirement projected for the ACE.

The total basic storage capacity of the 11 AAFS and the 20 TAFDS available to support the ACE under this employment concept, is 9,000,000 gallons, if all systems are employed. In addition, the 11 Beach Unloading and Booster Pump Assemblies of the 11 AAFS available to support the ACE, provide an additional 1,320,000 gallons of fuel storage and dispensing capability, while the 18 HERS of the WES provide another 162,000 gallons storage capacity.

The potential Class III(A) bulk fuel storage and dispensing capability currently available for exclusive use of the ACE, then, is computed to be 10,482,000 gallons. Not included is the 310,000 gallon capacity inherent in the 62 semi-trailer refuelers of the MAF major motor transport units. This total storage capacity exceeds the 10 days of supply requirement of 7,730,000 gallons established in paragraph 5.2.2, and indicates that only nine of the 11 AAFS systems, available to support the ACE's Class III(A) requirement, need be dedicated to JP bulk fuel storage support of a 634 aircraft ACE.

5.5 MAF Bulk Fuel Transfer Capabilities. The analysis thus far demonstrates that sufficient bulk fuel storage capacity exists in available AAFs, TAFDS, HERS, and various mobile refueler systems to support the daily and 10 day level of Class III(A) JP fuel required of a 634 aircraft ACE. The bulk fuel storage capability needed to meet the JP fuel requirement is displayed at Table 5-4, and, for study purposes, constitutes a baseline storage concept for developing alternative fuel transfer systems to support five widely dispersed EAF's. Whether the AAFS Tank Farm assemblies allocated to the EAF System in Table 5-4

## DISTRIBUTION OF BULK FUEL STORAGE AND TRANSFER ASSETS

| | FACILITY-1 | FACILITY-2 | SELF | BARE BASE-1 | BARE BASE-2 |
|---|---|---|---|---|---|
| 10 DOS | 338,000 GAL | 338,000 GAL | 2,000,000 GAL | 2,124,000 GAL | 2,962,000 GAL |
| TAFDS (MWSG) | | | | | |
| -20 SYSTEMS<br>-2.4 MIL GAL<br>-6 TANKS/TAFDS | 2 SYSTEMS<br>+ 3 TANKS<br>(300,000 GALS) | 2 SYSTEMS<br>+ 3 TANKS<br>(300,000 GALS) | 5 SYSTEMS<br>(600,000 GALS) | 5 SYSTEMS<br>(600,000 GALS) | 5 SYSTEMS<br>(600,000 GALS) |
| HERS (MWSG) | | | | | |
| -18 SYSTEMS<br>-162,000 GALS<br>-12 TANKS/SYS | 2 SYSTEMS<br>(18,000 GALS) | 2 SYSTEMS<br>(18,000 GALS) | 3 SYSTEM<br>(27,000 GALS) | 4 SYSTEMS<br>(36,000 GALS) | 7 SYSTEMS<br>(63,000 GALS) |
| AAFS 1/ (FSSG) | | | | | |
| -8.8 SYSTEMS<br>- 5.3 MIL GAL STORAGE PIPELINE<br>- 30 TANKS/ TANK FARM | - - - | - - - | 2 AAFS<br>+ 13 TANKS<br>(1,460,000 GALS) | 2 AAFS<br>+ 16 TANKS<br>(1,520,000 GALS) | 3 AAFS<br>+ 26 TANKS<br>(2,320,000 GALS) |
| TOTAL | 318,000 GAL | 318,000 GAL | 2,087,000 GAL 2/ | 2,156,000 GAL | 2,973,000 GAL |

NOTES:

1/ 265 AAFS 20,000 GALLON CAPACITY FUEL STORAGE TANKS ARE REQUIRED FOR ACE CLASS III(A) SUPPORT.

2/ THE ADDITIONAL 87,000 GALLON JP FUEL STORAGE CAPACITY PROVIDED THE SELF IS TO SUPPORT THE TWO VSTOL FACILITIES.

TABLE 5-4

are positioned at the sites designated, or are centralized under FSSG control no more than three miles inland from the Beach Loading Assembly, the primary consideration is that nearly nine complete AAFS will be required to support the ACE's requirement for 7,730,000 gallon of JP for a 10 day supply level. The options for distributing fuel to the EAF System under consideration are discussed in the following paragraphs beginning with an evaluation of the MAF's current bulk fuel transfer capability.

5.5.1 Current Bulk Fuel Transfer Capabilities. The primary means of distributing bulk fuel products in quantity includes the hoseline system of the AAFS and the current fleet of sixty-two 5000 gallon capacity tractor-tailor refueler vehicles available to a MAF.

5.5.2 AAFS Fuel Transfer Capability. A detailed examination of each AAFS reveals that one AAFS is capable of independently receiving, transferring, storing and dispensing 720,000 gallons of various type fuels over a distance of three miles by means of thirty-six 20,000 gallon capacity fuel storage tanks, ten 600 GPM capability booster pumps, and 27,000 feet of two inch to six inch diameter hose of varying lengths organized into five functional assemblies shown at Table 5-5.

AAFS ASSEMBLIES

| ASSEMBLY | 20,000 GAL TANKS | 600 GPM PUMPS | HOSELINE (IN FEET) |
|---|---|---|---|
| 1 Beach Unloading Assembly (BUA) | 2 | 2 | 6,425 |
| 1 Drum Unloading Assembly (DUA) | - | 1 | 375 |
| 2 Booster Pump Assemblies (BPA) | 4 | 2 | 12,400 |
| 5 Tank Farm Assemblies (TFA) | 30 | 5 | 6,750 |
| 6 Fuel Dispensing Assemblies (FDA) | - | - | 1,100 |
| Total: | 36 | 10 | 27,050 |

TABLE 5-5

The three mile fuel transfer capability of one AAFS resides in the 5 booster pumps, the 6 storage tanks, and the 18,000 feet of 6 inch x 50 foot discharge hose that constitutes the Beach Unloading Assembly (BUA) and the Booster Pump Assembly (BPA) of each AAFS. The remainder of the AAFS hoselines and booster pumps unload, circulate, and dispense fuel to supported units through the 600,000 gallon capacity Tank Farm Assemblies.

Historically, a MAF sized bulk fuel storage and transfer concept has routinely followed a standard pattern. AAFS Tank Farm Assemblies have been consolidated under centralized management of FSSG Bulk Fuel Companies within three to five miles of one or more Beach Unloading Assembly sites. From these consolidated bulk fuel storage sites, all types of Class III and III(A) fuels have been distributed to nearby TAFDS by hoseline or refueler vehicles, dispensed to other supported MAGTF elements by drums or cans, or obtained from the fuel storage areas by 1200 gallon capacity refueler vehicles organic to the several MAGTF elements. Accordingly, only one or two of the eight Beach Unloading (BUA's) and Booster Pump Assemblies (BPA's) available to one Bulk Fuel Company have normally been engaged to receive and transfer fuel from the beach to the centralized bulk fuel storage complex. An additional one or two Booster Pump Assemblies would be employed transferring different types of fuel a minimum distance to TAFDS fuel storage complexes at nearby air facilities and between Tank Farm Assembly complexes. The remaining BUA's and BPA's would normally be held in reserve to support additional AAFS that could be deployed to support independent operations.

5.5.3 Typical Bulk Fuel Transfer Layout. The tactical bulk fuel storage and transfer systems are designed to deploy in any combination of the basic system to meet specific requirements of deploying MAGTFS. Systems may be assembled in any combination of 20,000 gallon capacity storage tanks, i.e., 20,000, 40,000, 100,000 gallons, etc. Both the AAFS and TAFDS are comprised of self-contained components that can be joined together with quick-disconnect, cam locking fittings to receive, transfer and dispense liquid fuels. The systems are designed to respond to a variety of operational commitments and allow maximum flexibility in assembly layouts. The AAFS is normally employed to receive fuel over the beach for storage and distribution ashore, while the TAFDS is used specifically to service an expeditionary airfield with fuel normally obtained from the AAFS. Both systems may also receive fuel from nearly any source with appropriate adapters. Either system may be tailored to increase or decrease capacity by adding or deleting tanks and accessories, and, with proper maintenance, are capable of functioning continuously for a period of 45 days without replacement of major components.

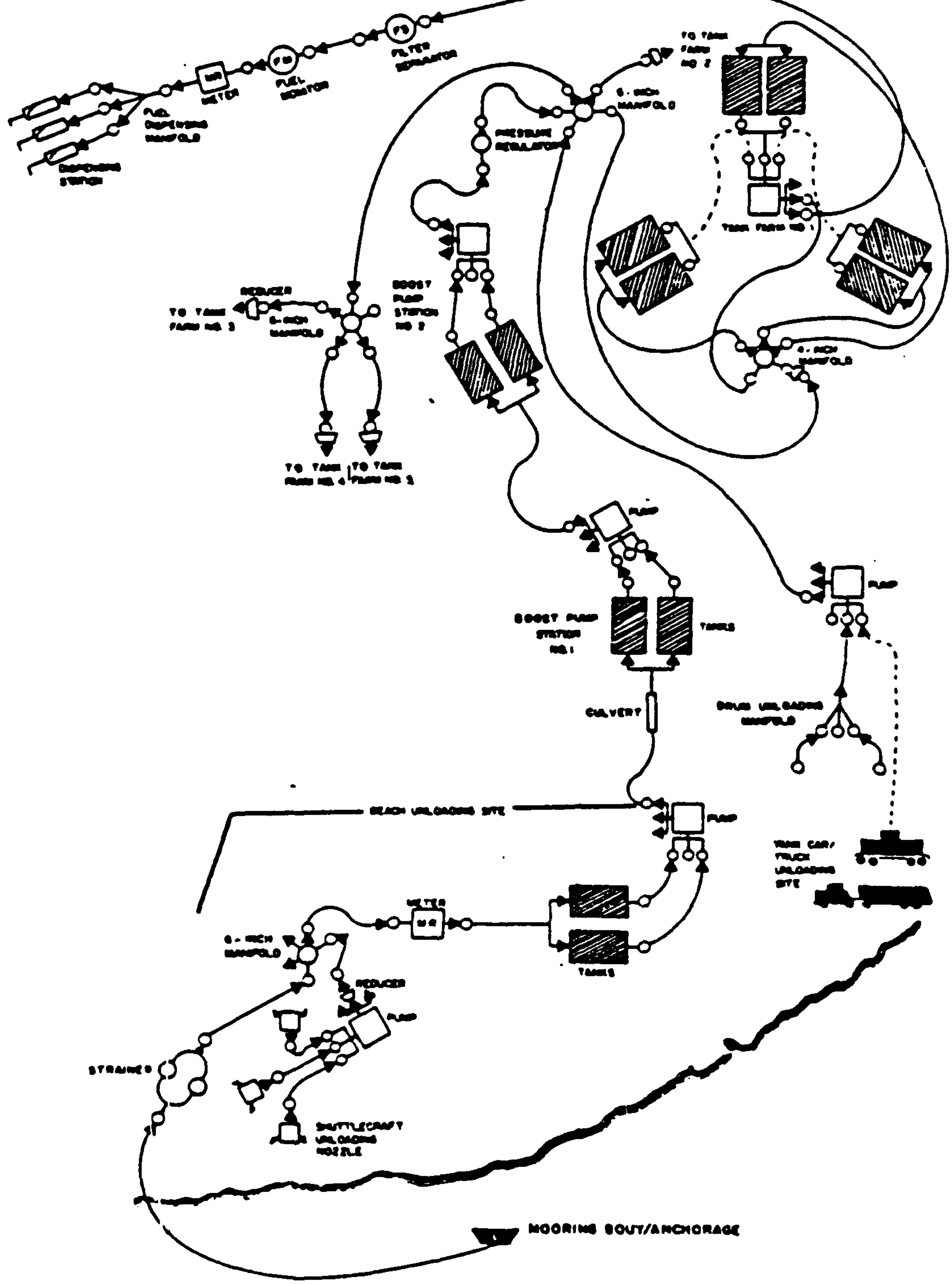
The AAFS and TAFDS can be installed without the use of special tools and a complete storage and dispensing system (600,000 gallon AAFS or 120,000 gallon TAFDS) can be ready for operation in 48 to 72 hours after the initial assault. Figure 5-2 depicts a typical AAFS layout while Figure 5-3 shows a typical TAFDS layout at an airfield.

5.6 Fuel Transfer Assembly Limitations. Despite the remarkable flexibility inherent in the tactical bulk fuel storage and transfer system to be deployed in an infinite series of layouts, it has several limitations. Those which impact on the system capability to transfer fuel over extended distances include technical, environmental, operational, and organizational considerations.

5.6.1 Technical Factors. Three variables govern the distance and the height to which fuel may be pumped by the AAFS and the TAFDS. They are pump discharge pressure, weight of the fuel per gallon, and the friction loss in the fuel transfer hose line. The standard calculations accruing from this composite limitation dictate that the hoses, pumps, filters, etc., that comprise one AAFS are sufficient only to pump fuel a distance of three miles. Other technical considerations affecting fuel transfer distances include:

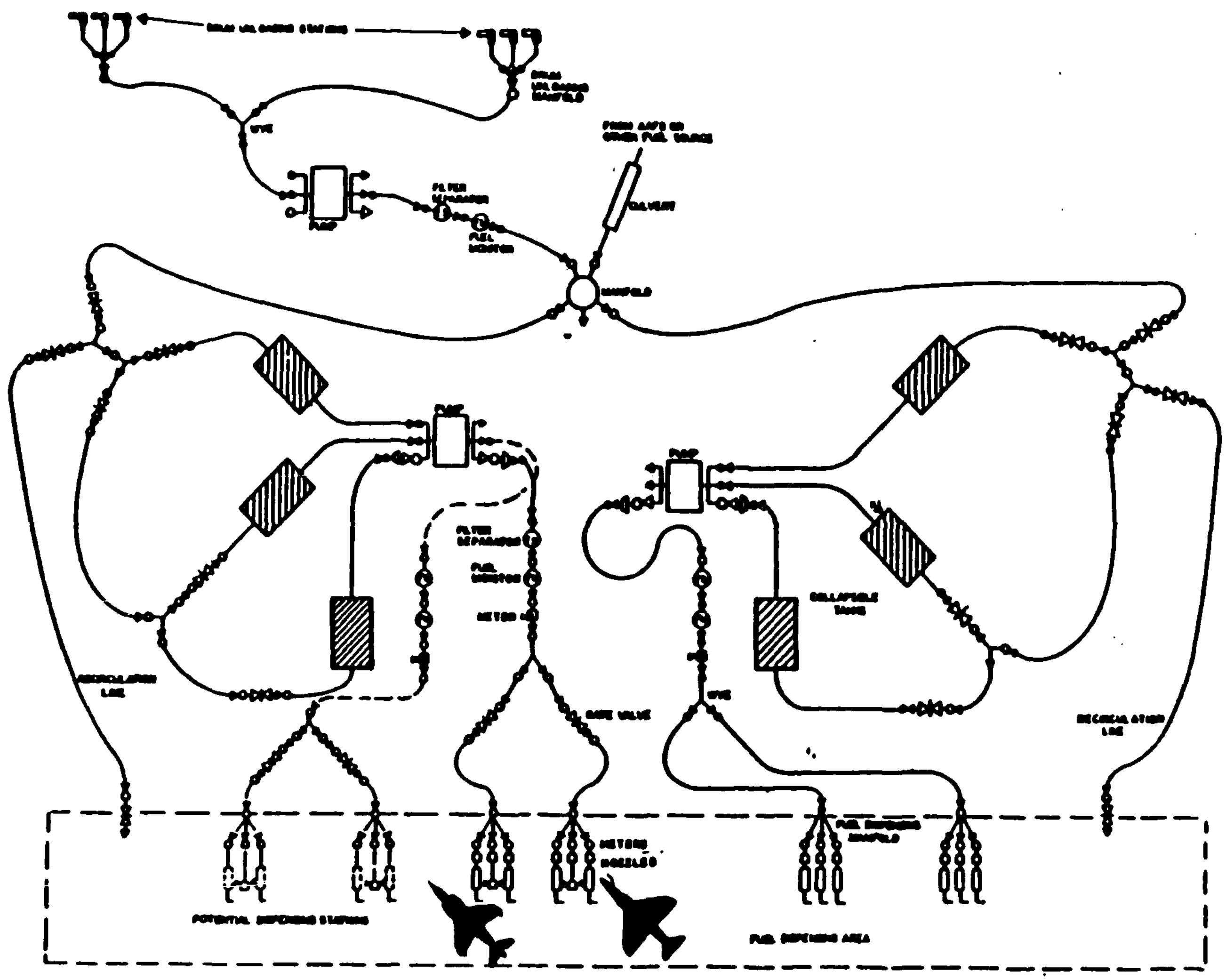
- The need for all fuel tanks in any one group to be emplaced on reasonably level terrain to avoid a lower tank overfilling and thus becoming overstressed and rupturing.
- Accessibility to existing trails or planned road networks to facilitate transportation of loads that can't be manhandled, inspection/maintenance of the system, and movement of firefighting vehicles.
- A requirement for each different type fuel to be transferred and stored separately.

5.6.2 Environmental Factors. The system must avoid transfer routes along streambeds or through ponds and marshy areas where floods can disrupt the transfer hoseline, water will deteriorate the hoselines, maintenance problems




Amphibious Assault Fuel System (AAFS) Schematic

FIGURE-5-2



Tactical Airfield Fuel Dispensing System (TAFDS) Schematic

FIGURE-5-3

are magnified, and, in the case of transfer line leaks, the fire hazard is increased over a wider area. Fuel storage sites and fuel transfer routes need to be located out of depressed areas since vapors from fuels are heavier than air, collect in low spots, and generate explosive conditions susceptible to ignition from static electricity alone.

5.6.3 Operational Factors. In addition to the extended distance hoseline system vulnerability to interruption from system failure or natural causes, i.e. floods, snowfall, landslides, etc., an extended hoseline provides the enemy a lucrative interdiction target at many points. This could constitute a security problem of a magnitude beyond the capability of the current size bulk fuel company to resolve and impair its ability to maintain system fuel flow to all elements of a MAGTF. Of equal consideration is the limitation on extended distance transfer of fuel imposed by a separate storage and transfer requirement for each type fuel, and the number of AAFS as well as personnel and equipment assets that can be assigned to support several widely dispersed facilities simultaneously. For example, one EAF deployed 24 miles inside an AOA would require an entire bulk fuel company of eight AAFS to provide only one type fuel, based on current concepts of employment. The three remaining AAFS, of the 11 AAFS currently available to support an ACE in a MAF sized MAGTF, could not, therefore, provide a required level of Class III(A) support to the other EAF within the system that might be operating simultaneously.

5.6.4 Organizational Factors. A bulk fuel company is organized to centralize and provide all bulk fuel capabilities of the FSSG. Its concept of employment includes delivering bulk fuel by hoseline a distance of about three miles over level terrain; providing elements to operate amphibious bulk fuel systems in support of MAGTFs up to a MAF size; and furnishing detachments for reinforcing divisions and aircraft wings as may be required. Elements of the bulk fuel platoons and company headquarters may be task organized and employed to provide nearly any combination of the basic AAFS to meet specific requirements.

Each of the four bulk fuel platoons within a bulk fuel company is capable of operating two AAFS, but a platoon can be divided to operate two complete AAFS, or lesser increments (20,000 to 360,000 gallon capacity) independent of each other. Conceptually, then, a bulk fuel company could deploy eight AAFS independent of each other, each one capable of transfering one type of fuel a distance of only three miles; deploy the eight AAFS in tandem to a distance inland of 24 miles to one supported facility; or, divide the eight AAFS and personnel assets into combinations to deliver fuel to several installations simultaneously only to that distance the AAFS components comprising each combination would permit.

5.7 <u>Refueler Vehicles</u>. The primary bulk fuel mobile refueler vehicle fleet of a MAF sized MAGTF currently includes sixty-two 5000 gallon capacity semi-trailers located in the heavy motor transport units of the FSSG and MWSG. All 5000 gallon capacity refuelers are expected by HQMC (Code LME) to be dedicated to hauling Class III(A) bulk fuel from AAFS Tank Farm Assemblies to the one or several EAF's that may be established in an AOA. The sixty-two 5000 gallon refuelers represent a potential 310,000 gallons of JP fuel that can be transported to several EAF's simultaneously, but, only if a suitable road system is available in an AOA to accommodate these large capacity, heavy tractor-trailer vehicles.

Depending on the distance the 5000 gallon refuelers must travel from an AAFS to the EAF's or bare bases to be supported, it is conceivable that several trips could be made daily by these refuelers to sustain the 773,000 gallon daily fuel consumption rate of a 634 aircraft ACE.

In the event no suitable road net existed in an AOA, however, the large capacity, mobile refueler capability to deliver fuel would be severely constrained, i.e. a 5000 gallon refueler speed over unimproved roads is restricted to 10 MPH. In addition, even with a suitable road system, the location of EAF's and bare bases at considerable distance from their supporting AAFS fuel storage areas, i.e. 25 miles or more, could limit the number of 5000 gallon refueler trips to one per day.

Assuming only a one trip per day fuel delivery capability by the sixty-two 5000 gallon refuelers would provide the EAF system 310,000 gallons of JP fuel per day. This quantity would generate a daily shortfall of 463,000 gallons of Class III(A) aviation fuel among the several EAF sites.

5.8 <u>SIXCON Fuel Module and Logistic Vehicle System</u>. The MAF bulk fuel transfer capability is programmed to be enhanced by acquisition of the SIXCON Fuel Module and Logistic Vehicle System (LVS) beginning in Fiscal Year 1985. The SIXCON fuel module will be a 900 gallon capacity liquid fuel tank with necessary fittings and hoses to accept and discharge fuel by means of a SIXCON Pump Module. The 900 gallon capacity tank will be housed in a 4'x8'x6'8" Shipping Frame and provide the Force Logistic System (FLS) a capability to store, transport, and dispense up to 900 gallons of fuel in a single, self-contained module. Six modules (five fuel and one pump) can be connected to form an International Organization for Standardization (ISO) Container 8'x8'x20' lift, or a lesser combination of modules for transport on a Logistic Vehicle System (LVS) vehicle. Each MAF is expected to receive approximately 420 SIXCON Fuel Modules. HQMC (Code LME) anticipates that a sufficient number of these 420 SIXCON Fuel Modules, programmed for each MAF, will be made available to supply the daily Class III(A) fuel requirements of two VSTOL facilities deployed in a MAF sized AOA.

The Logistic Vehicle System (LVS) is a single class of vehicle within the tactical vehicle fleet intended to move standard ISO containers and equipment up to 22.5 tons over improved roads. The LVS cross-country cargo capacity is 12.5 tons. The LVS replaces a current series of cargo hauling trucks and trailers and, with the SIXCON Fuel Module, will constitute an additional mobile refueler capability. In its SIXCON Fuel Module transport configuration, the LVS will consist of a MK-48 front power unit and one MK 14 container hauler. The MK 48 can pull two MK 14 container haulers in tandem over a road system as long as the total cargo capacity does not exceed 22.5 tons. Distribution of the LVS fleet to the operating forces is tentatively scheduled to include approximately 250 MK 48 and 150 MK 14 to each MAF.

Analysis of the LVS/SIXCON Fuel Module combination for use as a refueler reveals that one LVS MK 48/MK 14 combination can transport 2,515 gallons of JP fuel cross-country. Where a suitable road net is available, the LVS bulk fuel cargo capacity can be increased to 4,500 gallons of JP fuel in five SIXCON Fuel Modules. For study purposes, it will be assumed that 25 LVS MK48/MK14 and 125 SIXCON Fuel Module combinations will be available to support daily JP fuel deliveries to the EAF system.

5.9 Potential Bulk Fuel Transfer Capability By Mobile Refuelers. The HQMC (Code LME) concept of employment of mobile refuelers in support of an ACE is to employ 5000 gallon semi-trailer refuelers over suitable road systems to support the SELF and two bare bases, while the LVS/SIXCON Fuel Module combinations transport JP fuel cross-country, if necessary, to VSTOL facilities anticipated to be deployed forward of the larger EAF configurations. All fuel deliveries would be made from the consolidated FSSG Tank Farm Assemblies directly to the supported EAF complexes.

The Study Team compared the total bulk fuel mobile delivery capability of the 5000 gallon refuelers and LVS/SIXCON Fuel Module systems, anticipated to be available to support the ACE, with the daily and 10 day level of JP fuel supply required at each EAF configuration. The analysis indicated that where a suitable road system existed from the AAFS to each EAF and bare base (to a distance not exceeding 25 miles), the sixty two 5000 gallon capacity refuelers and 25 LVS/125 SIXCON Fuel Module combinations could transport 424,000 gallons of JP fuel in a single trip daily. If the refueler fleet could make two trips daily, the 848,000 gallon fuel delivery capability would exceed the 773,000 gallon daily JP fuel requirement of the entire ACE.

In the absence of a suitable road network, or degradation of the refueler fleet for various reasons, the MAF's mobile refueling capability would be reduced significantly. The cross country mobility of 5000 gallon refuelers is 10 MPH, and possible long term damage to the semi-trailer refueler fleet could restrict their use in this mode to emergency situations only. The LVS can haul SIXCON Fuel Modules cross-country at speeds far below its rated 52 MPH and with the total cargo capacity restricted to 2,515 gallons of JP fuel for each LVS/SIXCON Fuel Module combination. Accordingly, if the 25 LVS/125 SIXCON system were able to make only one trip daily cross-country, a total of 62,875 gallons of JP fuel could be delivered to the two VSTOL facilities located 25 miles distant from the AAFS Tank Farm Assembly.

Under ideal conditions of available road systems to each EAF configuration, and no interruption of mobile refueler deliveries, it is conceivable that the ACE's daily fuel requirements could be met. However, the ideal is seldom achieved and worst case conditions (i.e. a capability to deliver only 62,000 gallons of fuel by LVS/SIXCOM) should be planned for. In addition, refueler supply of the daily ACE fuel requirement does not address the need to build up a safety level of Class III(A) at each EAF configuration to meet a surge in aircraft sorties and to sustain the ACE in the event the mobile transfer of fuel by refueler or hoseline to each airfield is interrupted by weather, enemy action or equipment failure. Finally, the discussion would not be complete without consideration of the potential distances that could separate available bare bases and constructed EAF's within an AOA. A review of the various MARCOR scenarios indicates several factors could combine to require siting the MMROP MAF ACE at available bare bases and constructed EAF sites within an AOA where the cumulative fuel transfer distance would exceed 60 miles. Among these factors are the location and availability of bare bases, the location of terrain suitable for constructing EAF's, the potential enemy threat, and the necessity to relocate airfields laterally or forward in an AOA to support the Ground Combat Element (GCE).

As described above, the combined limitations of a mobile refueler fleet and current hoseline transfer capability may prove inadequate to sustain the flow of Class III(A) to an EAF system sited at extended distances from the fuel source.

Some additional bulk fuel transfer capability is required. This additional bulk fuel transfer capability could be 1) increased mobile refueler assets with priority engineer construction effort directed towards developing and maintaining an extensive road system in the AOA, or 2) deployment of an extended fuel line transfer system from a centralized AAFS to the EAF system or from the beach to AAFS located at each EAF configuration.

5.10 <u>Alternative Bulk Fuel Transfer Concepts</u>. Discussion with HQMC (Code LME) and other Marines who have had experience deploying the AAFS indicates that the only system limitation on increasing the distance each AAFS can transfer fuel is number of booster pumps and discharge hoselines available in each AAFS to perform this function. For example, by employing all eleven BUA's and BPA's resident in the 11 AAFS available to provide Class III(A) support to an ACE, a fuel transfer distance of 33 miles can be achieved from one 6 tank Tank Farm

Assembly to the next Tank Farm positioned in tandem from the Beach Unloading Assembly to one supported EAF. Alternatively, the tandem concept of employing 11 AAFS in depth and laterally to five separated EAFs could cover a cumulative distance of 33 miles. Fuel transfer distance can be extended even further in depth and laterally to the five airfield complexes by an additional modification to the bulk fuel system employment concept.

5.10.1 Increased Use of Booster Pumps. A further examination of Table 5-5 reveals that each AAFS contains ten 600 GPM booster pumps and 18,000 feet of 6 inch fuel discharge hose that enables fuel to be transferred over a distance of 3 miles, provides for the recirculation of fuel within each of the five Tank Farm Assemblies, and distributes fuel to supported activities. Accordingly, the 11 AAFS available to supply Class III(A) to the ACE would contain 110 booster pumps and 198,000 feet of discharge hose. Conceptually, the 110 booster pumps, divided into increments of two booster pumps for each 3 miles of fuel transfer distance, could conceivably pump fuel in a straight line for a cumulative distance of 165 miles. The 198,000 feet of discharge hoseline currently available to the 11 AAFS, however, limits transfer distance to 37.5 miles. Obviously, additional discharge hoselines would be required to extend the AAFS fuel transfer distances. Included in this conceptualization of an AAFS extended fuel transfer system is the division of the Tank Farm Assemblies into two 20,000 storage tank increments to be employed with each set of two booster pumps in a series of tandem fuel transfer points along a fuel distribution route inland and laterally to the EAFs.

5.11 Multiple Fuel Transfer Systems. Whether the Class III(A) is stored in Tank Farm Assemblies or flows through a series of Booster Pump Assemblies from the fuel source directly to each TAFDS, the Class III(A) support requirement of an ACE bedded down on multiple, dispersed EAFs could be met. A series of schematics demonstrating a representative example of extended distance fuel transfer layouts is displayed at Figures 5-4 through 5-6. The 3 mile interval between Booster Pump Assemblies (BPA) shown in each Figure is merely illustrative of an extended distance fuel transfer system concept. It is not intended to represent the specific distances to which fuel may have to be transferred to support each EAF configuration.

# BULK FUEL TRANSFER LAYOUT-1

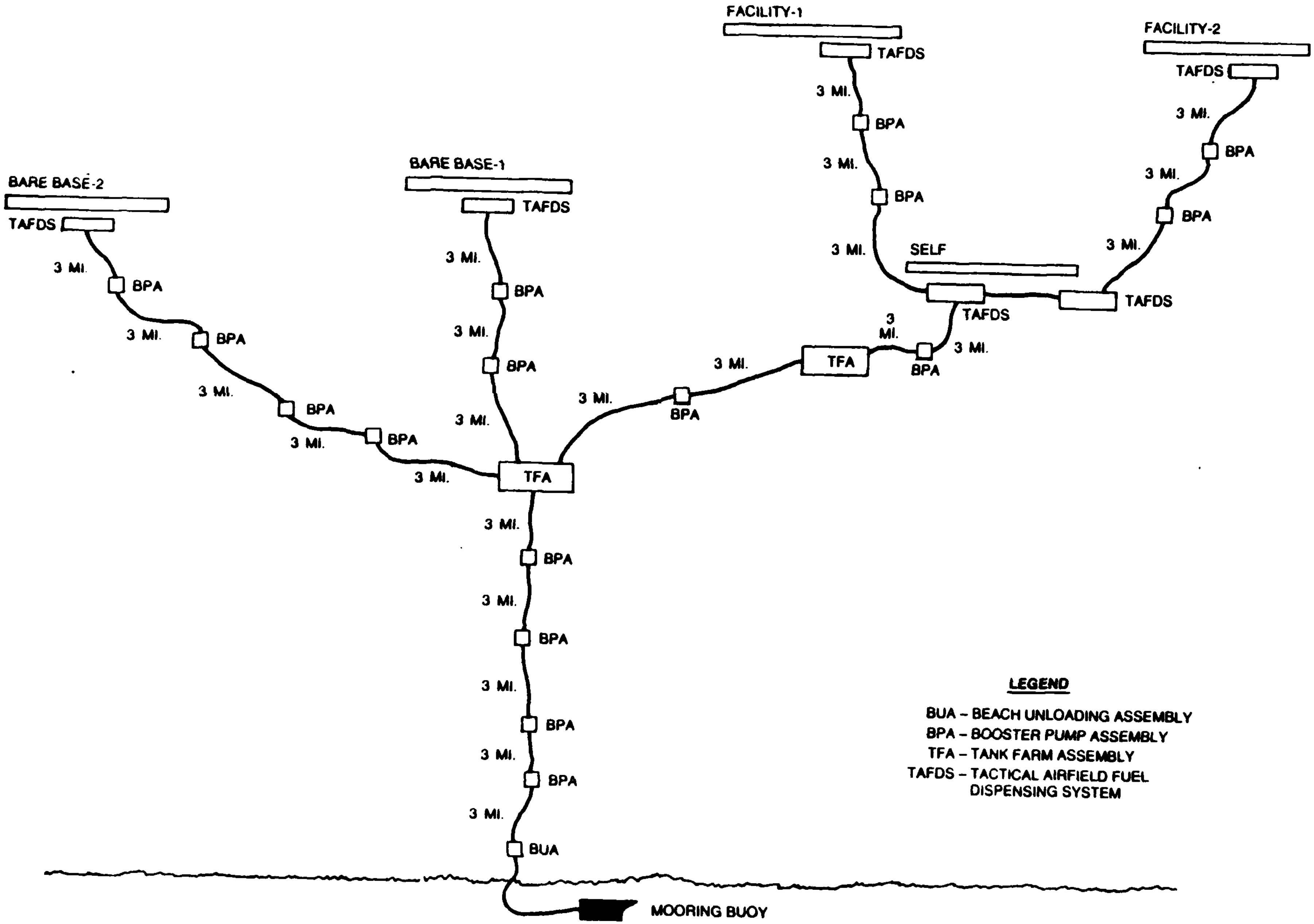



FIGURE [illegible]4

# BULK FUEL TRANSFER LAYOUT-2

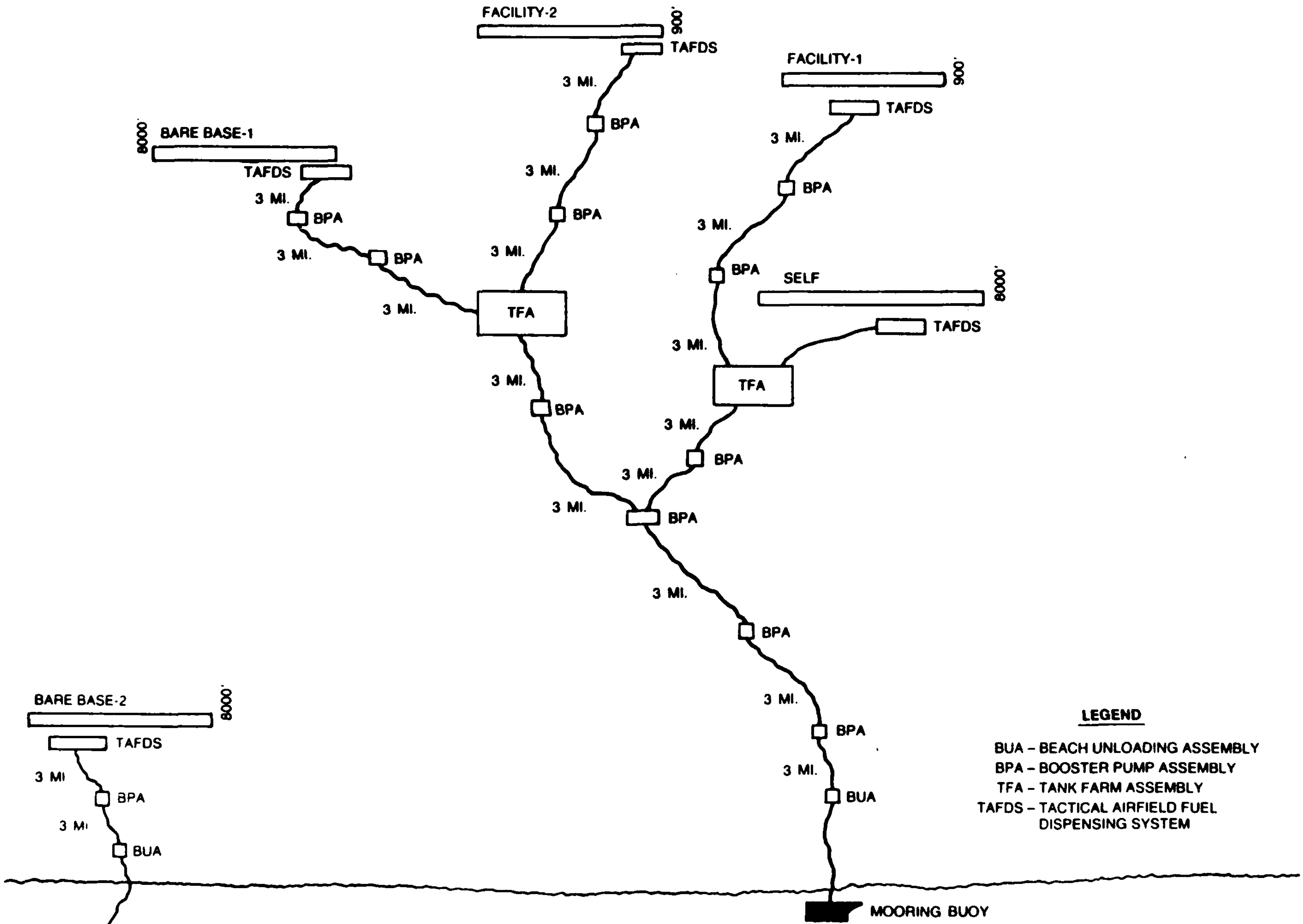
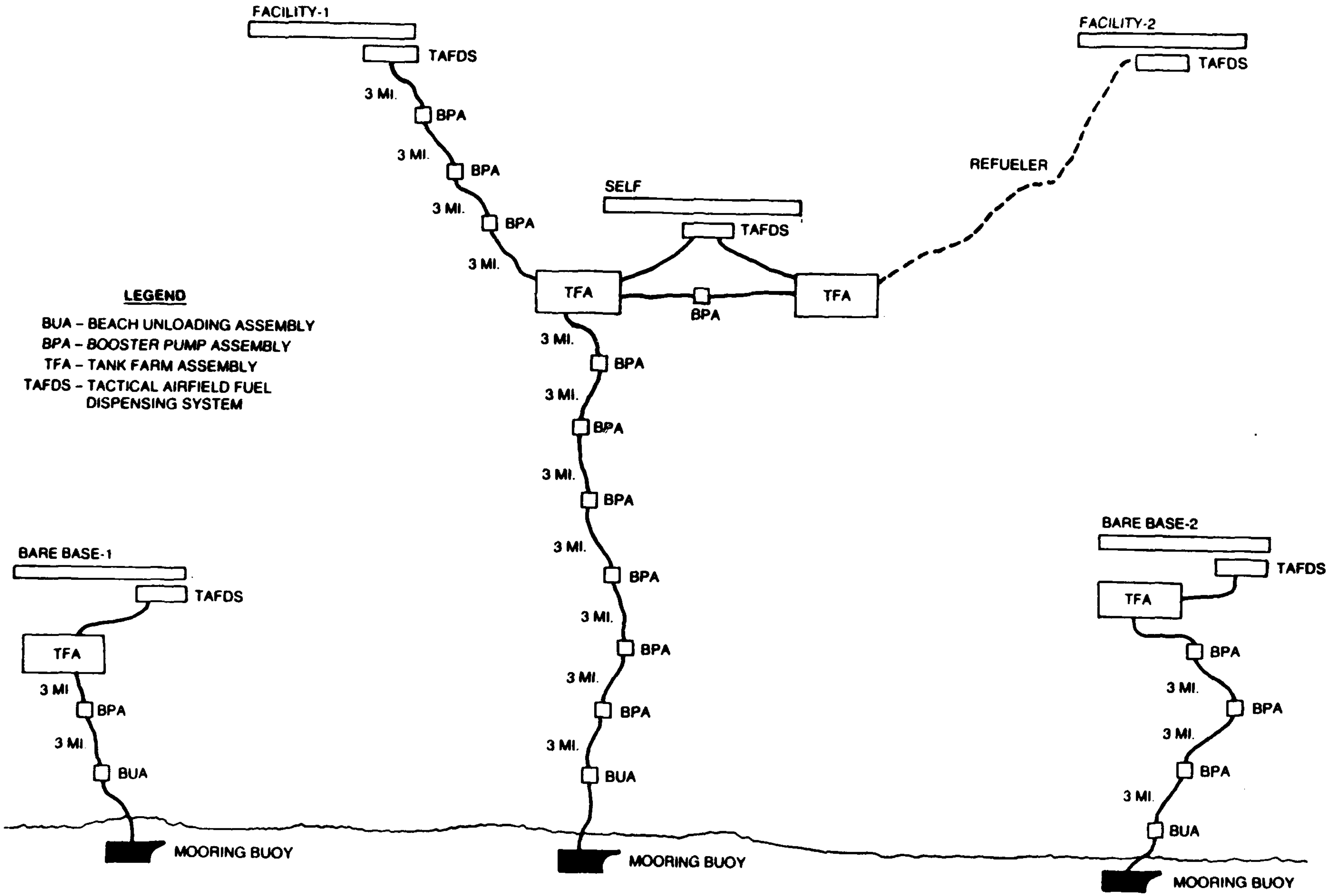



FIGURE 5–5

## BULK FUEL TRANSFER LAYOUT-3




FIGUR[illegible]-6

A multiple system of extended distance fuel transfer lines would constitute an operational problem in terms of security of lines and the capability of bulk fuel company personnel to continually inspect and maintain the system. However, the discussion at this point involves fuel transfer distance to multiple EAFs as a function of system capability and assets. The MMROP ACE, thus can be supported with the required level of Class III(A) at multiple sites by a modification of the concept of AAFS employment and the addition of those hoselines necessary to accommodate a tandem deployment of AAFS fuel storage tanks. Similarly, the TAFDS, though primarily an aviation bulk fuel storage and dispensing system can, with the addition of the requisite number of booster pumps and discharge hoses, also be incorporated into the fuel transfer layout. TAFDS components, except for special aviation fuel filters, are identical to those comprising the AAFS and should be considered an additional means of transferring bulk fuel over extended distances where the operational need dictates such employment.

5.12 Other Sources of Fuel Transfer Support. The delivery of bulk aviation fuel to a widely dispersed EAF system could conceivably require transfer of fuel to distances and in quantities neither the AAFS nor mobile refuelers could accommodate, no matter what additional assets were provided the Bulk Fuel Companies and Motor Transport units. In such a case, i.e., extended distance transfer beyond 33 miles, excessive terrain elevations, or severe climatic conditions, the Class III(A) fuel transfer system may be augmented by other means of fuel transfer. One such extended fuel transfer capability involves the use of a rigid metal pipeline transfer system.

The U.S. Army Petroleum Pipeline and Terminal Operating Company has such a capability in the form of a 4 inch to 8 inch diameter coupled welded pipeline system that can be deployed a distance of 60 miles. This system, deployed in 15 mile increments with a booster pump at each 15 mile pipeline intersection, can operate 24 hours a day. The pipeline can be buried to preclude interruption from enemy interdiction or climatic conditions, and, with additional booster pumps, can traverse higher terrain elevations than is possible with an expeditionary, fabric hoseline system. Delivery of fuel beyond the 60 mile terminus end of the rigid pipeline system is by refueler vehicle, expeditionary transfer systems similar to the AAFS, fuel containers, and drums.

The Marine Corps is in the process of upgrading some of the 600 GPM pump sets in its Booster Pump Assemblies to 800 GPM capable pumps. This upgrade is intended to accommodate the increased fuel transfer flow the U.S. Navy is developing to deliver fuel ashore in an amphibious operation. In addition, add-on control kits that will monitor pump suction and discharge pressures, and will automatically regulate engine speed for maximum fuel delivery by the improved 800 GPM pumps, have also been developed. This booster pump upgrade effort could provide significant improvements in increasing pump set spacing and may eliminate the need to install one and perhaps both of the collapsible fuel storage tanks at each booster pumping station. The upgraded, significantly more capable 800 GPM booster pump set is an essential component in development of an extended distance fuel transfer system.

The second essential element of a fuel transfer system is the hoseline. Recent advances in hoseline technology have opened the way to the development of innovative hose laying and retrieval equipment that will accommodate rapid installation of an extended distance fuel transfer system to multiple EAF sites. The new technology will permit the AAFS to deploy up to 3000 feet of 6 inch diameter fuel transfer hoseline from truck mounted hoseline reels in lieu of hand laying and coupling 50 foot sections of fabric hoseline. These two developments, the 800 GPM pump sets and rapid deployment hoseline reels, will enhance significantly the AAFS ability to meet the Class III(A) requirements of multiple EAF sites.

Other possible improvements to developing a rapidly deployable extended distance fuel transfer system include:

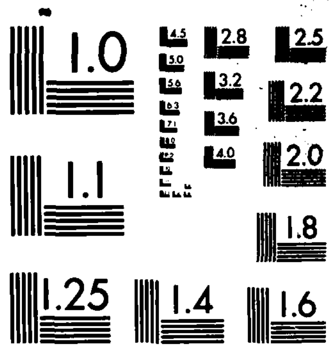
o Development of plastic hoselines that can be buried, would be impervious to climate conditions or terrain variances, and can transfer fuel by means of booster pumps directly from the fuel source to whatever distance is required to support a multiple EAF System configuration.

o A variation of the U.S. Navy DRACON fuel storage bladder that will accommodate 130,000 gallons of liquid fuel in a collapsible container measuring approximately 220 feet long by 11 feet wide.

o Development of fuel hydrants that can be connected to extended distance fuel lines to receive Class III(A) directly from the fuel source and

AD-A165 967 ON THE DEVELOPMENT OF AN OPERATIONAL CONCEPT FOR THE MARINE CORPS EXPEDIT..(U) MARINE CORPS DEVELOPMENT AND EDUCATION COMMAND QUANTICO VA 17 DEC 85 2/3

UNCLASSIFIED F/G 1/5 NL




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

dispense fuel to several aircraft simultaneously at multiple improved and unimproved EAF sites.

The use of aerial refuelers as an additional means of fuel delivery was considered, but rejected as an inefficient use of a valuable resource for the limited quantity of fuel that could be transferred (i.e. 6000 gallons by C-130 and 9,000 gallons by C-141).

5.13 Summary. The Study Team analysis of the Class III(A) aviation fuel requirements of the MMROP MAF ACE indicates that sufficient bulk fuel storage assets are available to a MAF to sustain the daily operations of the ACE and provide in excess of a 10 day level of JP fuel supply needed to support each EAF and bare base at which the 634 plane ACE will be bedded down.

The bulk fuel transfer capability of the MAF includes both a current 5000 gallon capacity mobile refueler fleet and a projected SIXCON Fuel Module/LVS vehicle system mode of delivery that, under ideal conditions of a suitable road system in an AOA, could provide part but, most probably, not all of the daily Class III(A) aviation fuel needed to sustain a 634 aircraft ACE.

Multiple EAF's and bare bases sited at widely separated locations in an AOA could require Class III(A) to be transferred to a cumulative distance exceeding 60 miles. The current three mile bulk fuel transfer capability of each AAFS can be extended by employing a concept of 20,000 gallon fuel storage tanks and booster pumps deployed in tandem from a fuel source to each EAF configuration. Improvements to the Booster Pump sets and new hoseline technology will enhance the current bulk fuel transfer capability.

Other means of delivering bulk fuel to an EAF system deployed at distances beyond the capability of the AAFS or mobile refueler assets to service already exist or are deserving of evaluation. These delivery techniques include a rigid metal pipeline system equivalent to that employed by the U.S. Army Petroleum Pipeline and Terminal Operating Company; use of plastic hoselines that can be buried; installation of fuel storage tanks of larger capacity than the current 20,000 gallon collapsible tank; and fuel hydrants connected to extended distance hoselines transferring bulk fuel directly from the fuel source.

The Study Team has identified a finite level of Class III and III(A) support issues and has proposed solutions to some of the more significant problems inherent in transferring fuel to a widely dispersed EAF System. It is obvious, however, that a more detailed analysis of the entire spectrum of Class III and III(A) support, i.e. containerization of fuel storage/transfer assets, fuel throughput procedures, and fuel transfer methods for extended distance in severe climates is indicated. Such an effort would benefit future planning for and logistic support of the entire MAGTF in an expeditionary environment. In the interim, doctrinal publications and technical manuals that address Class III and III(A), support of a MAGTF, should be modified to reflect the additional requirements that multiple EAF sites and/or bare bases will levy on any bulk fuel transfer and storage systems.

# CHAPTER VI

## CLASS V (A) STORAGE REQUIREMENTS

6.1 General. This Chapter identifies the bomb dump storage requirements associated with the major Class V(A) items to be stored at the various EAF facilities. It addresses those requirements both in terms of gross weight and net explosive weight and does not identify the specific quantities of individual items of ordnance. The basic planning data, which included the specific quantities, was provided to the Study Team by the SAC based on a Center for Naval Analysis (CNA) computation of both non-nuclear air-to-surface ordnance requirements (NNOR) for the Program Objective Memorandum (POM)-83 update, and the current Class V(W) ground ammunition requirements of the MMROP MAF ACE for the same time frame.

The computations are based on MARCORS-1A scenario with no aircraft attrition applied. The air-to-surface ordnance expenditure rates were provided for each type aircraft included in the MMROP MAF ACE, excluding the KC-130, the RF-4B and the EA-6B. Since no appropriate data exists for the FA-18, its Class V(A) planning factors were based on the F-4 rates with a 30% NNOR increase per sortie rate applied to reflect the substantially greater ordnance capacity of the FA-18 over the F-4.

The primary purpose for computing the ordnance storage requirements was to determine the level of engineer support needed to construct the number of bomb dumps necessary to sustain the daily, prescribed days of ammunition supply to be stored at each EAF facility. Other than that purpose, there is no requirement within the SOW to evaluate the Class V or Class V(A) requirements.

This Chapter does not, therefore, address the issue of Class V(A) throughput procedures involving aviation ordnance maintenance, transportation, and delivery from the FSSG to the bomb storage dumps for assembly and subsequent delivery to the arming areas on the EAFs. While it is recognized that such an analysis is critical from the perspective of ACE operations, it is outside the scope of the study effort. However, certain aspects concerning organizational responsibilities and personnel staffing warrant comment.

6.2 Class V (A) Supply, Distribution and Storage Requirements. A review of the direct labor available to both the FSSG and the Headquarters and Maintenance Squadrons of the fixed wing (VA/VF) MAGS to perform the logistic functions incident to ammunition storage, maintenance, assembly, and delivery provides the follwing insights.

The FSSG has the responsibility for moving Class V(A) from the beach to the FSSG Ammunition Supply Points (ASPs) and for subsequent delivery of required levels from the ASPs to the bomb storage dumps at each EAF facility. The personnel to perform these functions are located in the Ammunition Platoon and the two Direct Support Ammunition Platoons, Ammunition Company, Supply Battalion, FSSG, and consist of a total of 6 officers and 268 enlisted personnel.

The personnel assigned to the Ordnance Section, H&Ms of each VA/VF MAG receive, store, assemble, and assist in the delivery of the ready for issue (RFI) ordnance from the bomb storage dumps to the arming areas. Each Ordnance Section consists of 2 officers and 54 enlisted. The total complement of the three fixed wing MAGs within the ACE totals 6 officers and 162 enlisted. It should be noted that these personnel process what equates to an average of 57% of the entire MAGTFs Class V requirements.

6.3 Class V (A) Requirements. Based on the planning factors provided in the CNA computations, it was established that the 30 days of supply (DOS) of Class V(A) air-to-surface expenditure rate for the 634 aircraft within the ACE will approximate 28,772 short tons (ST) gross weight, i.e., palletized/packaged, for the fixed wing aircraft, and 3,736 ST gross weight for the rotary wing aircraft for a total of 32,508 ST gross weight.

For study purposes, it has been assumed that approximately 15 DOS will normally be stored at each EAF facility. This consists of a total gross weight of 16,538 ST and a net explosive weight of 9,924 ST.

6.4 Bomb Dump or Ammunition Cell Requirements.

6.4.1 Net Explosive Weight as a Criteria. The net explosive weight is exactly what the term implies, i.e., the total quantity of explosives material or high explosive equivalency, in each item or round, to be used when applying quantity distance criteria or other standards for ammunition storage or transportation. The net explosive weight is the standard used for calculating the size of ordnance magazines and ammunition cells within the magazines. According to the critieria contained in Naval Sea Systems Command (NAVSEA) OP-5/1; "Ammunition and Explosives Ashore," a maximum of 250 ST of net explosive weight can be stored in a properly constructed ammunition storage cell in order to preclude the potential of sympathetic detonations in adjoining cells and to provide a reasonable degree of protection against propogation of explosives due to fragments. Although smaller cells may be used, the Study Team opted to use the largest permissible size to determine the number of cells and related construction effort required. Use of the 250 ST cell is an accepted baseline within the engineer community. Such use is reflected in System J36 of the Advanced Base Functional Component (ABFC) System and in the most recent Naval Facility Engineering Command and Marine Corps sponsored studies on earthwork construction in support of a MAGTF. Since the net explosive, or charge weight, of the total Class V(A) requirement of the MMROP MAF ACE was not provided to the Study Team, it was determined that the gross weight of Class V(A) multiplied by a factor of .60 would approximate the net explosive weight of the ordnance load being evaluated (i.e., the explosive content of the ordnance less the weight of packaging and non-explosive components of the ammunition).

6.4.2 Marine Aircraft Group Organization as a Criteria. Another fact that might bear on the number of cells or bomb dumps established at any one EAF is the number of Marine Aircraft Groups located on the facility. Normally, a separate bomb dump is established for each MAG and is operated by the Ordnance Section, within the H&MS, trained to conduct the ordnance functions unique to a specific type aircraft. However, for study purposes, the number of cells to be constructed was based solely on the net explosive weight of the ordnance required at each EAF by either the fixed wing or the rotary wing organizations. This method provided an adequate, accurate basis for computing the related engineer support efforts.

6.5 Ordnance Storage Requirements. Table 6-1 depicts the ordnance storage requirements for 15 DOS at each EAF in terms of gross weight, net explosive weight, and the number of 250 ST cells needed to support the requirement. It reflects a requirement for 42 cells with 17 allocated to the SELF and the remaining 25 distributed equally to the remaining facilities.

6.6 Class V(W) Ground Ammunition Storage Requirements. No additional major engineer construction effort was determined needed to accommodate the MMROP MAF ACE's Class V(W) ground ammunition storage requirements. The ACE's 15 day level of Class V(W) supply was determined to be 313 short tons by net explosive weight. This quantity of ammunition can be accommodated by storage compatibility code within the forty-two 250 short ton Class V(A) ammunition storage cells distributed at each EAF configuration shown at Table 6-1.

An analysis of the intense combat daily usage rate for Stinger and Improved Hawk Air Defense Missiles by the FAAD Batteries and Hawk Batteries also indicates that storage areas for these Class V(W) items can be constructed at each battery site without an extensive engineer construction effort. A 15 day level of supply of Hawk missiles, for example, even under the intense combat rate usage, constitutes 87 short tons of ordnance by net explosive weight per firing battery. This quantity of Class V(W) can be stored in an earth bermed ammunition storage cell measuring 75'x75'; a construction effort well within the capability of the Wing Engineer Squadron to construct.

6.7 Summary. As stated in the introduction to this Chapter, the primary purpose of computing the Class V(A) storage requirements is to develop a basis for determining the engineer effort required to construct the requisite number of ammunition cells. That effort is addressed in the following Chapter.

## Class V (A) 15 Days of Supply

| Site | Gross Weight ST | | | | Net Explosive Weight ST | | Number of 250 ST Cells |
|---|---|---|---|---|---|---|---|
| **Facility-1** | | | | | | | |
| Fixed Wing | 2,166 | X | .60 | = | 1,300 | | 5 |
| Rotary Wing | 207 | X | .60 | = | 124 | | 1 |
| Total | 2,373 | | | | 1,424 | Total | 6 |
| **Facility-2** | | | | | | | |
| Fixed Wing | 2,166 | X | .60 | = | 1,300 | | 5 |
| Rotary Wing | 207 | X | .60 | = | 124 | | 1 |
| Total | 2,373 | | | | 1,424 | Total | 6 |
| **SELF** | | | | | | | |
| Fixed Wing | 6,697 | X | .60 | = | 4,018 | | 16 |
| Rotary Wing | 38 | X | .60 | = | 23 | | 1 |
| Total | 6,735 | | | | 4,041 | Total | 17 |
| **BB-1** | | | | | | | |
| Fixed Wing | 1,895 | X | .60 | = | 1,137 | | 5 |
| Rotary Wing | 916 | X | .60 | = | 550 | | 2 |
| Total | 2,811 | | | | 1,687 | Total | 7 |
| **BB-2** | | | | | | | |
| Fixed Wing | 1,746 | X | .60 | = | 1,048 | | 4 |
| Rotary Wing | 500 | X | .60 | = | 300 | | 2 |
| Total | 2,246 | | | | 1,348 | Total | 6 |
| **Grand Total** | | | | | | | |
| Fixed Wing | 14,670 ST | X | .60 | = | 8,803 ST | | |
| Rotary Wing | 1,868 ST | X | .60 | = | 1,121 ST | | |
| | 16,538 ST | | | | 9,924 ST | | 42 (250-ST) Cells |

TABLE 6-1

## CHAPTER VII

## ENGINEER SUPPORT REQUIREMENTS

7.1 Introduction. The principal and most recent study references addressing engineer construction incident to deploying an EAF are listed at Chapter's end. Those sources, plus various Naval Sea System Command (NAVSEA) publications on storage of ordnance ashore, and the practical knowledge and experience resident in the Marine Corps personnel contacted have provided the Study Team with a wealth of information and a range of insights relative to the construction effort required to install the total EAF system. This Chapter addresses those efforts from the planning through execution phase.

7.2 Engineer Support of the EAF. The engineer support associated with deploying an EAF system in an AOA involves several separate, but interrelated efforts. These activities include the analytical planning prior to an operation, site preparation, and installation of various components in a sequence approximating the following:

- o Analyzing the physical characteristics of the AOA to select appropriate EAF sites.
- o Preparing earthwork calculations and resource allocation plans.
- o Repairing any damage to existing bare bases.
- o Constructing EAF sites, logistic support facilities, and required road nets.
- o Installing runway, taxiways, parking area surfaces, and EAF components.

7.3 Site Selection and Construction Planning. The selection of appropriate locations for the various EAF facilities within an AOA and the determination of the engineer requirements incident to their installation are normally best accomplished by the conduct of a comprehensive site selection trade-off analysis. Such analysis can facilitate selection of the most advantageous sites, minimize the magnitude of engineer effort required and, in turn, make maximum efficient use of limited engineer resources.

A thorough trade-off analysis can entail voluminous manual calculations and time consuming assessments of available charts, surveys, tables, maps, photographs, etc. However, in certain situations, the time available between receipt of a warning order to deploy a MAGTF and its insertion into an objective area is compressed, and engineer planners are precluded from conducting a thorough analysis. Potentially, the requirements for in-depth engineer planning associated with the site preparation and installation of the individual EAF facilities -- particularly those required to support an ACE of 634 aircraft, may not be adequately supportable by the current manual methods of calculating requirements. In recognition of this, the Marine Corps has taken innovative measures to enhance the construction planning process.

7.3.1 Horizontal Construction Planning System (HCOPS). A HQMC (Code LME) sponsored developmental effort to automate selected advance base engineer planning for amphibious operations is being designed. The Horizontal Construction Planning System (HCOPS) will consist of off-the-shelf micro-computers and displays capable of interfacing by radio with a variety of sources to obtain data on terrain intelligence, e.g., topography, vegetation, climate/weather, hydrology, geology, and cultural features. Additional features of the HCOPS will be earthwork design software and data bases listing the characteristics and productivity of earthmoving equipment. The three major subsystems comprising the HCOPS will include:

- The Marine Corps Lightweight Combat Terminal (LCT)
- The Terrain Data Acquisition and Processing Subsystem (TDAP)
- A set of software programs designated "EARTHCALC"

The significant benefit accruing to engineer planning for deployment of an EAF system is that the HCOPS will perform complex horizontal construction calculations and compute construction designs orders of magnitude faster than the current manual methods. The system will also provide for optimum EAF siting and greatly enhance flexibility in adapting to EAF siting changes. In addition, it will calculate the impact of changes in, or a loss of, earthmoving equipment enroute to or within an AOA. The HCOPS will enable engineer planners to project potential EAF sites on large color-coded displays. Then, by superimposing a typical EAF Facility Module, e.g. a SELF, over the site topography displayed, engineers can calculate the various tasks/functions required to prepare and install an EAF and minimize, among other considerations, cut and fill.

Other HCOPS modules, including an Equipment Module and a Scheduling Module, will accord engineers time to develop work schedules based on the construction time required for a given availability of equipment — or the specific equipment needed to meet a given time schedule — to complete a specified engineer task.

The HCOPS, projected to be available by FY 1989, will constitute a quantum enhancement of the engineer planner's capability to rapidly plan and construct EAF's at optimum locations within an AOA with the most efficient use of heavy construction equipment. Its value to effectively deploying an EAF system and ensuring the early availability of ACE aircraft in an AOA is obvious.

7.4 <u>Earthwork Calculations and Resource Allocation</u>. Engineer horizontal construction tasks in support of an EAF system encompass the earthwork structures and prepared surfaces necessary to support the installation of EAF components and the supporting Class III(A) and V(A) storage facilities. These earthwork construction tasks specifically required include:

- Site preparation involving the cutting, filling, compacting, and grading of terrain surfaces to ease the task of installing matting to form runways, taxiways, and parking areas.

- Construction of bomb dumps with shaped earth bermed ammunition storage cells to store aviation ordnance, and the graded, compacted, ditched roadway system essential to Class V(A) storage and transfer functions.

- Individual berming and installation of fuel storage tanks comprising the AAFS and TAFDS complexes necessary to support the Class III(A) requirements of the ACE.

Additive to the deliberate engineer construction effort, but not a part of this study, are the significant vertical construction requirements of an ACE supporting a MAF sized MAGTF, i.e., maintenance, command and control, security, and other combat service support (CSS) structures as well as cantonments for billeting personnel during an extended operation.

7.4.1 Resource Allocation Plan. From an engineering standpoint there are a myriad of factors which can influence the efficient and timely installation of an EAF system. Already discussed is the criticality of selecting sites that make maximum use of available topography to minimize earthwork construction. Other factors that may have a significant effect on timely installation include those which impact on:

- o Distances between EAF facilities and support areas, e.g., bomb dumps, which may generate the need for an extensive road network.
- o Numbers of non-EAF facilities and support areas that must be constructed simultaneously.
- o Availability and productivity of engineer forces and equipment.

The scope of this study precludes an in-depth analysis of these and other factors, e.g., ammunition and fuel throughput, expeditionary shelter requirements and design, and alternate surfacing systems. They all need further evaluation before the total spectrum of engineer support of an EAF system can be determined.

7.5 Sources of Engineer Support. The major issue involving engineer support for the EAF system is the availability of engineer forces -- internal and external to the Marine Corps -- with the requisite personnel, skills, and equipment to accomplish the deliberate construction and installation tasks.

The primary engineer construction capability within the MAF consists of the designated engineer battalions and engineer squadrons within the Marine Divisions, Force Service Support Groups (FSSG), and the Marine Aircraft Wings (MAW). Additional engineer personnel and equipment are distributed throughout the air and ground combat elements of a MAF, but their special mission requirements limits their availability to contribute to the EAF system construction or installation efforts. For example, the Landing Support Battalion, FSSG includes in its mission statement a requirement, "... to provide limited close combat engineer support to meet essential requirements during operations ashore. ...", and the battalion does possess heavy engineer equipment suitable for airfield site preparation. However, the battalion's primary mission is beach support operations, i.e., to facilitate the landing of MAGTF personnel and equipment and the distribution of landing force supplies. This includes the preparation of dump sites and egress routes from the beach and clearing of disabled equipment. These primary mission tasks will normally fully tax the battalion's limited engineer capabilities and militate against considering the battalion as a potential source of engineer support to meet EAF requirements,

Those MAF elements whose primary mission is to provide expedient and deliberate engineer support of the air and ground combat elements of a MAF are listed in Table 7-1.

MAF ENGINEER ORGANIZATIONS

| UNIT | USMC OFF | USMC ENL |
|---|---|---|
| Combat Engineer Battalion MAR DIV (T/O 1368N) | 44 | 877 |
| Wing Engineer Squadron, MWSG, MAW (T/O 8714N) | 36 | 704 |
| Engineer Support Battalion, FSSG (T/O 3758N) | 56 | 1738 |
| | 136 | 3319 |

TABLE 7-1

Each organization listed in Table 7-1 has included within its mission and function statement the requirement to provide a specified level of support for the EAF system. The Combat Engineer Battalion and the Wing Engineer Squadron are currently limited by mission, organization, and equipment to site preparation and installation of forward operating sites and "expedient runways." The WES is also tasked with accomplishing expedient minor repair of existing facilities. The Marine Division Combat Engineer Battalion's primary mission is to concentrate its personnel and equipment resources in direct support of the Ground Combat Element. Such employment effectively precludes their availability for construction/installation of the EAF System with the exception of assisting in siting the 72'x72' VSTOL pads that may be deployed within the

Marine Division area of operation. The Engineer Support Battalion, FSSG, then is the only MAF engineer element specifically tasked to "prepare, site, install, and maintain expeditionary airfield (EAF) runways and taxiways."

7.5.1 Wing Engineer Squadron (WES), MWSG. The Wing Engineer Squadron, MWSSG possesses a limited range of horizontal and vertical construction capabilities and performs missions of specific value to the construction and installation of an EAF System. These capabilities include the requirement to:

- o Provide engineer reconnaissance/survey for the MAW.
- o Repair, improve and maintain existing road nets within the MAW area of responsibility.
- o Provide construction and maintenance of expedient roads.
- o Construct, improve, and maintain helicopter and light reconnaissance aircraft landing sites.
- o Develop, improve and maintain drainage systems.

Of the 36 officers and 704 enlisted Marines who comprise the WES, only those personnel and equipment included in its Engineer Section are specifically organized to provide the direct labor necessary for EAF construction. The TAFDS Section and Material Handling Section can contribute to the installation of EAF components and support facilities when the EAF construction effort progresses to the point of allowing them to begin this activity. Table 7-2 depicts those WES units that can support EAF System construction and installation.

WING ENGINEER SQUADRON, MWSG

| UNIT | Type Labor | USMC OFF | USMC ENL | MAN-HOURS AVAIL. 10-HRS/DAY 1/ |
|---|---|---|---|---|
| Engineer Section | Construction | 8 | 268 | 1,800 |
| Material Handling Section | Installation | 1 | 41 | 410 |
| | TOTAL: | 9 | 309 | 2,210 |

NOTE: 1/ Direct labor availability is based on two-thirds of the unit's available manpower performing direct labor. Remainder of unit personnel are supervisory, administrative, or other skilled personnel. Total Material Handling Platoon is considered direct labor for installation purposes.

TABLE 7-2

The range of engineer earthmoving equipment available to the WES, while limited, includes rollers, scrapers, and tractors that should be considered as part of the MAGTF's EAF System construction resources. The contribution that the WES can provide in deploying the EAF System will be discussed in a later paragraph.

7.5.2 Engineer Support Battalion, FSSG. The Engineer Support Battalion is specifically tasked in its T/O, inter alia, to:

- o Repair, stabilize, and reinforce taxiways and runways within organizational capabilities.
- o Prepare, site, install, and maintain expeditionary airfield (EAF) runways and taxiways.
- o Provide repair and maintenance of airfield runways and taxiways beyond the capability of the WES.

Although the battalion has a T/O strength of 56 officers and 1,738 enlisted personnel, as depicted in Table 7-3, only 6 officers and 462 enlisted Marines are normally available to perform the direct labor functions associated with the construction and installation of the EAF System. Table 7-3 focuses on those specific units in the battalion whose personnel, skills and equipment are germane to the engineer construction/installation effort.

ENGINEER SUPPORT BATTALION, FSSG

| UNIT | TYPE LABOR | USMC OFF | USMC ENL | MAN-HOUR AVAIL 1/ 10 HR/DAY |
|---|---|---|---|---|
| Engineer Equip. PLT, SPT Co. | Construction | 1 | 54 | 360 |
| Engineer Company (3) | | 5 | 124 | |
| Equipment PLT (3) | Construction | (1) | (42) | 840 |
| Engineer PLT (6) | Installation | (1) | (39) | 1,560 |
| | TOTAL: | 16 | 426 | 2,760 MH |
| | Direct Labor Construction, MH/DAY | | | 1,200 |
| | Direct Labor Installation, MH/DAY | | | 1,560 |

NOTE 1: Based on two-thirds of unit's available manpower being direct labor. The remaining one-third consists of supervisory, administrative and other skill personnel.

TABLE 7-3

The total construction man-hours available to the Engineer Support Battalion, as well as other engineer organizations, in support of the EAF System will normally be eroded by a simultaneous requirement to conduct other critical engineer support tasks, e.g., clear egress routes and prepare Logistic Support Areas. However, for the purpose of this study, it has been assumed that the total man-hours available are assigned to meet the priority requirements of airfield construction and installation. While this may not be the case in individual scenarios, it illustrates a "Best Case" capability and a common base from which less optimistic estimates can be derived.

An array of earlier Navy and Marine Corps sponsored studies have been conducted on engineer support required within a MAF level MAGTF deploying a series of EAFs. In one significant Naval Facilities Engineer Command study it was determined that the engineer construction and EAF component installation effort necessary to support achieving an operational capability of four configurations of the EAF system by D+60 would approximate 180,000 man-hours. This man-hour requirement, when compared to the limited engineer man-hour level of construction effort available in a MAF for EAF support, indicates that a major part of the required engineer support must necessarily be obtained from sources external to the MAF. The primary source of this engineer support is Naval Construction Forces.

7.6 Naval Construction Forces. Naval Construction Force (NCF) is a generic term applied to that group of deployable naval organizational components which have the common characteristics of possessing the capability to construct, maintain, and/or operate shore, inshore, and/or deep water facilities in support of the Navy and the Marine Corps. Included in the NCF mission is the requirement to provide amphibious assault construction, especially airfield construction, on a priority basis.

7.6.1 Naval Mobile Construction Battalion. Of the several elements comprising the NCF, the Naval Mobile Construction Battalion (NMCB) is the one force that provides shore, and inshore facility construction support to Navy and Marine Corps operating forces. The wartime strength of the NMCB is 24 officers and 738 enlisted. Of this total, 307 Navy SEABEES are normally available to provide total direct labor to vertical and horizontal construction tasks.

Using a standard work day of 10 hours as cited in the Joint Contingency Requirements Study (JCCRS), JCMS-333-79 of 20 December 1979, each battalion is potentially capable of providing 3070 man-hours of direct labor per day. Of that total, one-third (1023 MHs) is available for horizontal construction while the remaining two-thirds (2047 MHs) represents a vertical construction capability.

Having determined the appropriate productive engineer man-hours available within the various engineer organizations, it is next necessary to evaluate the effort and time required to install an EAF system.

7.7 Level of Effort/Time for EAF Construction/Installation. A Naval Facilities Engineer Command sponsored study, "Naval Construction Force Requirements In Support of a Marine Amphibious Force In an Amphibious Objective Area" dated 17 December 1981, analyzed an NMCB's horizontal construction capability in terms of installing the following array of EAF facilities:

- Two 72'x1800' Expeditionary Airbases
- One 96'x5184' Expeditionary Airfield
- One 96'x8000' SELF
- Four bomb dumps with a total storage capacity of 9,750 short tons (ST) of Class V(A).

The scenario placed the AOA in Northern Europe and established the requirement to have four EAF sites and supporting facilities operational by D+60. The engineer forces employed consisted of three NMCBs and one Engineer Support Battalion. In the study, the horizontal construction capability of one NMCB was computed to be equivalent to 1020 man-hours per day.

The horizontal construction effort required to develop four bomb dumps and to install the four EAF facilities, cited above, was established as 189,000 MHs. This equates closely to the total man-hour requirement of 139,000 man-hours computed by the Study Team to construct three EAF facilities, expand two bare bases, and site the requisite ordnance and fuel dumps.

There are, of course, additional considerations, other than man-hours that affect the overall ability to rapidly emplace the EAFs.

7.7.1 Additional Influencing Factors. In addition to those factors affecting the EAF construction effort that have previously been discussed, the following additional factors are also germane to the issue of rapidly emplacing the EAF System and its requisite support facilities:

- o The time engineer forces are introduced into the AOA with sufficient equipment assets to perform construction tasks.
- o The scheduling and allocation of equipment and personnel resources to maximize efficient use of assets.
- o The sequence established for construction of each EAF and bare base.

7.7.2 Introduction of Engineer Forces. Elements of a MAF sized MAGTF engineer force will normally be introduced into an AOA with the assault echelon to perform the close combat engineer tasks associated with clearing obstacles, assisting in rapid movement across the beach, and in facilitating the attack momentum of the Ground Combat Element. The MAGTF's deliberate engineer construction forces and NMCBs, however, would not normally be landed in force prior to D+5. It normally requires this period to land the Ground Combat Element; build up sufficient levels of logistic support assets to sustain the ground combat effort; and phase ashore the MAF engineer personnel, construction material, and heavy construction equipment, i.e., 158 major engineer construction items for the Engineer Support Battalion, and approximately 58 items of NMCB heavy construction equipment.

7.7.3 Scheduling and Allocation of Equipment. The engineer construction effort involved in the complete site preparation for two VSTOL facilities, a SELF, and the parking areas at two bare bases will place heavy demands on available crawler tractors, road graders, and earth compacting equipment. A MAF can expect to experience varying degrees of difficulty in providing the construction assets necessary to complete horizontal construction projects within a specified period of time depending on several factors. These would include the operational concept, the tactical situation, terrain conditions, and personnel shortfalls or equipment degradation. The achievement of the required initial operating capability (IOC) for each EAF could well be a function of how well the engineer planners develop a project schedule and allocate available engineer equipment prior to an operation, and on the ability to manage the engineer effort once it is initiated in an AOA.

An in-depth evaluation of how best to allocate equipment and personnel resources in support of a MAF sized operation was accomplished in 1978 by the Naval Civil Engineering Laboratory, Port Hueneme, California, Technical Note N-1514 titled "Earthwork Construction In Support of a Marine Amphibious Force - A Case Study." This study includes several general limiting assumptions on labor/time available, site topography, threat to a MAGTF, nature of the facilities available in an AOA, and the availability of three NMCB's to augment a MAGTF engineer construction capability. Specifically, the AOA was assumed to be a predominantly undeveloped area with marginal, or no logistic facilities; the topography presented no extremely adverse or beneficial conditions; and the MAF was under no threat from either aerial or NBC attack. Though it does not purport to be the definitive work on the subject, the study nevertheless constitutes a significant contribution to the understanding of the issue of scheduling engineer construction projects in support of, inter alia, an EAF system and to the efficient allocation of limited engineer resources.

The core of the study effort is the formulation of a computer assisted Critical Path Method (CPM) scheduling analysis of a MAF level engineer construction support requirement separately considering both project activity durations and activity durations, and activity resources. The study suggests, and the Study Team's own analysis of the problem supports the recommendation, that a project/equipment management system (PEMS) employing the CPM be developed and employed under the supervision of a MAF engineer planner to: establish construction project priority; schedule projects to achieve optimum allocation of construction resources; assign independent and joint project tasking; and to provide a tool to enable concerned personnel to supervise the projected status of critical engineer equipment on a real time basis. The proposed PEMS and its auxiliary CPM resource scheduling analysis subroutine could prove to be a valuable addition to future engineer planners if it were to be incorporated in the HCOPs projected to be available by fiscal year 1989.

7.8 Horizontal Construction Requirements of Each EAF Configuration. Chapters IV, V and VI have identified the amount of AM-2 matting required for the runways, taxiways, taxilanes and parking areas required by the various EAF configurations; the number and size of bomb dumps needed at each facility to support Class V(A) and V(W) usage; and the Class III(A) aviation fuel storage level required.

The engineer horizontal construction support required to prepare the EAF facilities and support areas can now be described in terms of the total man-hours of effort involved in each project.

In an effort to provide a general appreciation for the magnitude of the engineer construction effort involved, the Study Team has applied the earthwork planning factors for the man-hour level of effort developed in the 1981 NAVFAC sponsored study, "Naval Construction Requirements in Support of a Marine Amphibious Force in an Amphibious Objective Area", to the EAF system configured to support the 634 aircraft ACE.

The data developed by the Study Team to describe this level of construction effort is intended only to provide a representative data point of the time involved in earthwork construction incident to each project cited above. It cannot constitute a definitive answer to the construction effort required for the EAF system under consideration. Such data can be valid only when the EAF site baseline is adequately defined in terms of topography; climate; equipment types, mix, and productivity; quality of construction to be accomplished; and the distances engineer equipment and construction material must be transported. Accordingly, the man-hour level of construction effort described in following paragraphs, should be viewed as an abstract set of factors presented for illustrative purposes only. It is based on a standard range of man-hour level of effort available to a given set of personnel, and the standard productivity characteristics of a given range of heavy construction equipment organic to a specified engineer force.

7.8.1 Earthwork Construction. For study purposes, it was assumed that the AOA was situated in a well developed area with no severe terrain to overtask engineer resources. The engineer forces consist of the Engineer Support

Battalion, the Wing Engineer Squadron, and three NMCBs (P-25) with a full range of heavy construction equipment. Man-hours are again based on a 10 hour day. The earthwork required is that necessary to prepare the sites for two VSTOL facilities and a SELF, as well as to expand the existing parking area at both bare bases. The calculations needed were derived from various reference documents; however, the primary source is the NAVFAC P-405, SEA BEE P&E HANDBOOK, April 1979 edition, Tables 4-7, 4-9, and 4-11, for constructing cleared, ditched, and drained roads; constructing ammunition and fuel storage berms; and preparing surfaces for installation of runways, taxiways, and parking areas. The formulas used by the Study Team are displayed in Table 7-4. The results for each EAF facility are depicted in Table 7-5.

7.8.2 Installation of EAF System Components. Subsequent to preparation of the sites for the EAF System, the EAF components and logistic support areas can be installed by the combined efforts of the Engineer Companies, FSSG, the WES, NMCBs, EAF units of the ACE, and the MAGTF's bulk fuel and ordnance specialists. Component installation is dependent on the type EAF facility involved. The two bare bases will require AM-2 matting or other suitable surfacing for expansion of the parking areas plus the installation of the aircraft recovery, field lighting, and FLOLS systems. The SELF will require installation of a full array of components. The two VSTOL facilities will require all but the aircraft recovery system. All facilities will be equipped with a communication system which requires a standard 10 hours to install at each EAF/bare base site. Also included in the installation calculations is the time required to site and fill the 20,000 gallon fuel tanks within the TAFDS and AAFS at each facility. The results of the installation man-hour analysis for each EAF and bare base is shown at Table 7-6.

The principal reference for calculating man-hours required to install EAF components is NAVAIR 51-35-7, Technical Manual, Logistics Data Initial Staging Area to Field Installation, Expeditionary Airfields, June 1977 updated edition. Because the EAF configurations in the manual differ from those forming the basis of this Study, the AM-2 matting installation time schedules (unload, breakout and install computations) were analyzed to determine an average rate for installation. It was determined that an average of 4.3 mats could be installed per hour to include the following actions:

## EARTHWORK CALCULATIONS

### BOMB DUMPS

- 250 short ton (ST) above ground, earth bermed cell with dimensions of area = 200 square feet, length = 435 feet, volume = 3222 cu. yards. Total site to be cleared for each cell = 3986 square yards.

- Each cell is provided 0.4 miles of 24' wide roads, surfaced with asphalt, and sloped, banked and ditched 6' on each side of the road.

- Road Construction = 800MH/Mile

- Cell Construction = 160MH/250 ST Cell

### AAFS/TAFDS

- Clear, level the surface, and construct berms for each 20,000 gallon capacity fabric fuel storage tank = 3MH per Tank

### EAF/BAREBASE SITE PREPARATION

| | | |
|---|---|---|
| - Clear and grub surface | = | 7 MH per 1000 square yard |
| - Remove 1' material with scrapers | = | 40MH per 1000 cu. yards |
| - Replace 1' material with scrapers | = | 40MH per 1000 cu. yards |
| - Spread and compact material | = | 60MH per 1000 cu. yards |
| | | 140MH per 1000 cu. yards |
| - Ditch and drain prepared surface | = | 22MH per 100 square yards |
| - 6' on each side | | |

TABLE 7-4

## EARTHWORK REQUIREMENTS FOR THE EAF SYSTEM

### VSTOL FACILITIES

| PROJECT | | MANHOURS |
|---|---|---|
| Site preparation (48,600 sq. yards) | = | 2439 |
| Bomb dumps (6 x 250ST Cells) | = | 960 |
| Road net (2.4 miles/6 cells) | = | 1,920 |
| TAFDS berms (15 Tanks) | = | 45 |
| | TOTAL: | 5,364 MH |
| | TOTAL FOR TWO FACILITIES: | 10,728 MH |

### SELF (Converted from an EAF)

| PROJECT | | MANHOURS |
|---|---|---|
| Site preparation (428,833 sq. yards) | = | 19,899 |
| Bomb dumps (17 x 250ST Cells) | = | 2,750 |
| Road net (5.8 miles/17 cells) | = | 5,406 |
| TAFDS/AAFS (103 Tanks) | = | 309 |
| | TOTAL: | 28,364 MH |

### BARE BASE 1

| PROJECT | | MANHOURS |
|---|---|---|
| Expand parking Area (100,765 sq. yards) | = | 4,993 |
| Bomb dumps (7 x 250ST Cells) | = | 1,120 |
| Road net (2.8 miles/7 cells) | = | 2,240 |
| TAFDS/AAFS (106 Tanks) | = | 318 |
| | TOTAL: | 8,671 MH |

### BARE BASE 2

| PROJECT | | MANHOURS |
|---|---|---|
| Expand parking Area (200, 482 sq. yards) | = | 9,891 |
| Bomb dumps (6 x 250 ST Cells) | = | 960 |
| Road Net (2.4 miles/6 cells) | = | 1,920 |
| TAFDS/AAFS (146 Tanks) | = | 438 |
| | TOTAL: | 13,209 MH |
| | TOTAL EARTHWORK: | 60,972 MH |

TABLE 7-5

## EAF COMPONENT INSTALLATION

### VSTOL FACILITY 1

| PROJECT | MANHOURS |
|---|---|
| Install 14.475 mats @ 4.3 mats/hour | 3,374 |
| FLOLS | 28 |
| Field Lighting System | 388 |
| Communication System | 10 |
| TAFDS (15 Tanks x 5 MH/Tanks) | 75 |
| TOTAL: | 3,875 MH |

### VSTOL FACILITY 2

#### SELF

| | |
|---|---|
| Install 148,313 mats @ 4.3 mats/hour | 34,491 |
| FLOLS | 36 |
| Field Lighting System | 1,760 |
| Communication System | 10 |
| M-21 Aircraft Recovery System | 348 |
| TAFDS/AAFS (103 Tanks x 5 MH/Tank) | 515 |
| TOTAL: | 37,160 MH |

#### BAREBASE 1

| | |
|---|---|
| Install 37,783 mats @ 4.3 mats/hour | 8,788 |
| FLOLS | 36 |
| Field Lighting System | 1,760 |
| Communication System | 10 |
| M-21 Aircraft Recovery System | 348 |
| TAFDS/AAFS (106 Tanks x 5 MH/Tanks) | 530 |
| TOTAL: | 11,472 MH |

#### BAREBASE 2

| | |
|---|---|
| Install 75, 181 mats @ 4.3 mats/hour | 17,484 |
| FLOLS | 36 |
| Field Lighting System | 1,760 |
| Communication System | 10 |
| M-21 Aircraft Recovery System | 348 |
| TAFDS/AAFS (146 tanks x 5 MH/TAnks) | 730 |
| TOTAL | 20,368 MH |

TOTAL INSTALLATION TIME: 76,750 MH

TABLE 7-6

- o Unload and breakout matting at each site.
- o Install matting on required surfaces.
- o Remove and stow AM-2 matting packaging material.

The man-hours involved in installation of other EAF components were extracted from each EAF equivalent displayed in NAVAIR 51-35-7. No attempt was made by the Study Team to compute the additional time required to install an expanded lighting system on the larger EAF configurations used in this study. Based on data contained in other previously referenced documents, it was determined that five man-hours is required to layout and fill one 20,000 gallon capacity TAFDS and AAFS fuel storage tank in its earthbermed configuration.

A consolidated display of the total earthwork construction and EAF component installation man-hour requirement is included in Table 7-7.

7.9 Additional EAF System Construction Limitations. Additive to the time necessary to construct/install the EAF system is the initial staging at each airfield site of the vast quantities of material that comprises an EAF package. Timely delivery of AM-2 matting, for example, by M127 trailer or the newer LVS MK14 container hauler to the SELF and bare bases, in a sequence required to support the installation schedule, may require construction of a suitable road net where none exists. Delivery of EAF material to VSTOL facilities sited at some distances inland, close to the Ground Combat Element, could be accommodated by CH-53 helicopter lift with little or no delay in achieving a desired IOC for that EAF configuration.

The time necessary to marshal personnel, equipment and material resources at each EAF site is a variable that will be unique to each deployment and will affect the rapidity with which engineer forces can achieve the desired IOC of each EAF configuration.

7.10 Sequence of Construction.

7.10.1 General. To some extent, evaluation of construction requirements would be dependent upon the sequence, or order of priority, in which the various EAF

EAF/BARE BASE CONSTRUCTION AND INSTALLATION TIME
(Man-hours (MH) based on 10-Hours/Manday)

| | EARTHWORK CONSTRUCTION TIME | | | | COMPONENT INSTALLATION TIME | | | | | TOTAL MAN-HOURS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | AAFS/TAFDS 3/ | | | | | | | | | |
| SITE | SITE 1/ PREPARATION | BOMB 2/ DUMPS | CONSTR | INSTALL | AM-2 4/ MATTING | FLOLS | M-21 A/C RECOVERY | LIGHTS | COMM | CONSTR | INSTALL | MH TOTAL |
| FAC-1 | 2,439 | 2,880 | 45 | 75 | 3,374 | 28 | - | 388 | 10 | 5,364 | 3,875 | 9,239 |
| FAC-2 | 2,439 | 2,880 | 45 | 75 | 3,374 | 28 | - | 388 | 10 | 5,364 | 3,875 | 9,239 |
| SELF 5/ | 19,899 | 8,156 | 309 | 515 | 34,491 | 36 | 348 | 1,760 | 10 | 28,364 | 37,160 | 66,524 |
| BB-1 6/ | 4,993 | 3,360 | 318 | 530 | 8,788 | 36 | 348 | 1,760 | 10 | 8,671 | 11,472 | 20,143 |
| BB-2 | 9,891 | 2,880 | 438 | 730 | 17,484 | 36 | 348 | 1,760 | 10 | 13,209 | 20,368 | 33,577 |
| TOTAL: | 39,661 | 20,156 | 1,955 | 1,925 | 67,511 | 164 | 1,044 | 6,056 | 50 | 60,972 | 76,750 | 138,722 |

NOTES:

1/ Based on removing/replacing 1' of material and ditching/draining to 6' on each side of prepared surfaces.

2/ Based on 160 MH/250-ST ammunition cell and 795 MH/.4 miles of internal road/250-ST cell.

3/ Based on 3MH to construct berm/20,000 gal fuel storage tank and 5 MH to install/fill each fuel storage tank.

4/ Based on NAVAIR 51-35-7 Technical Manual analysis of AM-2 MAT unload/breakout/installation time.

5/ SELF converted from EAF with Conversion Kit to include MAC A/C Parking and additional parking apron required.

6/ Bare bases require site preparation to expand existing parking area only. Rapid runway repair time @ 4 hours/patch/30 MAN crew is not included.

TABLE 7-7

facilities are to be prepared and brought to an operational state. In those situations wherein one or more bare bases are uncovered in the very early stages of the assault it may be both possible and practicable to repair the damages caused by friendly pre-assault and assault fires or by enemy denial operations.

Under those circumstances, the initial requirement may be to conduct rapid runway repairs discussed in paragraph 7.12 while simultaneously commencing construction on one or more EAF facilities employing AM-2 matting. If a bare base(s) is not uncovered, or if the damage inflicted is so severe that it will require extensive repair/construction, then, of course, the urgent requirement would be for the early construction of a VSTOL airbase leading to the development of a larger facility, e.g., an Expeditionary Airfield.

The precise sequence of bringing the individual facilities on line is not germane to the total study effort or the basic purpose of this chapter. However, an arbitrary sequence has been established in order to set forth the total construction requirements in terms of earth work, component installation, manhours required, and elapsed time to become operational. Under any sequence plan, the initial requirement is for the establishment of the six VTOL sites (72' x 72'). However, when viewed in the context of the total EAF requirement, the engineering effort to install the six sites is minimal and it has been assumed that they will be operational prior to D+5. The requirements associated with the remaining EAF facilities as computed by the Study Team, assuming ideal conditions prevail, are depicted in Table 7-8.

In reviewing the contents of the Table it must be understood that to some extent, the earthwork and component installation efforts will take place simultaneously. The degree of "overlap" cannot be precisely determined and thus for the purpose at hand, it has not been reflected in the computations and Table 7-8 reflects sequential efforts. Thus, it can be anticipated that in each case the total elapsed time could be different than that shown. Other influencing factors, as they relate to specific type facilities, are summarized in the following paragraphs.

HORIZONTAL CONSTRUCTION/COMPONENT INSTALLATION REQUIREMENTS 1/

| SITE | EARTHWORK REQUIREMENTS (MAN-HOURS) | EARTHWORK AVAILABLE (MAN-HOURS) | EARTHWORK REQUIREMENTS (MAN-DAYS) | COMPONENT INSTALLATION REQUIREMENTS (MAN-HOURS) | COMPONENT INSTALLATION AVAILABLE (MAN-HOURS) | COMPONENT INSTALLATION REQUIREMENTS (MAN-DAYS) |
|---|---|---|---|---|---|---|
| VSTOL FACILITY 1 | 5,364 | 1,500 (FSSG/WES) | 3.5 | 3,875 | 985 (FSSG/WES) | 3.9 |
| VSTOL FACILITY 2 | 5,364 | 1,500 (FSSG/WES) | 3.5 | 3,875 | 985 (FSSG/WES) | 3.9 |
| BARE BASE-1 1/ | 8,671 | 1,020 (NMCB-1) | 8.5 | 11,472 | 2,000 (MNCB-1) | 5.7 |
| BARE BASE-2 2/ | 13,209 | 1,020 (MNCB-2) | 12.9 | 20,368 | 2,000 (MNCB-2) | 10.0 |
| SELF 3/ | 28,364 | 1,020 (MNCB-3) | 27.8 | 37,160 | 2,000 (MNCB-3) | 18.5 |
| TOTAL: | 60,972 | 6,060 | 56.2 | 76,750 | 7,970 | 42.0 |

NOTES: 1/ Based on level of earthwork/installation effort required for each site compared with manpower effort allocated to the project. Computation of IOC for each EAF/bare base must include when engineer forces are landed and distance from the landing beaches to the site that personnel, equipment, and EAF construction material must be transported (i.e. EAF components for a SELF will require over 753 M127 trailer loads at gross weight of 24,000 lb traveling over improved road to the EAF site).

2/ Distinctions based on parking area, bomb dump, and fuel storage variations to accommodate different base loadings.

3/ Engineer Support Battalion and one NMCB engineer assets can augment SELF construction/installation on completion of VSTOL facilities and Bare Base 1.

TABLE 7-8

7.10.2 VSTOL Facility. The earthwork required to prepare the site for a VSTOL facility is considered relatively less complex and demanding when compared with the effort entailed in constructing a major fixed wing facility. The primary distinction (other than sheer size) is the fact that runway slope and gradients are not as critical for VSTOL and rotary wing operations as they are for fixed wing. Accordingly, construction and installation of the VSTOL facilities and their support areas are within the capability of the Engineer Support Battalion and the Wing Engineer Squadron.

The combined horizontal construction capabilities of these two units approximates 3000 man-hours/per day, while their combined installation capability is computed to be 1970 man-hours per day. With this combined construction and installation capability divided equally between the two VSTOL facilities, it will require 3.5 man-days to meet the 5364 man-hour earth work requirement at each site. In addition, it will require 3.9 man-days to meet the 3875 man-hours required to install the requisite components at each VSTOL facility. In total, it will require seven man-days of effort at each site to construct and install the two VSTOL facilities.

7.10.3 Bare Bases. As stated in Chapter I, each bare base is assumed to have approximately 140,000 square yards of parking area. The engineer effort required to bring each bare base to a fully operational status will normally consist of: rapid repair of runways, taxiways, and parking areas; expanding the parking areas to accommodate base loading requirements; component installation; and development of necessary bomb dumps and fuel storage areas. These composite requirements are best met by the NMCBs. As stated previously, each NMCB possesses a 3000 man-hour/per day combined horizontal construction and installation capability. Under these circumstances, it will require approximately 14 man-days to complete one bare base and 23 man-days to complete the second. The difference resides in the parking area, bomb dump, and fuel storage requirements predicated on the variances in the base loading addressed in Chapter IV.

7.10.4 <u>SELF Construction/Installation</u>. The major earthwork and installation effort facing the engineer force in completing the EAF System involves the siting and construction of the SELF. Preparation of 428,833 square yards of surface to install runway, taxiway, and parking area matting; 17 bomb dumps, including 5.8 miles of supporting roadway; and a fuel site to store 2,000,000 gallons of Class III(A) aviation fuel entails 28,364 man-hours of earthwork effort. Following preparation of all surfaces, an additional 37,160 man-hours of direct labor will be required to install EAF components and the fuel storage system. One NMCB should be capable of completing all necessary installation functions in 46 man days.

The Study Team determined that the composite capabilities of the Marine engineer units and three NMCBs are adequate to meet the requirements of the EAF system. It must be recognized, however, that the analysis was based on an optimistic, best case "scenario," i.e., that the priority of engineer effort would be dedicated to the EAF and that there would be little or no degradation of effort occasioned by a shortfall or loss of engineer equipment or personnel. Finally, it was assumed that the terrain did not present a severe or overly difficult challenge.

7.11 <u>Enhancement of EAF Construction Effort</u>. An entire range of research efforts is being pursued under the Navy/Marine Corps Airfield Damage Repair (ADR) project and by the Air Force to enhance engineer support of the EAF system. One of the ADR project's primary purposes is to develop systems to expedite the restoration of an EAF damaged by enemy attack. In the process, alternative concepts for surfacing expeditionary airfields are being evaluated. The new technology being investigated may reduce the significant logistic support and engineer construction and installation requirements incident to EAF system employment.

Among the several promising developments being evaluated are fiberglass reinforced polyester/polyeurathane (FRP) technology; chemical or mechanical soil stabilization techniques to prepare weatherable Alternative Launch and Recovery Surfaces (ALRS) requiring either no pavement or very thin pavement; alternate, reduced weight matting systems that may be rapidly deployed over marginal strength soils; and tire track systems to reduce aircraft tire-to-ground contact pressure and permit aircraft towing over marginal strength soils.

The importance of such investigations to engineer construction support of the EAF system resides in the potential for reducing the time, material, equipment, and personnel resources that would currently be required. For example, Table 4-9 of this study indicates that the 634 aircraft ACE requires 830,781 square yards of AM-2 matting surfaced parking area. The earthwork effort and engineer resources necessary to prepare this surface area consumes a significant number of the total man-hours required to install the EAF system under the ideal conditions postulated for study purposes. Alternate surfacing materials and less demanding site preparation techniques for aircraft parking areas are all potential areas of conserving engineer resources, logistic support, and potentially, costs. Of even greater importance, innovative methods have the promise of permitting an ACE earlier attainment of an operational status ashore and/or the employment of additional dispersed sites.

As stated above, the research into innovative surfacing methods and materials has been heavily concentrated in the area of airfield damage repair. Although not specifically a "construction problem" in terms of this chapter, the importance and promise of Rapid Runway Repair (RRR) leads to its inclusion.

7.12 Airfield Damage Repair. The need for significant improvement in the ability to rapidly effect repairs to airfield surfaces and critical support facilities essential to aircraft launch and recovery, has long been recognized by all Services. To some extent that need has been intensified and perhaps crystalized by an increasingly capable and complex threat with respect to the types of weapons and their damage incurring potential that enemy forces can direct at airfields.

To meet that need, the Services have initiated a series of coordinated and complementary research and development efforts to provide solutions to the problems encountered at permanent air installations, conventionally surfaced bare base airfields, and matting surfaced expeditionary airfields.

The Air Force Engineering and Services Center is conducting a full spectrum R&D program to develop an improved capability by FY89 tailored to the operational characteristics of Air Force engineer equipment and aircraft.

The Navy has taken several initiatives to include development of an Advanced Base Functional Component (ABFC) P-36 dedicated to airfield damage repair; advanced procurement plans for P36 PWRMS; and, establishment of Advanced Development Project Y1606: New Construction Tools.

The Navy and Marine Corps have embarked on the development of an Airfield Damage Repair (ADR) Project Master Plan which will evaluate that technology necessary to field a capability for: repairing operating surfaces; providing operating surface and utility redundancy; accomplishing remote assessment of runway damage; and conducting an automated selection of a minimum operating strip (MOS). The ADR has as one objective, the intent to maximize use of Air Force developed R&D technology to include the ongoing effort described above.

To date, the Commandant of the Marine Corps in conjunction with MCDEC and NCEL, has documented developmental testing of a crater cover. This cover is constructed of fiberglass reinforced polyester (FRP). It will significantly reduce the repair logistics burden and improve safety of operations over repaired craters.

The Navy/Marine Corps Project Master Plan has, in detail, identified the operational and technological ADR shortfalls and the current ADR operational capabilities. As a result of the apparent emphasis and priority being accorded the RRR problem, it does not appear necessary to expound at length upon the subject within this report — particularly since it is not a stated study tasking. However, there is merit to summarizing the major methods being pursued to solve the related problems of crater repair and surface repair. Although there are methods under development that will accomplish both type repairs, the majority of processes currently available or under investigation concentrate on one.

7.12.1 <u>Crater Repair</u>. The current method involves removing loose debris and surrounding damaged runway surface from the crater; backfilling the cavity with the same debris; compacting the fill to a specified depth below the original surface level; and filling the remaining area with a suitable material, e.g., sand or crushed stone, compacted to a minimum required hardness. This is a time consuming, labor and equipment intensive task.

New methods of RRR of craters being evaluated include use of aluminum hexagonal honeycomb grids to fill craters and confine sand compacted over the grids; use of fiberglass reinforced polyester (FRP) membranes; stabilizing soil with geotextile (synthetic fabric) placed over a minimally prepared (graded and/or compacted) weak subgrade; employing enzymes, polymers, or a combination of both to provide a potentially extremely hard subsurface using almost any on-site soil through a method of soil blending.

7.12.2 Runway Surface Repairs. The only currently viable methods of repairing surface damage (scabbing) in an expeditionary application is the use of matting panels (AM-2 and ALFAB) and FRP panels. However, other methods are under study. The Naval Air Engineering Center is developing a Rapid Runway Repair Kit capability for EAF units which will include 2'x12' AM-2 aluminum matting panels and their associated installation and anchoring parts, tools, and support equipment. Important features of the AM-2 kit system are that it is universally applicable to all runway surfaces, kit components are stored and shipped in containerized pallets, and the kit can be easily assembled. When assembled, the patch can be towed over a filled crater and anchored to any type surface. In the case of runways constructed of AM-2 matting, panel kits are interchangeable with the damaged or dislocated panels on a one-for-one exchange basis once the surface or crater repair has been accomplished.

Other initiatives to enhance the RRR capability have also been tested. One method involves the use of a combined fiberglass reinforced polyester/aluminum panel consisting of an AM-2 type aluminum frame with an FRP outer section. A second method, designated Advanced Multipurpose Surfacing System (AMSS) employs either a single, one-half inch thick, field fabricated, FRP mat anchored over a filled crater, or a dual membrane method suitable for a combination crater repair/surface repair. A third approach is the use of prefabricated FRP panels, similar to the AM-2 matting concept, that can be assembled adjacent to the crater area and then towed over the crater and anchored in place.

7.13 Soil Stabilization. Among the most effective means of minimizing engineer construction time and maximizing the efficiency of the effort involved in preparing surfaces for the installation of EAF runways, landing sites, taxiways and parking aprons are soil stabilization techniques capable of accommodating a broad range of environmental and soil conditions.

The EAF System requirements for landing surface subgrade strength differ greatly from those for typical concrete or asphalt constructed airfields. The lightweight portable aluminum AM-2 matting currently used as EAF surfacing has considerably less support capability, and thus places greater importance on the subgrade strength. Consequently the following factors must be considered in determining the degree and the method of soil stabilization to be employed. These factors include:

- o Configuration and intended use of the airfield.
- o Existing soil strength in terms of its measured California Bearing Ratio (CBR) and Airfield Index (AI).
- o Soil composition.
- o Environmental conditions that affect the type of materials necessary to prepare airfield surfaces.

The most commonly employed means of soil stabilization are mechanical and chemical. Two potentially important, new methods under investigation by the Naval Air Engineering Center, Lakehurst, New Jersey are the use of geotextiles and subsurface drainage systems.

In mechanial soil stabilization techniques the soil to be prepared is either compacted, blended, or excavated and replaced. Chemical stabilization of soil is similar to a soil blending technique; however, it involves combining (blending) a chemical admixture stabilizer with existing unsuitable subgrades, soils, or soils transported to the site from another location.

The use of geotextiles in soil stabilization involves placing a synthetic fabric over a minimally prepared (graded and/or compacted) weak subgrade. Coarse aggregate soil layer is then spread over the geotextile which prevents the intrusion of the coarse over-layer into the weak subgrade, and vice versa.

Subsurface drainage is a technique used to alleviate unstable subgrade conditions generated by poor drainage or a high content of ground water. This approach to soil stabilization may be used in conjunction with one or more of the methods discussed previously, but not alone, because the airfield surface will still require some form of preparation.

French drains are the simplest and most common of subsurface drainage systems. This technique involves the construction of trenches under, around, and/or adjacent to the intended area for matted surfacing. The trenches are then lined with a suitable (porous) geotextile material with a coarse aggregate (drainage material) placed on top of the geotextile to fill the void of the trench. The geotextile is then wrapped over the drainage material. The geotextile forms a barrier preventing 1) small soil particles (smaller than the drainage material) from intruding into the drainage material and clogging its drainage capability, and 2) the larger drainage material from "pumping" into the adjacent soil. Ground water may then seep into the trenches through the geotextile and exit via smaller attaching trenches.

Other soil stabilization methodologies under investigation include the use of enzymes, polymers, or a combination of the two as a blend with existing native soils using a water base. However, the problem of questionable durability of the surface produced using those methodologies; useful shelf life; and a requirement for special application equipment may limit their use as a possible dust suppressant medium until a future technological breakthrough enhances their value in airfield surface preparation.

7.14 Summary. The engineer support requirements of the EAF system needed to beddown a 634 aircraft ACE can be accommodated by the deliberate construction engineer forces of a MAF; the Engineer Support Battalion, FSSG with assistance of the Wing Engineer Squadron and augmentation by three Naval Mobile Construction Battalions.

The analysis further indicates that the Navy and Marine Corps engineer horizontal construction and installation capability is sufficient to provide the requisite level of engineer support required by the EAF system included in this study without having to consider alternate sources of engineer support.

A baseline engineer construction/installation matrix to illustrate level of effort required to construct/install the EAF System used in this study establishes a total direct labor construction/installation man-hour requirement of 139,000 MH. This baseline level of effort is, or course, subject to increase dependent on limiting variables that could be encountered in each AOA, i.e., insufficient resources; delays in marshalling engineer assets; severe topographic or environmental conditions; diversion of engineer resources to non-EAF construction tasks, etc.

Projects are underway to exploit new technologies and methods to enhance engineer support of the EAF system. Among them, automating the engineer planning process; developing an expeditious rapid runway repair capability; and finding a less logistically demanding method of surfacing airfields than with AM-2 matting, all have the potential of reducing the considerable engineer resources that support of an EAF System now requires.

Such developmental efforts should continue, and be expanded as an essential means of expediting deployment of the EAF system in an AOA and thus expediting the operational availability of the ACE ashore.

REFERENCE SOURCES


- "Navy/Marine Corps Engineer and Construction Operations (1980-1985)," (Marine Corps Development and Education Command)

- "Earthwork Construction in Support of a Marine Amphibious Force," Technical Note N-1514 dated January 1978 (Naval Facilities Engineering Command)

- Naval Construction Force Requirements in Support of a Marine Amphibious Force in an Amphibious Objective Area," dated December 1981 (Naval Facilities Engineering Command)

- Design and Installation of the Expeditionary Airfield, Marine Corps Base, Twentynine Palms, California," dated 30 December 1976 (3rd Marine Aircraft Wing)

- "Comfort Level IV and IVA After Action Report," dated 25 April 1983 (3rd Marine Aircraft Wing)

- Technical Manual; Logistic Data Initial Staging Area to Field Installation, Expeditionary Airfield," NAVAIR 51-35-7, dated June 1977 (Naval Air Systems Command)

- Naval Construction Force Manual P-135." dated February 1978

- TM-38-35-15/1; "Installation, Operation and Maintenance Amphibious Assault Field System (AAFC) and Tactical Airfield Fuel Dispensing System (TAFDS)," February 1978)

- "Chemical Stabilization of Subgrade Soil for the Strategic Expeditionary Landing Field," Georgia Institute of Technology, School of Civil Engineering, Atlanta, Georgia, 30332; June 1983

CHAPTER VIII

SUPPORT EQUIPMENT

8.1 General. The SOW requires that the range of support required in such areas as crash/rescue, ordnance, fuel, communications, and air traffic control be determined. The ordnance, fueling, communications, and air traffic control requirements have been addressed in separate chapters. This Chapter will discuss three types of support equipment that are considered essential to the safe, efficient, and sustained operations of the various EAF facilities, i.e., foreign object damage (FOD) removal, snow/ice removal, and crash/rescue equipment.

8.2 Foreign Object Damage.

8.2.1 The Problem. Foreign object damage (FOD) to jet engines is a serious problem both in terms of readiness and hard dollar costs. An engine that has suffered extensive damage from foreign objects normally needs to be removed from the aircraft and undergo major overhaul. The process is expensive and unless a replacement engine is immediately available, the aircraft will remain in a down status for an extended period. In fact, in recent years the threat of inadequate numbers of replacement engines was both real and serious.

Foreign object damage can best be prevented by insuring that runways, taxiways, taxilanes, parking aprons, maintnenace areas, and fueling and arming areas are free of all foreign objects that have the potential of causing damage. This task is difficult at best under normal, peacetime operations at permanent airfields; it is several orders of magnitude more difficult in an operational environment and on surfaces constructed of AM-2 or similar matting. The major difficulties to be anticipated are:

- An excess of stones, rocks, and other natural debris capable of being ingested by the engine — particularly in the period immediately following installation of the facility. Enemy action and friendly counteractions may add to this problem in terms of both natural debris and the presence of small caliber projectiles and cartridges, shrapnel, etc.

- The intensity of operations, combined with the absence of separate and suitable maintenance facilities, may result in greater than normal amounts of maintenance waste, e.g., screws, rivets, and safety wire being adrift. That same level of intensity may limit the frequency and or timeliness of FOD sweeps.

- The spacing between the AM-2 matting joints will tend to conceal smaller items of FOD or hold larger ones and will make satisfactory sweeping more difficult in comparison to that conducted on conventional surfaces or on future surfaces constructed of materials such as polymers.

- At those EAF configurations wherein both fixed wing and rotary wing operations are being conducted, rotor wash will create potentially serious FOD problems. Difficulties of this nature have been reported during training exercises at Twenty-Nine Palms (Comfort Level IV exercise).

Clearly, there is a need to insure that the various operating surfaces are, to the fullest possible extent, kept free of FOD.

8.2.2 Equipment in Use. FOD reduction at permanent military and commercial airfields is accomplished through the use of FOD sweepers which operate on one or a combination of vacuum, mechanical, or air agitated pick-up methods. These sweeps are frequently supplemented by FOD walks by personnel to ensure that the surfaces are, in fact, free of debris.

Discussion with a representative of the Deputy Chief of Staff, Logistics and Engineering, U.S. Air Force disclosed that the Air Force employs air transportable sweeper equipment designed for use on conventional concrete surfaces. Air Force planning documents provide only for use of permanent, airfield installations regardless of the potential area of commitment, and they do not plan to use matted surfaces. Thus, they are satisfied with their present FOD equipment and do not have efforts underway to procure new equipment designed specifically for matted surfaces.

A demonstration by the Federal Aviation Agency (FAA), Engineering and Maintenance Division, at Washington's National Airport, coupled with an extensive review of marketing brochures depicting commercial equipment, clearly establishes the availability of a wide range of off-the-self FOD sweepers which might be suitable for use in EAFs.

8.2.3 EAF FOD Sweeper Requirements. FOD sweepers for use in EAFs must be air transportable, capable of traveling over rough terrain and unimproved roads, and preferably small enough to operate around and under tactical aircraft. They should have a capacity approaching that cited in Navy specifications MIL-C-29195 (YD) of 30 July 1979, (i.e., capability of sweeping one millon square feet per hour), and be suitable for use on matted surfaces.

As discussed in Chapter IV, dense packing of the fixed wing aircraft will intensify the FOD problem as it will be most difficult, if not impossible, to conduct adequate mechanized FOD sweeps unless the aircraft are relocated frequently. Dense packing also acts against designing/procuring a sweeper capable of moving around and under the aircraft.

8.2.4 Present Procurement Efforts. The need for a deployable sweeper designed specifically for expeditionary operations was identified as far back as March 1965, in Developmental Bulletin No.1-65, "Guidelines for Implementation of the Short Airfield for Tactical Support Concept," issued by Marine Corps Schools, Quantico, Virginia. Discussions with the Deputy for Development, Marine Corps Development and Education Command (MCDEC), in July 1983 established that there is no record of that stated requirement being pursued. He also stated that there are no on-going efforts to further validate the requirement. In part, these facts were substantiated by a representative of HQMC (Code ASL) who stated that although a Required Operational Capability (ROC) has not been issued, there is separate procurement action underway.

POM 85 contains a requirement for the procurement of 37 vacuum type runway sweepers; 18 units scheduled for procurement in 1985; 19 units scheduled in 1986. The specific design of these sweepers has not been finalized, however, they will be required to meet the specifications contained in MIL-C-29195(YD), will be air transportable by C-130/C-141 aircraft, and will be suitable for use on matted surfaces. It is intended that these sweepers be declared contingency assets maintained in a ready status for deployment, and be allocated to each MWSG.

Liaison with the Civil Engineering Office, Port Hueneme, California, established that sweepers designed to meet MIL-C-29195 (YD) should have the capability of sweeping one million square feet per hour. In addition, there should be one back-up unit for each three million square feet of surface area to be swept. Considering the total square of each type facility, there is a requirement for 3 sweepers at each SELF and bare base and one sweeper at each 900' or 1800' VSTOL facility.

It is not intended that these machines, presently scheduled for procurement, be small enough to operate around and under dense packed or closely packed aircraft. FOD sweeps in these areas can best be accomplished during periods when large portions of the parking area are clear of parked aircraft, or by sweep walks by Marines, or a combination of both. Although the use of skilled manpower for this purpose is not desirable, it appears to be necessary.

It should be noted that on 27 July 1983, the NAEC recommended to NAVAIR that an allowance of three runway sweepers per MAW be established and procured at a unit cost of $90,000 through the Defense Construction Supply Center. The vehicles proposed are standard commercial configurations currently used on most Naval Air Stations and do not meet the needs of the EAFs. This apparent disparity between Marine Corps requirements and Navy procurement efforts needs to be resolved.

### 8.3 Snow and Ice Removal.

8.3.1 The Problem. The EAF must be operable under all metorological and climatological conditions and, in fact, existing contingency plans commit Marine Corps forces to areas where significant amounts of snowfall and serious icing conditions are experienced regularly. If the EAF is to find utility in these areas, the MAGTF must possess the capability to rapidly remove both snow and ice from both permanent and matted surfaces.

Under extreme weather conditions, the task is a difficult one on permanent surfaces and a significantly more complex one when matted surfaces are involved.

At the present time, there is no suitable snow or ice removal equipment allocated to Marine Corps operational units. Snow and ice removal would have to be accomplished by use of standard bulldozers, road scrapers, and other vehicles equipped with conventional steel edged blades. Because of the potential damage that will occur as a result of the blade engaging lights, markers, pendants, anchors, and connecting joints between matting panels and the nonskid surface cover, the use of steel edged blades is simply not acceptable on matted surfaces.

A review of commercial marketing literature establishes that there are available rubber or philan (plastic) type edges for attachment to conventional blades which might make them usable on matted surfaces. However, clearing by blade equipment alone is time consuming and does not provide for adequate disposal of large quantities of snow. Nor will any blade equipment clear ice. Without a suitable solution to both problems, the capability of the EAF to function under extreme weather conditions could be seriously impaired.

8.3.2 Equipment in Use. As cited above, the Air Force does not plan for the use of matting surfaced EAFs and the only anticipated use of matting is for rapid runway repair. They employ conventional, commercial, air transportable equipment and have no plans to develop or procure equipment suitable for use on matted surfaces.

During the July 1983 demonstration of FOD equipment at National Airport, the Study Team also discussed the issue of snow and ice removal and inspected the equipment on hand. The FAA individuals participating are responsible for the selection, procurement, operation, and maintenance of snow/ice removal and prevention equipment and were highly knowledgable of the subject matter.

Four different types of equipment specifically designed to perform four separate, but related functions were inspected:

- First, the snow is pushed into windrows using equipment with blades up to 25 feet in length, equipped with rubber or plastic edged blades, and with shock absorbers that permit the blade, on contact with a solid object, e.g., a light standard, to move upward, ride over the object, and return to a present height above the surface.
- Second, the windrown snow is blown from the runway or loaded into trucks using snow blowers with a capability of disposing of approximately 2200 tons of snow per hour.
- Third, the runway is brushed and blown clean by a dual purpose vehicle. The length of the brush on the largest machine inspected was in excess of 20'.

- Fourth, if weather conditions dictate, an ethylene glycol mixture is sprayed on the runways and taxiways to melt the ice and limit the buildup of additional snow/ice.

It is clear from the discussions with the FAA personnel, and from an inspection of their equipment, that the equipment exists to expeditiously clear large volumes of snow and ice under other than the most extreme conditions. It is equally clear from the discussions with the FAA personnel and commercial representatives, and from a review of available marketing literature, that there is state-of-the-art equipment available to cope with ice and snow removal from matted surfaces and at a rate that will insure that the EAF remains operational except under the most extreme conditions. In fact, several pieces of commercial equipment have the capability to perform all four of the functions listed above through the means of various attachments. These include an air transportable snow blower with a 5,000 tons per hour capability. For comparision purposes, the equipment in use at National Airport is rated at 2,200 tons per hour.

8.3.3 Present Procurement Effort. As with the FOD equipment, the requirement for expeditionary snow and ice removal equipment was also identified in Developmental Bulletin No. 1-65. Again, the Deputy for Development, MCDEC, established that there is no record of the requirement being pursued after publication of the bulletin. Discussions with HQMC (Code ASL) also verify that while the need for snow and ice removal equipment is recognized, no Required Operational Capability (ROC) document has been prepared. No separate procurement action similar to that initiated for the FOD sweepers is underway. Clearly, appropriate actions should be initiated to procure suitable equipment for allocation to the contingency assets.

8.4 Crash Fire Rescue (CFR) Equipment. The type and quantity of CFR vehicles and equipment required to support the EAF concept is currently under study. When a minimum guidance policy is approved, it will be promulgated to all concerned.

The present T/O's and T/E's of the MAB's comprising the ACE have Crash Fire Rescue equipment capable of meeting any fire fighting requirements, and newer more capable equipment is being procured. Discussion with authoritative personnel at Headquarters, U.S. Marine Corps, Department of Aviation (ASL-44) and the crash and fire rescue section of Marine Corps Air Station, Beaufort, South Carolina and Marine Corps Air Station, Cherry Point, North Carolina, indicated that much of this equipment (i.e., the MB-1s, MB-5s and M-1000s) is scheduled to be replaced beginning in June 1984, by the P19A, a new rough terrain firefighting and rescue vehicle with a 1,000 gallon onboard capacity and 500 GPM output capacity. Each MAF is to receive 20 P-19As (4 per MABS), plus ten 530-Cs (a smaller firefighting truck) and ten skid mounted, air transportable, twin agent units (TAUs).

Based on the capabilities of the P-19A and the stated allowances per MAF, there would be sufficient quantities of this vehicle to satisfy Crash Fire Rescue requirements for the EAF System. Although the 530-C vehicles and TAUs provide additional assets to fire fighting support, the P-19A is the primary Crash Fire Rescue vehicle.

8.4.1 Crash Cranes. Again, in the case of crash cranes, there are adequate numbers available to support the requirement for crash causes. Discussions with Headquarters, U.S. Marine Corps (Code ASL-44) indicated that each MAW has five 30 ton rough terrain hydraulic cranes (one per MABS) dedicated to rescue operations. These cranes are sufficient to handle the heaviest Marine Corps tactical aircraft and, based on the five airfield concept specified for this study, each airfield would have one crane. It was further indicated that additional assets could be obtained from the MWSG if required. A review of the N-Series T/E, N-8730, N-8740, and N-8750 indicated that each MWSG has an allowance of six 30 ton cranes.

8.4.2 Ambulances/Rescue Equipment. According to Headquarters, U.S. Marine Corps (Code LME), aircraft crash/rescue ambulance vehicles are provided by the medical section within the MABS during expeditionary operations. The specific requirement for the number of ambulances is not specified, yet NAVAIR 00-80R-14 requires that rescue vehicles and alert crews arrive at the scene of an emergency within three minutes. Based on the additional requirement to be able to assume the condition of readiness of standby alert, it is mandatory to have a minimum of two properly equipped vehicles at each airfield. According to the N-Series T/E, allowances for each helicopter MABS indicate two M718A1 (1/4 ton 4X4) ambulance trucks. Fixed-wing MABS have an allowance of three M886 (1 1/4 ton 4X4) ambulances. This figure was also confirmed by the In Use Master Report and should be sufficient to handle emergency conditions for the ACE.

8.5 Summary. Adequate firefighting equipment assets are being procured to support the EAF system. Additional quantities of crash and rescue vehicles are required to achieve required emergency response times at each EAF configuration. The deficient area remains the Foreign Object Damage (FOD) and snow/ice removal equipment capability. Larger capacity, more efficient FOD vehicles are needed. The non-existent capability to remove heavy snowfall and ice from a variety of EAF surfaces, especially AM-2 matting, requires priority attention in view of the severe climatic conditions that will be encountered in the various AOA's to which the EAF system may be deployed.

CHAPTER IX

AIR TRAFFIC CONTROL

9.1 Introduction. The control of air traffic in a notional AOA containing as many as five facilities with a 24 hour IFR operational capability, and supporting the operation of 634 aircraft with diverse operating modes, represents a significant challenge. Compounding the problem are the remote VSTOL forward sites which, at present, are planned to accommodate only day-VFR operations. The Study Team in its analysis was cognizant that major strides are being made in expeditionary air control and new equipment is being fielded which will significantly improve the air control capability. In determining the range of air control required for each building block element under the EAF employment concept, the Study Team examined existing capabilities as well as those programmed, and compared them to known requirements. The following functions are the responsibility of the Marine Air Traffic Control Squadron (MATCS) in the EAF environment:

- Provide for the safe, orderly, and expeditious flow of air traffic arriving within and departing the designated control area or control zone under all weather conditions.
- Control the movement of taxiing aircraft, vehicles, and pedestrians within the landing area.
- Receive and forward all flight plan information from arriving/departing tactical aircraft to adjacent or senior air traffic control facilities, when required.
- Provide flight identification information on transiting or incoming friendly aircraft to the appropriate air defense control agency.
- Control the expeditious launch of assigned ground alert aircraft.
- Provide navigational assistance by using navigational aids and issuing flight advisory information.
- Identify, report, and assist in in-flight emergencies.
- Act as the control agency for initiating designated search and rescue (SAR).
- Operate precision radar control facilities to provide for the safe recovery of friendly aircraft during conditions of reduced visibility.

- o Coordinate with the local TAOC to ensure continuity of radar control for aircraft departures and recoveries.

- o Execute the appropriate action for the air defense alert conditions specified by the TAC.

- o Establish arrival and departure routes, procedures, and the traffic holding points (fixes) within the control area.

9.2 Air Traffic Control Requirements. Figure 9-1 matrixes the air traffic control requirements of each EAF configuration with the exception of the six forward VTOL sites. As indicated above, these sites are planned for day/VFR operations, but, the Study Team anticipates that there will be occasions when they must be utilized under other conditions, and HQMC has recently placed a requirement on NAVAIR to develop a lighting package for them.

AIR TRAFFIC CONTROL REQUIREMENT MATRIX 1/

| EAF ELEMENT | AIR TRAFFIC CONTROL CAPABILITY | | | | |
|---|---|---|---|---|---|
| | CONTROL TOWER | AIR SURVEIL-LANCE | APC | PAR | TERMINAL GUIDANCE (TACAN) |
| 900' V/STOL FACILITY (2) | X | X | X | X | |
| SELF | X | X | X | X | X |
| BARE BASE(2) | X | X | X | X | X |

Note: 1/ Assumes augmentation of MATCS (-) equipment and personnel.

FIGURE 9-1

9.3 Existing Air Traffic Control Capabilities. The following sections describe equipment presently in use supporting expeditionary air traffic control.

9.3.1 Control Towers.

9.3.1.1 AN/TSQ-120. The AN/TSQ-120 Air Traffic Control (ATC) Central is an air transportable traffic control tower facility which provides 360° visual air traffic control for rotary and fixed-wing aircraft within a designated control zone, both on the ground and in the air. In addition, visual control for ground vehicles in the vicinity of the runway(s) is provided. This is accomplished through the use of radio communications (HF, UHF and VHF), visual aids such as crash and emergency signal devices, and field lighting. Aircraft operations are coordinated with remote facilities and agencies (e.g., Landing Control Central (LCC), Federal Aviation Agency (FAA), or Marine Air Control Squadron (MACS)) by use of telephone and intercommunication control system.

The system consists of an Operations Central Group, a Terminal Group, the tower structure itself and Storage Containers, and a Transport Pallet.

The Operations Group is situated atop the tower structure which can be erected to a height of 8, 16 or 24 feet. It is equipped for three controllers (Local, Ground, and Data) and a supervisor who monitors information relayed from the LCC, Ground Controlled Approach (GCA), Air Surveillance Radar (ASR) Group and the remote mobile facility. In addition, data gathered from associated meteorological equipment, the TACAN, and the UHF beacon is monitored. The Operations Group measures 7'6" x 7'6" x 7'6" and weighs 2,660 pounds.

The Terminal Group, located at the base of the tower, houses all the radio equipment and recording devices used by the tower controllers as well as maintenance spares. It is a self-contained, independent structure measuring 12'8" x 6'11" x 7' and weighing 6,000 pounds.

The system, which is air conditioned by two 60 Hz air conditioners, requires primary power from a 60 Kw, 120/208 volt ac, three-phase 60 Hz generator (i.e., MEP-006A).

9.3.1.2 AN/TRC-131A. The AN/TRC-131A, ATC Central is an air transportable unit limited to one controller position. It provides a facility for visual ground and air control for aircraft within a designated control zone. Visual control of ground vehicles is also provided. It has limited radio communications and requires manual recording of data.

The ATC Central is generally used in conjunction with the AN/TSQ-120 tower and is situated at the end of the runway. The controller monitors the radio frequency of the tower and notifies the tower when visual contact of an aircraft on final has been made. The controller checks that the landing gear and arresting hook appear to be down and that the approach seems normal. Any unusual situations are communicated to the tower.

If no AN/TSQ-120 is available, the AN/TRC-131A mobile unit can be situated mid-runway and perform limited functions of the AN/TSQ-120 system.

It has both UHF and VHF radios and a wind measuring set.

9.3.2 Air Surveillance, Approach Control and Precision Approach Equipment.

9.3.2.1 AN/TSQ-18. The AN/TSQ-18 and its subset equipments, the AN/TSQ-107 and the AN/TPA-8A, combine to provide the surveillance, approach control and precision approach capabilities indicated above.

The AN/TSQ-18 Landing Control Central consists of three air transportable shelters which contain equipment required to control, manage and monitor approach and departure flight operations and precision approaches. Each of the shelters can be deployed independently if the situation so warrants or all three can work in tandem. The three shelters include:

- OA 3997/TSQ-18 Radar Surveillance (ASR) Shelter Group
- OA 3998/TSQ-18 Ground Controlled Approach (GCA) Shelter Group
- OA 8391/TSQ-18A Landing Control Central (LCC) Shelter Group

The ASR shelter console provides two controller positions for controlling and monitoring the approach/feeder/departure of aircraft through the use of the AN/TSQ-107 Radar Surveillance Central. A supervisor position is provided within the shelter. It contains: HF, UHF and VHF radio sets, an intercom, control indicators, a barometer and a switchboard (SB-22).

The GCA shelter control provides two controller positions for controlling and monitoring precision approaches through the use of the AN/TPN-8A radar. It contains: HF, UHF, and VHF radio sets, a tape recorder, intercom and control indicators.

The LCC provides four controller positions: one each, GCA; two each, approach/departure control; and one each, flight data. In addition, a watch officer position is located in the shelter. Land line communications with external facilities (i.e., MACS, FAA regional control center and crash/rescue) is possible through the use of the SB-22.

9.3.2.2 AN/TSQ-107. The AN/TSQ-107 is an air transportable, surveillance radar and beacon system. It enables detection and identification of airborne targets at ranges up to 250 miles and a full 360° in azimuth. All information is remoted to the LCC and ASR shelters for the monitoring of the system and control of aircraft. The system is composed of a shelter and an antenna.

9.3.2.3 AN/TPN-8A. The AN/TPN-8A is an air transportable precision approach radar which provides an aircraft's azimuth and elevation position in relation to the runway with an effective range of 10 miles. The AN/TPN-8A has a search mode which can provide continuous 360° coverage in azimuth with a range of 40 miles. The antenna mount may be rotated manually to provide multiple runway coverage. Radar information is remoted to the LCC/GCA shelters for the monitoring and control of aircraft.

9.3.2.4 Terminal Guidance. In the present expeditionary airfield environment, terminal guidance is provided by two items of equipment. A Tactical Air Navigation Aid (TACAN), AN/TRN 29, and a UHF Radio Beacon Set, AN/TRN-33. Both devices provide ACE aircraft with navigational references for use within the AOA and/or positioning themselves for acquisition by the air control equipment described in the preceding sections.

9.3.2.5 AN/TRN-29. An AN/TRN-29 Tactical Air Navigation System (TACAN) is an air transportable, dual channel, automatic transfer radar navigation aid which, when interrogated by an aircraft, provides range, bearing, and identification over a 200 mile range. The unit has a built-in monitor for detecting failure. When failure occurs, there is automatic transfer to the second channel.

The AN/TRN-29 is used primarily for a "TACAN Fix", guiding the pilot into the zone of coverage of ASR for approach or departure. It can, in some instances, be used for pickup by precision approach radar (GCA) or for a TACAN approach when the required equipment for precision approach has failed or is unavailable.

The TACAN has a solid state antenna measuring 9' x 7' x 7' which can be erected to heights of 6, 12, 18, 24 or 30 feet on a portable tower.

The system is remoted to the LCC or the AN/TSQ-120 so it can be monitored for failure. System operation can also be discontinued, if required.

9.3.2.6 AN/TRN-33. The AN/TRN-33 is a non-directional navigational aid which transmits in the UHF radio frequency range. It is placed at the end of the runway to provide bearing information and station identification for aircraft. In some weather conditions, it can be used as an approach and landing aid.

The AN/TRN-33 transmits International Morse Code modulated continuous wave or voice modulated signals. Automatic keying produces the International Morse Code that identifies the ground station housing the beacon system.

System operation is remoted to the AN/TSQ-120 or LCC to monitor failure and discontinue operation, if required.

9.3.4 Remote Area/Forward Site Guidance. As previously stated, the current EAF employment concept does not consider operations from forward sites by helicopter or V/STOL aircraft under any conditions other than day/VFR, but, with the recent decision to provide lighting for night helo operations from these sites, it is logical to assume that a minimal IFR operational requirement for both helo and V/STOL aircraft types will ensue. The Marine Remote Area Approach and Landing System (MRAALS) has a capability for fulfilling this requirement, provided the appropriate airborne components required are installed. MRAALS was a required operational capability set by MCDEC, NAVELEX, and NAVAIR under the sponsorship of CMC, (DC/S Aviation). The development of the MRAALS began in the early 1970's. The two MRAALS subsystems, the AN/TPN-30

Ground Transmitter and the AN/ARN-138 Airborne Receiver, were designed primarily for use by helicopters to satisfy the requirement to deliver V/STOL assault support to remote areas during reduced visibility conditions. A Chief of Naval Operations Specific Operational Requirement, 34-26 of December 1971 specified a system capability to support V/STOL aircraft approach operations to a reduced visibility minimum of 50 feet.

The MRAALS AN/TPN-30 Ground Subsystem is a Ku-band scanning beam providing 360° TACAN DME + 20 degrees localizer/0-20 degrees elevation guidance information. The ground system will be transportable by two (2) men. The airborne component AN/ARA-63 Pulse Code Scanning Beam (PCSB), when installed in CH-46 or CH-53 helicopters, will operate in conjunction with the AN/TPN-30. The airborne AN/ARN-138 Multi-Mode Receiver (MMR), when fielded, will be compatible with the current-generation civil Instrument Landing System (ILS) and the National Microwave Landing System (MLS) under development by the FAA.

The MRAALS Ground Transmitter Subsystem AN/TPN-30 is a landing aid which can provide helicopters and other V/STOL-type aircraft equipped with this instument the capability of locating a suitable remote landing zone and making an approach in Instrument Meteorological Conditions. The ground subsystem will provide the pilot with information about the position of his aircraft relative to a predetermined glideslope and centerline, in addition to the slant/range/distance-to-touchdown-point during his final approach to landing.

The airborne subsystems will display this information visually on the standard ILS cross-pointers and range/rate-of-closure indicators. The pilot will manually control the aircraft during the approach to landing. The Multi-Mode Receiver (MMR) AN/ARN-138 is currently under development by two contractors on competitive contracts. This airborne subsystem will provide the capability to use centerline offset and course hardening when a split-site configuration of the AN/TPN-30 is used at expeditionary airfields.

The AN/ARA-63 carrier landing system avionics, which is also capable of interfacing with the AN/TPN-30, will display glideslope and centerline information on the avionics standard ILS cross-pointers and range on the standard TACAN Distance Measuring Equipment(DME) indicator. The AN/ARA-63 is an off-the-self system, not an integral component of the MRAALS. It is expected that the AN/ARA-63 can provide an interim MRAALS capability for helicopters until IOC of the AN/ARN-138.

The AN/TPN-30 has no interface requirements other than to aircraft, as described above. Operator personnel may communicate with the DASC/FASC and other control agencies with T/E equipments. There are seven (7) MRAALS assigned to each MATCS. The MRAALS description and developmental status is displayed at Table 9-1.

MRAALS STATUS

| Component | Description | Status | |
|---|---|---|---|
| AN/TPN-30 | Ground Transmitter Subsystem | Fielded | |
| AN/ARN-138 | Multi-Mode Receiver | EDM Contract Award | Dec 1979 |
| | | DT&E | Oct 1982-Oct 1983 |
| | | Preproduction Control | Oct 1983 |
| | | Tech Eval/Op Eval | Nov 1984-Sep 1985 |
| | | Production Contract | Aug 1986 |
| | | IOC | Apr 1988 |
| AN/ARA-63 | Carrier Landing System | Validation/Verification Test | |
| | | Final Report | |
| | | IOC | May 1982 |
| | | FOC | Aug 1983 |

TABLE 9-1

9.4 Planned/Programmed Air Control Capabilities. As indicated in the introductory section of this Chapter great strides are being made in the introduction of improved expeditionary air control equipment. Significant enhancements in operating capability accrue from automated modes and the volume of sorties and/or control operations in progress that can be handled at any given time. These improvements are described in the following sections.

9.5 New Surveillance, Approach Control and Precision Approach Equipment.

9.5.1 Marine Air Traffic Control and Landing System (MATCALS). With the exception of the terminal guidance devices and remote site landing aids previously mentioned, MATCAL's will replace most of the equipment previously described. An integrated system MATCAL has three subsystems: the air traffic control subsystem (ATCS) based on the AN/TSQ-107 surveillance radar, the all weather landing system (ALS) using the AN/TPN-22 precision approach radar, and the communication and control subsystem (CCS) the AN/TSQ-131(V). A further system, the AN/UYQ-34, is a subsystem of the AN/TSQ-131(V).

Three Marine Air Traffic Control and Landing System (MATCALS) plus 7 Marine Remote Area Approach and Landing System (MRAALS) will be assigned to each Marine Air Traffic Control Squadron (MATCS). A MATCS will be capable of supporting up to three major, geographically separated, expeditionary airfields (EAFs) dependent upon the IMC (Instrument Meteorological Conditions) or VMC (Visual Meteorological Conditions) control requirements. The MATCALS provides all aspects of surveillance, identification, tracking, aircraft vectoring, and track hand-over and cross-telling. Within 60 nautical miles of the expeditionary airfield, the system provides automated tracking based upon correlation of radar, IFF, and/or data link replies.

The MATCALS system provides simultaneous landing control, in one or more of the three Marine Corps modes, for up to six aircraft and a sustained safe landing rate of one aircraft per minute routinely, with the technical capability of increasing to two per minute. The three landing modes are:

- o Mode I: Fully coupled, automatic control to touchdown
- o Mode II: Pilot-controlled approach, with guidance cues provided by cockpit displays, such as cross-pointer indicator, heads-up displays, or ground-air data link.
- o Mode III: Pilot-controlled approach, with guidance cues provided by a ground-based operator in the classic Ground Controlled Approach (GCA) talk-down procedure.

9.5.2 <u>AN/TSQ-131(V)</u>. Control and Communications Subsystem AN TSQ-131(V) is being designed and constructed to provide the MATCS a facility for automated air traffic and all-weather landing control of aircraft. The AN/TSQ-131(V) will contain the necessary operator stations, displays, processors and peripherals, controls, voice and data communication systems, and interface devices for Air Traffic Controllers to conduct air traffic control and landing operations at both expeditionary and/or fixed airfields. This system is in production now and will be available to the Fleet Marine Force in late 1985. The first system was provided to the Naval Electronic Systems Engineering

Activity (NESEA) in October 1980 for test bed and check-out. It is designed to handle increased sortie rates and air traffic capacities. Normal operations will allow precision approaches within a 10 mile final approach, or approximately one aircraft per minute. Additionally, it provides greater capacity in the surveillance mode over the older AN/TSQ-18. In the surveillance mode, it will utilize radar, IFF beacon, and data link, and can provide tracking for 60 aircraft within a 60 mile radius.

The AN/TSQ-131(V) is being developed, with the Air Traffic Control Subsystem and All-Weather Landing Subsystem, by the Naval Electronics Systems Command (NAVELEXSYSCOM) in response to Specific Operational Requirement (SOR) 34-32 promulgated by the Chief of Naval Operations in July 1983. During development testing, brassboard integration of proposed AN/TSQ-131(V) components with an AN/TPN-22 Precision Approach Radar (PAR) and AN/TSQ-107 Air Surveillance Radar (ASR) were used to compile computer programs, record flight data, demonstrate a variety of display techniques, and test interfaces between the three items of equipment. The software for the AN/TSQ-131(V) was developed and integrated with the AN/TPN-22 and AN/TSQ-107.

The AN/TSQ-131(V) Control and Communication Subsystem consists of two identical, mobile 8' x 8' x 20' International Organization for Standardization (ISO) shelters. Both shelters, with the various communications, radar control, and tactical navigation and maintenance facilities, constitute the MATCALS installation.

The AN/TSQ-131(V) can be easily transported by air, land and sea in compliance with ISO requirements (ANSI MH5.1-1979). Aircraft suitable are the C-130, C-141A&B, C-5A and the CH-53 using external lift.

The design of the AN/TSQ-131(V) is such that shelter set-up can be accomplished by six qualified personnel in a dual shelter configuration with power and air conditioning applied, the communication system with antennas fully operational, and all AN/UYQ-34(V) displays operational in a stand-alone mode within two hours. Shelters are designed to be capable of being leveled on sand, mud, pavement and terrain sloping up to 10 degrees.

The AN/TSQ-131 provides all the necessary equipment for air traffic controllers to perform the functions for approach, arrival, departure and landing control of aircraft. It is capable of functionally interfacing with other MATCS subsystems/equipment, other airfield components, and other Marine Air Command and Control System (MACCS) agencies.

The AN/TSQ-131 has four Operator Stations. Each provides the capability for visual monitoring, control and data input to control the approach, arrival, departure and landing of aircraft. In addition, the following remote control and status monitoring capabilities are available at each station:

- o Operator Station #1 - AN/TRN-33 UHF Beacon system and AN/TRN-44* TACAN system.
- o Operator Station #2 - AN/STQ-107 Radar Surveillance Control.
- o Operator Station #3 - AN/TPN-22 Precision Approach Radar.
- o Operator Station #4 - AN/TPN-30 Aircraft Approach Control Transmitting Sets (ILM).

* Replaces the ARN-29 described earlier.

9.6 EAF Supportability. The functional responsibilities of the Marine Air Traffic Control Squadron (MATCS) and the capabilities of organic equipment and personnel are described in the earlier sections of this chapter. The operational requirements at each EAF building block element employed in a notional AOA in support of a 634 aircraft ACE are depicted in Figure 9-1. That same Figure assumes that some MATCS augmentation would be required. The MAGTF forming the basis of this study contains one MATCS which can be divided into three Marine Air Traffic Control Teams, each capable of supporting one air facility without back-up or relief personnel. As is apparent, a single MATCS could not support the IFR operational requirements of five facilities simultaneously with its current T/O and T/E resources. Reinforcement of the MATCS with one or more additional Air Traffic Control Teams would easily satisfy the five facility support requirement. The Study Team next examined the sortie generation potential of each of the facilities with the base loading of numbers/type aircraft allocated, and compared it to the capabilities of an Air Traffic Control Team. With the equipment programmed to be on-line in the near term, an Air Traffic Control Team can accommodate 60 aircraft per hour on a routine 24 hour basis and possesses a short term surge capability to accommodate twice that number.

9.7 Aircraft Sortie Loading. After reviewing several source documents to determine combat sortie rates and following discussion with DC/S air planners, the Study Team developed what it considers conservative sortie rates for each type aircraft. The team further factored the total generated into day and night sorties using experience factors of 67% day and 33% night. Table 9-2 depicts the aircraft sortie rates utilized, the number/type aircraft per EAF building block element and the number of day/night sorties it estimated each could fly.

ESTIMATED AIRCRAFT SORTIE RATE

| | A/C | NO. | SORTIE RATE | NO. DAY SORTIES | NO. NIGHT SORTIES | TOTAL |
|---|---|---|---|---|---|---|
| V/STOL FACILITY #1 | AV-8B | 20 | 2.0 | 44 | 22 | 66 |
| | AH-1T | 12 | 3.0 | 16 | 8 | 24 |
| | TOTAL: | 32 | | 60 | 30 | 90 |
| V/STOL FACILITY #2 | AV-8B | 20 | 2.0 | 44 | 22 | 66 |
| | AH-1T | 12 | 2.0 | 16 | 8 | 24 |
| | TOTAL: | 32 | | 60 | 30 | 90 |
| SELF | AV-8B | 60 | 2.0 | 80 | 40 | 120 |
| | KC-130 | 8 | 1.8 | 10 | 4 | 14 |
| | OV-10 | 12 | 1.68 | 14 | 6 | 20 |
| | CH-46E | 84 | 2.33 | 131 | 65 | 196 |
| | TOTAL: | 164 | | 235 | 115 | 350 |
| BARE BASE #1 | F/A-18 | 36 | 1.43 | 34 | 17 | 51 |
| | A-6E | 20 | 1.2 | 16 | 8 | 24 |
| | KC-130 | 8 | 2.8 | 10 | 4 | 14 |
| | EA-6B | 15 | 1.2 | 12 | 6 | 18 |
| | AH-1T | 24 | 2.0 | 32 | 16 | 48 |
| | UH-1N | 24 | 2.2 | 36 | 17 | 53 |
| | CH-53D/E | 48 | 2.16 | 62 | 41 | 103 |
| | TOTAL: | 175 | | 202 | 109 | 311 |
| BARE BASE #2 | F/A-18 | 36 | 1.43 | 34 | 17 | 51 |
| | A-6E | 20 | 1.2 | 16 | 8 | 24 |
| | KC-130 | 8 | 1.8 | 10 | 4 | 14 |
| | RF-4B | 7 | 1.43 | 7 | 3 | 10 |
| | AH-1T | 24 | 2.0 | 32 | 16 | 48 |
| | CH-46E | 72 | 2.33 | 112 | 56 | 168 |
| | CH-53D/E | 64 | 2.16 | 92 | 46 | 138 |
| | TOTAL: | 231 | | 303 | 150 | 453 |

TOTAL SORTIES: DAY 860 NIGHT 434

TABLE 9-2

As indicated, the maximum number of sorties per day at any given facility is 453 and this is well within the capability of an air traffic control team. The Study Team must note that operations by MAC aircraft were not included in the sortie loading factors, but it is suggested that subsequent to the initial arrival of the assault follow-on echelon they will not significantly impact on air control capacity.

9.8 Summary. The inadequacy of the single MATCS assigned to the MMROP MAF ACE to support the operations of five airfield sites with its current T/O and T/E resources represents a significant shortfall, but one that can be easily remedied by reinforcement with a minimun number of personnel and equipment assets. The ACE sortie load potential for air traffic control at each site (assuming each has a MATCS capability) can be accomodated easily while the sophistication of emerging equipment/systems provides a degree of air traffic control and recovery tempo previously unattainable.

# CHAPTER X

## IMPACT OF NEW AIRCRAFT ON THE EAF OPERATIONAL CONCEPT

10.1 Introduction. In any assessment of the impact of new aircraft on the EAF operational concept it is first necessary to define what support the EAF provides for the current inventory of aircraft and then to analyze the capabilities/limitations of aircraft planned or programmed into the inventory to determine what, if any, impacts are created by the introduction of those aircraft.

10.2 Functional Requirements of the Current System. To support the current inventory of AV-8A, A-4M, F-4S, OV-10A, and KC-130 fixed wing aircraft as well as the UH-1, AH-1, CH-46 and CH-53 rotary wing inventory the EAF system provides:

- A range of rapidly emplacable launch/landing surfaces.
- The capability to support launch and recover of every type of aircraft in its own unique operating mode, i.e., conventional take-off/landing, short take-off or landing, vertical take-off or landing.
- A round-the-clock, all weather capability.
- A capability to operate in all climatological conditions.
- A capability to support the aircraft operational tempo required of an ACE on a sustained basis in all MAGTF operational scenarios.

10.3 Introduction of New Aircraft. Current Marine Corps planning and programming documents, i.e. MMROP, FYDP and the Marine Aviation Master Plan, respectively provide for the introduction of three new aircraft during the reference time period of this study. The F/A-18 replaces the F-4S in the fighter/attack inventory, the AV-8B replaces the AV-8A/C and A-4M in the attack inventory, and the JVX is programmed to replace the CH-46 in the medium lift helicopter inventory. Table 10-1 depicts the programmed phase-in/phase-out dates in squadron equivalents by aircraft type.

## AIRCRAFT PHASE-IN/PHASE-OUT SCHEDULE

| TYPE AIRCRAFT | FY84 | FY85 | FY86 | FY87 | FY88 | FY89 | FY90 | FY91 | FY92 | FY93 |
|---|---|---|---|---|---|---|---|---|---|---|
| F/A-18 | 3 | 4 | 6 | 8 | 9 | 12 | 13 | 14 | 14 | 14 |
| F-4S | 11 | 10 | 7 | 5 | 4 | 2 | 2 | - | - | - |
| AV-8B | 2 | 3 | 4 | 6 | 7 | 9 | 9 | 9 | 9 | 9 |
| AV-8A/C | 3 | 2 | 2 | - | - | - | - | - | - | - |
| A-4M | 4 | 4 | 4 | 3 | 2 | - | - | - | - | - |
| CH-46 | 16 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 15 |
| JVX | - | - | - | - | - | - | - | .5 | 2 | 3 |

NOTE: Includes training squadron aircraft and those transitioning into new types.

TABLE 10-1

10.4 Capabilities Comparison. Figure 10-1 compares the field operating characteristics of the new aircraft being introduced with those that they are replacing.

## GROSS WEIGHT COMPARISONS

| TYPE AIRCRAFT | MAXIMUM GROSS TAKE-OFF WEIGHT | MAXIMUM LANDING WEIGHT |
|---|---|---|
| F/A-18 | 56,900 lbs (conventional) | 33,000 lbs (arrested) |
| F-4S | 56,000 lbs (conventional) | 40,000 lbs (arrested) |
| AV-8B | 29,750 lbs (VTOL) | 17,200 lbs (VTOL) |
| A-4M | 25,500 lbs (conventional) | 16,500 lbs (arrested) |
| JVX | 40,000 lbs (VTOL) est. | 24,300 lbs (VTOL) est. |
| CH-46 | 24,300 lbs (VTOL) | 24,300 lbs (VTOL) |

FIGURE 10-1

Table 10-2 depicts representative combat radii of fixed wing aircraft operating from an expeditionary airfield, and, for comparison, also depicts the land assault mission profile contained in the JVX Operational Requirement.

## REPRESENTATIVE MISSION PROFILES

| AIRCRAFT | ORDNANCE | RUNWAY LENGTH | COMBAT RADIUS | MISSION |
|---|---|---|---|---|
| AV-8B | 6MK 82 (SE)<br>FULL GUN AMMO<br>DECM POD | 900' | 280NM | HI THREAT CAS 1/ |
| F/A-18 | 6 MK 82 (CON)<br>2 AIM 9 | 2000' | 311NM | HI THREAT CAS 1/ |
| F/A-18 | 6 MK 82 (CON)<br>2 AIM 9<br>2 TANKS | 3000' | 474NM | HI THREAT CAS 1/ |
| A-6E (TRAM) | 12 MK 82 (SE)<br>2 TANKS<br>1 AIM 9 | 5000' | 650NM | HI THREAT CAS 1/ |
| A-6E (TRAM) | 12 MK 82 (SE)<br>2 AIM 9 | 4000' | 420NM | HI THREAT CAS 1/ |
| EA-6B | 4 PODS | 4000' | 615NM | SOJ |
| JVX | — | VERTICAL | 400NM | LAND ASSAULT 2/ |

1/ Flyout optimum cruise speed/altitude, minimum power descent. Ingress 50NM at high to maximum power, at low altitude AGL (approx. 200'). Egress 50NM at maximum to high power, at low altitude AGL (approx. 200'). Climb to optimum cruise speed/altitude minimum power descent, fuel for reserve. Assumes air-to-surface ordnance expended. Can trade distance for loiter, time, out of threat.

2/ Vertical takeoff with 5,760 lbs/24 troops interval payload at 3,000 ft. MSL/91.5°F at 95% IRP. Climb to 3,500 MSL. Transit at VBR for 200NM. Descend to 3,000 ft. MSL/91.5°F, hover out of ground effect at 95% IRP, land and discharge payload. Vertical takeoff, climb to 3,500 ft. and fly at VMCP to 200NM. Descend to 3,000 ft. MSL/91.5°F, HOGE and land.

TABLE 10-2

As shown in the capabilities depicted in the preceding tables the new aircraft being introduced will not impose a significant change in the requirements of the EAF to support them. Their wheel loadings, tire-to-ground contact pressures and speeds are all within the EAF system support parameters. It should be noted that the phased replacement of the A-4M by the AV-8B, while reducing the base loading requirement of the fixed wing aircraft, will impose a larger base loading requirement on the smaller facilities and/or create a requirement for additional VTOL sites.

Of significance, however, is the high unit cost of the new aircraft which strongly supports a need for greater dispersion of these assets and/or hardening of the EAF bases. As discussed in Chapter IV, dispersion of the aircraft can be accomplished through the employment of unimproved remote sites or by expansion of EAF facilities. Of interest and possible use in dispersal of aircraft is a development project under the auspices of the Naval Civil Engineering Laboratory as part of the joint Airfield Damage Repair Project. Called FLOTRAK, the system is based on the use of plastic, segmented tracks which can be quickly wrapped around an aircraft's tires. The tracks reduce aircraft tire-to-ground pressure, permit movement over marginal strength soil, and allow aircraft to access runways over unsurfaced soil routes.

10.5 Additional Requirements. The air control section of this report addresses planned acquisitions which support aircraft operations in an AOA and interface with EAF facilities and/or equipment. Of concern is the need for terminal guidance (either by visual or electronic means) at the VTOL landing sites. Experience gained with the AV-8A operating from this configuration has identified the requirement for a landing aid system that can provide visual or electronic references to enable the pilot to precisely and expeditiously position the aircraft over the center of the pad, thereby expediting landings and reducing the need for two-way communication and prolonged low hovers.

It is anticipated that this requirement will, therefore, have relevance to the AV-8B and JVX as well, although the JVX is a unique combination of helicopter and fixed wing concepts that carries three crewmembers. Additionally, the JVX has not reached a point in its development process where unique EAF compatibility and operational requirements have been firmly established. Discussions with the JVX PMA, APML and facilities support offices indicate, however, that Marine Corps operational requirements for EAF interface will be a major consideration in the determination of test and evaluation criteria during full scale development.

NAEC is currently researching the requirement for a landing aid system for use with the 72 foot VTOL forward operating site. Possibilities range from simple markers located on the periphery of the landing pad to the use of electro-luminescense lighting. Currently there is no target date for incorporation of such a system; however, NAEC is working with several lighting contractors to satisfy the requirement.

10.6 Summary. The impact of new aircraft in various stages of acquisition for the Marine Corps inventory during the study time frame do not significantly alter the capabilities required of the EAF system. A requirement to provide for increased dispersion of the aircraft operating from these facilities should receive priority attention.

# CHAPTER XI

## GROUND DEFENSE OF THE EAF

11.1 General. The flexibility, ability for rapidly massing resources, and the capability for the swift application of combat power inherent in the ACE provides the MAGTF with a formidable capability to attain the landing force objectives and to blunt an enemy's offensive threat. Accordingly, enemy forces can be expected to direct significant conventional and unconventional resources towards the destruction of air facilities and, in turn, the ACE's ability to sustain air operations. The requirement to counter the enemy threat and ensure uninterrupted operations or limit damage presents serious air and ground defense problems. These problems are intense under all conditions of combat. However, they are magnified during the early and unsettled stages of an amphibious operation.

This chapter addresses the ground defense of the EAF system with the exception of the VTOL sites which are normally located forward in the AOA and whose defense would be the responsibility of the ground combat unit within whose area the site is situated.

11.2 Historical EAF Defense Postures. In previous conflicts, such as Korea and Vietnam, permanent and expeditionary airfields enjoyed relative freedom from large scale ground or air attacks. Though subject to sporadic rocket fire and infrequent small unit raids, the major air facilities were never seriously jeopardized and combat air operations were not interrupted for extended periods of time.

In these conflicts the EAFs were usually situated to the rear of major tactical maneuver elements that provided a buffer between them and major enemy forces. Frequently, tactical maneuver units in reserve or not committed to offensive operations were positioned and tasked to augment the EAF defense posture. In addition, a preponderance of the MAGTF's combat service support units were also tenanted in the Force Rear Area in mutually supporting defensive clusters. Rear area security plans were integrated and active defensive measures were coordinated to deter large scale enemy incursions into the rear area. Finally, extended operations, specifically in Vietnam, enabled passive defense measures to be implemented fully. EAF personnel, equipment and supporting facilities were hardened; aircraft were revetted, camouflaged, and dispersed; and an effective complex of surveillance and barrier systems were employed.

11.3 Nature of the Threat to the EAF. Future conflicts, requiring deployment of an EAF system of the magnitude and complexity required to support an ACE of 634 aircraft, will generate defensive problems of an order of magnitude not previously encountered. This will be particularly true as ground is uncovered, the AOA expands, and/or complete EAF systems, i.e., five facilities, are operational.

Technological advances in weapon systems, intelligence and communication systems, and threat strategies have significantly reduced the time, distance, and force ratios that previously favored the ACE and its supporting EAF system. The capabilities of stand-off air and ground launched indirect fire weapons have increased in range, effectiveness, and lethality. Even the most unsophisticated potential adversary now has ready access to Warsaw Pact manufactured anti-aircraft missiles, artillery rockets, and ground bombardment systems, e.g., the SA-7 (Grail) and SA-9 (Gaskin) missiles; the BM-21 (122mm) and RPU-14, 140MM artillery rockets; and the 122mm D-74 and 130mm M-46 field guns.

For example, an enemy sympathizer, partisan, or sleeper agent armed with an SA-7 or SA-9 can launch attacks from within 3 kilometers of a facility against ACE aircraft being launched or recovered. The artillery rocket systems, mentioned previously, can be launched from ranges of 10,000 to 20,000 meters in multiples of 16 and 21 rockets. The 122mm and 130mm field guns can hit an EAF from a distance of 15,000 meters and 27,150 meters, respectively. Airborne stand-off weapons add yet another dimension to the threat.

11.4 Threat Strategies. Chapter II contains a summary of the threat confronting the United States and its military forces. In part, that threat analysis is based on MARCORS scenario 1A, 2A, 4 and 5 which range from a full scale conflict in Europe, to a mechanized force threat in Northeast Asia, and independently initiated small unit harrassing attacks conducted by terrorist organizations, partisan sympathizer, or indigenous militia forces in Southeast Asia.

The forces that could be expected to oppose future MAGTF's have a common thread of military strategy dominated by several key principles of war. This threat is Soviet inspired and supported world wide. It permeates the thinking and conduct of all USSR allied forces and movements from the highly mobile, well balanced forces of the Warsaw-Pact in Europe, to the lighter, but well equipped, less sophisticated forces in other parts of the world. The principles consistently adhered to are the offensive, massed forces, and speed of attack, coupled with simultaneously executed economy of force operations against priority targets — especially command, control and communications systems, and air facilities in rear areas. This is a combined arms strategy that relies on overwhelming the enemy with massive forces and firepower coincident to rapid movement to exploit known or perceived enemy weaknesses.

11.4.1 Levels of Threat Against the EAF. Several levels of threat should be considered in evaluating the defensive capability that will be required by the EAF. As established in a variety of documents analyzing Soviet/U.S. concepts of operations, force ratios, strategy, and battlefield tactics, these threats can be categorized as:

- Level I - Those the EAF can defeat with its own defensive resources or at least contain until tactical maneuver elements respond to the threat.

- Level II - Those beyond the capability of the EAF to contend with.

- Level III - Nuclear, biological or toxic chemical attack.

11.4.2 Level I Threat. This level would include sabotage operations conducted by specially trained and equipped individuals or units; independently initiated terrorist, partisan sympathizer, militia, and stay-behind, sleeper activities; and, airmobile, airlanded, or amphibious raids by small units ranging in size from a squad to a platoon.

11.4.3 Level II Threat. Included in this category would be penetrations of the forward edge of the battle area (FEBA) by company size or larger mechanized/motorized infantry units; long range rocket or artillery attacks; and large scale air strikes or naval bombardments.

11.4.4 Level III Threat. These are special category attacks involving nuclear, biological or toxic chemical (NBC) strikes. As such, NBC attacks involve damage control operations rather than the defensive actions under discussion. Defense against NBC attacks generate consideration of hardening facilities, dispersing installations and aircraft, and recovery operations that are not within the scope of this study and will not be discussed further.

11.5. The EAF and Current Rear Area Security Doctrine. The incremental buildup of combat power ashore in a typical amphibious operation will place the EAF system in the Force Rear Area. This area can be defined as that which is normally in the rear of the highest echelon of the tactical maneuver elements of the division, excluding the reserve. As rear area residents, tactical air commanders, together with combat service support elements also located in the Force Rear Area, are responsible for the local security of their respective units and installations. They exercise this responsibility under the overall direction of a commander, designated by the Commander, Landing Force (CLF) to integrate local security plans into an overall Rear Area Security Plan.

11.6 Rear Area Security Forces and Measures. The doctrine for rear area security also prescribes the available forces that should be considered in planning the defense of rear area installations. These forces are listed as:

- o Combat service support units and elements thereof, such as predesignated security detachments from these units.
- o Combat and combat support units specifically assigned a rear area security mission, such as the reserve element of assault forces.
- o Friendly national military, paramilitary, and police forces.

The means of conducting rear area security includes both active and passive measures. Active measures involve coordinating defense plans with adjacent units; aerial and ground surveillance of the rear area; use of armed convoys; occupying key avenues of approach, vital road junctions, and key terrain features; conducting reconnaisance and combat patrols; erecting barriers and obstacles; and deploying a mobile reserve to repel, destroy or contain a hostile threat. Passive measures of security include dispersion of installations and resources; camouflage and blackout descipline; and hardening of sites to minimize damage to equipment and personnel.

11.7 Summary of Rear Area Security Doctrine. Beyond the definitive requirement for all commanders to provide for local security of their own units and installations, the doctrine does not specify a definite command pattern to provide for the delegation of authority to take charge, plan, and direct the overall defense of the rear area. Instead, the doctrine permits considerable flexibility in command arrangements and assignment of responsibility. Where necessary for operational control and coordination, the Force Rear Area may be divided into subareas and all units physically within a specific area may be integrated into the rear area security plans of that area. Plans to counter enemy incursions are coordinated between adjacent units and with higher headquarters and are normally to be implemented on an as required basis when a hostile threat develops.

The flexibility inherent in the doctrine tends to relegate the rear area security function, including that required by the EAF, to that of an additional duty of the command assigned the task. Under current doctrine and organizational precepts no unit, including the ACE, is adequately staffed or equipped to unilaterally provide for its own ground defense and/or, of course, a normally sized rear area.

This chapter discusses the measures necessary to enhance the capability of the ACE to provide for ground defense of the EAF facilities. The concept offered does not suggest that the ACE can unilaterally solve the problem. Instead, it only suggests methods of improving the existing capabilities. It also does not offer solutions to the overall rear area security issue.

11.8 Future Ground Defense Needs of the EAF. The relative freedom from ground attacks EAF's experienced in past conflicts will probably not exist in future contingency missions. Several limiting factors will combine to change the operational environment in which the ACE and its supporting EAF system must perform their respective missions. These limiting factors will involve one or both of the following requirements:

- o A need to install the several EAF configurations at widely separated distances.

- A need to disperse all MAGTF elements including major tactical maneuver forces and CSS units over a wide area as a passive means of protection particularly against massive artillery and nuclear attacks.

Although the EAF sites may still be located in the Force Rear Area, they may well be operating as independent complexes without the buffer of adjacent CSS units or close-by tactical maneuver elements to blunt enemy ground attacks. In such an operational environment, the EAF will need a more extensive ground defense capability than would accrue from a minimal number of ACE personnel manning the EAF perimeter, and ACE military police personnel performing their standard law enforcement/military police functions within the EAF perimeter.

While a Level II size attack against the rear area, including the EAF, would constitute a threat to the MAGTF of sufficient severity to require response by a part of the Ground Combat Element, a Level I size threat should be within the ground defense capability of the EAF to resolve with its own resources or with minimal assistance from other MAGTF units.

11.9 Fundamentals of EAF Ground Defense. The key fundamentals of an EAF defense posture include an aggressive, organized in-depth, integrated effort with a ground defense force capable of meeting threats from all directions, and under the control of a specifically designated ground defense commander.

The ground defense force must include a command, control and communications capability to organize and control both the security and ground defense of the EAF; equipment to detect enemy threats to the EAF as far removed from the perimeter as possible; the mobility to respond rapidly; and weapons systems with sufficient lethality to destroy hostile forces, delay and disrupt the attack or channel the enemy into areas suitable for counterattack by supporting ground combat elements.

11.10 EAF Ground Defense Posture. An aggressive EAF defense is accomplished by employing patrols, listening posts, observation posts, ground surveillance radars, and sensors to detect possible enemy threats at a distance from the EAF perimeter. Such defensive activities provide the capability to disrupt threats at the earliest possible time and before the enemy can launch direct or indirect fire attacks against the EAF.

Defense-in-depth is designed to deny the enemy key terrain in the vicinity of the EAF that could be used to observe EAF operations and direct fire. It permits the engagement of enemy forces progressively in order to disrupt or weaken an attack and preclude the enemy from destroying EAF resources by penetrating a single line of defense.

While ground defense operations are usually oriented to detect, halt, repel, eject or destroy an attack from a principal direction, EAF defenses must be orgainized to defend the air facility against an attack from any direction, to include a vertical assault or paradrop on the EAF itself.

Finally, the total defense posture of the EAF must be planned coordinated, integrated, and controlled by an agency specifically assigned this task. Such designation should be accomplished before the EAF deploys to permit the necessary planning, training, and coordination to be effected and to ensure the EAF defense plan is implemented on arrival in the objective area. Relying on a flexible plan to integrate EAF personnel and equipment resources into an ad hoc task organization of elements from EAF tenant activities in the objective area would be imprudent in view of the threat to a widely dispersed EAF system.

To meet their EAF security and ground defense responsibility, future commanders will require an organized ground defense force, to include an adequate staff, equipped to provide the command and control of all EAF security and ground defense forces. Such an organization will ensure efficient and responsive measures are applied to counter all levels of threat to the EAF with a minimum of resources.

11.11 <u>EAF Ground Defense Forces</u>. Any discussion of the capability of the ACE to provide for its own security at several widely dispersed sites must consider all units within the ACE, the adequacy of those units to perform the ground defense function, and those options available to resolve deficiencies.

As a prelude to the discussion, a distinction must be made between the terms perimeter security, perimeter defense, and ground defense of the EAF. In the case of an EAF or bare base, the primary mission of the forces assigned to the airfield complex is to conduct and support air operations. The secondary mission is to minimize the effect of hostile action on the primary mission. Hostile action can adversely affect the primary mission in two ways.

The first is degradation of the primary mission by taking personnel from primary duties in order to counter the enemy threat. The second is disruption and destruction of priority operational installations as a result of enemy action. Accordingly, sufficient numbers of personnel must be involved in security and defense to prevent disruption and destruction of priority facilities and equipment, but an over commitment of essential support personnel must be avoided in order to minimize the effect of removing ACE personnel from their primary mission.

To strike a balance between these two factors, the concepts of perimeter security, perimeter defense, and ground defense of the EAF are germane. Perimeter security is conceived of as the minimum employment of EAF personnel as an alert force occupying positions to a distance of 200 meters from priority EAF installations and operating areas to give warning and temporarily delay any ground attack against the complex. Perimeter defense consists of the deployment of additional EAF or bare base personnel to defensive positions around the airfield in response to an impending or actual ground attack on the airfield complex. The EAF ground defense concept includes both perimeter security and perimeter defense actions, but is expanded to emphasize the active ground defense activities of personnel whose primary mission is ground defense of the EAF or bare base, i.e., patrols, surveillance, occupying key terrain, and deploying as reaction forces to repel, delay, or defeat the hostile forces attacking the airfield complex.

11.12 EAF Perimeter Security Forces. Each element of the ACE located on an EAF should be expected to contribute to the security and defense of the EAF perimeter to the extent that such a contribution will not seriously degrade its ability to perform its primary combat, combat support, or combat service support function. The degree to which each type rear area unit, including those comprising the air combat element of a MAF sized MAGTF, can participate in the security of the EAF they occupy is the subject of a Marine Corps sponsored study, "Rear Area Coordination, Security and Defense," dated 15 January 1970.

A mathematical model developed for that study can be used to determine the number of personnel each type MAW element could contribute to the perimeter security or full time perimeter defense function without a decrease in operating efficiency. The model ascertains the ability of each unit to provide personnel for permanent perimeter security and defense by developing a basic efficiency curve for that unit. The unit's expected security contribution, when applied to the curve, defines the degradation of the unit's efficiency.

For example, if it is assumed that 10 percent is the maximum decrease in operating efficiency each unit can afford, it is possible to determine the adequacy of a unit's personnel resources to contribute to the perimeter defense required by any situation, and the extent of the deficiencies at each EAF where resources are inadequate. The number of units assigned to each EAF, as shown in Table 4-7, indicates that an adequate number of personnel are available to provide a minimum level of perimeter security at each site without a serious degradation in operational efficiency.

11.13 EAF Perimeter Defense. As opposed to perimeter security that involves a minimum alert force to give warning of an impending ground attack, perimeter defense could necessarily involve nearly total participation of all EAF and bare base personnel. Such a requirement would be generated by an imminent or actual ground attack against the airfield complex. It presupposes that EAF or bare base operations would be temporarily suspended. If not interrupted, essential operations would at least be reduced in scope to the degree necessary to allow the temporary redirection of additional ACE personnel to protection of vital installation and equipment (i.e., parked aircraft). Perimeter defense of the EAF or bare base would remain a primary mission of the majority of the ACE personnel until the hostile threat was resolved and normal operations could resume.

The security and defense of the EAF perimeter by a pro-rata share of ACE personnel is not to be construed as the total ground defense requirement of the EAF System against a ground attack. It merely represents the minimum level of security capable of being provided by ACE elements whose primary function is not air base defense or even rear area security, but, who, in essence, constitute an alert force, and the last line of defense against the various levels of ground attack the EAF may be subjected to.

11.14 Current MAW Security Forces. The current Tables of Organization for MAW law enforcement and security elements is under review at HQMC. Those law enforcement and security entities currently resident in the Marine Wing Headquarters Squadron (MWHS) and in the Marine Air Base Squadrons (MABS) of the fixed wing and rotary wing Marine Aircraft Groups (MAGS) are scheduled to be reorganized. Their final disposition has not yet been firmly established and a revised T/O is not currently available. It is anticipated, however, that all MAW law enforcement and security capabilities will be concentrated in the MWHS.

Whatever configuration the final T/O will take, it can be expected to provide each MAW a nucleus of law enforcement and security personnel that could serve as a basis for task organizing an MMROP MAF ACE Ground Defense Force. For study purposes, and in the absence of revised T/O's, those T/O's current as of September 1983, and shown at Table 11-1, will be used to illustrate task organization actions that can be taken in the future to support the ground defense requirements of an EAF System consisting of multiple sites deployed within an AOA.

The total, specifically designated security forces included in MAW T/O's shown at Table 11-1 consists of 10 officers and 430 enlisted personnel. Of this number, 3 officers and 12 enlisted personnel of the MWHS Security Section are specifically organized to conduct law enforcement activities designed to detect, deter, and investigate criminal activity of Marine or indigenous personnel to the extent that the combat environment permits.

The Detention Unit and Military Police Units of the various security sections perform the other necessary law and order functions in a combat zone. These functions include the following tasks:

- o Pass and ID control.
- o Law and order maintenance.
- o Resource protection, such as security of open storage supplies.
- o Traffic services, such as control of convoy movements and movement of critical supplies, munitions, and personnel.
- o Refugee and straggler control.
- o Prisoner confinement.
- o Enemy POW operations.

## MARINE AIR WING SECURITY FORCES

### MWHS-2 (T/O 8611R) SECURITY SECTION

| TITLE | GRADE | MOS | OFF | ENL |
|---|---|---|---|---|
| Provost Marshal | Maj. | 5803 | 1 | |
| Security Off. | Capt. | 9910 | 1 | |
| Criminal Invest. | WO | 5805 | 1 | |
| Provost Sgt. | MSGT | 5811 | | 1 |
| Security Chief | Gy Sgt. | 5811 | | 1 |
| Admin. Clerk | S. Sgt. | 0151 | | 1 |
| Criminal Invest. | S. Sgt. | 5821 | | 2 |
| Admin. Man | Sgt. | 0151 | | 1 |
| Criminal Invest. | S. Sgt. | 5821 | | 2 |
| Criminal Invest. | Sgt. | 5821 | | 1 |
| Barraks and GNDS NCO | Cpl. | 8911 | | 1 |
| Admin Clerk | LCPL | 0151 | | 2 |
| Security Section Total | | | 3 | 12 |

### DETENTION UNIT

| TITLE | GRADE | MOS | OFF | ENL |
|---|---|---|---|---|
| NCOIC | Sgt. | 5811 | | 1 |
| Detention Supervisor | LCPL | 5811 | | 6 |
| Guard | PFC | 5811 | | 6 |
| Detention Section Total | | | | 13 |

### MILITARY POLICE UNIT

| TITLE | GRADE | MOS | OFF | ENL |
|---|---|---|---|---|
| MP Officer | Capt. | 5803 | 1 | |
| Asst MP Officer | Lt. | 5803 | 1 | |
| MP Chief | Gy Sgt | 5811 | | 1 |
| MP | S. Sgt. | 5811 | | 4 |
| MP | Sgt. | 5811 | | 9 |
| MP | Cpl. | 5811 | | 14 |
| MP | LCPL | 5811 | | 28 |
| MP | Pfc. | 5811 | | 38 |
| MP Section Total | | | 2 | 94 |
| Grand Total | | | 5 | 119 |

### MAG (VA/VF/VA(AN)(T/O 8820R) SECURITY SECTION

| TITLE | GRADE | MOS | OFF | ENL |
|---|---|---|---|---|
| Security Off. | Capt. | 9910 | 1 | |
| Security Chief | Gy Sgt. | 8151 | | 1 |
| Sgt. of the Guard | Sgt. | 8151 | | 3 |
| Cpl. of the Guard | Cpl | 8151 | | 6 |
| Guard | LCPL | 8151 | | 20 |
| Guard | PFC | 8151 | | 39 |
| Section Total | | | 1 | 69 |
| 3 MAG (VA/VF) Total | | | 3 | 207 |

### MAG/VH) (T/O 8921R) SECURITY SECTION

| TITLE | GRADE | MOS | OFF | ENL |
|---|---|---|---|---|
| Security Off. | Capt. | 9910 | 1 | |
| Security Chief | Sy Sgt. | 8151 | | 1 |
| Sgt. of the Guard | Sgt. | 8151 | | 3 |
| Cpl. of the Guard | Cpl. | 8151 | | 6 |
| Barraks and GNDS NCO | Cpl. | 8151 | | 1 |
| Admin Man | LCPL | 8151 | | 1 |
| Guard | LCPL | 8151 | | 15 |
| Guard | PFC | 8151 | | 25 |
| Section Total | | | 1 | 52 |
| 2 MAG (VH) Total | | | 2 | 104 |

### TOTAL POTENTIAL SECURITY FORCE

| UNIT | OFF | ENL |
|---|---|---|
| (MWHS) | 5 | 119 |
| (3) MAG(VA/VF) | 3 | 207 |
| (2) MAG (VH) | 2 | 104 |
| GRAND TOTAL | 10 | 430 |

Table 11-1

The law and order enforcement and the other police functions described above, will be essential to efficient operation of the MAF ACE. While the MAW security sections do not currently have a specific mission to provide for ground defense of the EAF, they could, as discussed below, serve as a nucleus for constituting the ground defense force of the EAF system.

11.15 Notional EAF Ground Defense Force Organization. The 10 officers and 430 enlisted personnel within the various security sections have the potential of being organized into a notional EAF Ground Defense Force capable of providing both the law and order function and the immediate ground defense needs of the five dispersed EAF's. The notional organization is shown in Tables 11-2 through 11-6. The criminal investigation, military police, and ground defense functions have been combined into one organization. The prisoner detention function has been omitted based on the belief that it is best performed at the force level to support the needs of all elements of the MAGTF.

The notional Ground Defense Force for the three large airfield complexes would require 15 officers and 357 enlisted personnel from the 10 officers and 430 enlisted personnel included in Table 11-1; an addition of 5 officers. Of the remaining 73 enlisted personnel, the 13 Marines designated as the Detention Unit of the MWHS Security Section could continue to perform that function for the ACE, or be combined with the Force Detention Unit, if one is formed in an AOA. The remaining 60 personnel are available to perform a variety of additional ground defense tasks to include:

- o Increase the size of the notional Ground Defense Force at each airfield.
- o Deploy and man sensor systems around each airfield.
- o Form a security detachment for each VSTOL facility.

The ground defense requirements of the two VSTOL facilities deserve special consideration. The defense needs of these two forward operating facilities will depend upon their location with respect to the GCE and/or the ACE. If located within the area of responsibility of the GCE it would devolve upon that element of the MAGTF to include the VSTOL facilities within their Rear Area Security Plan. The commanders of each VSTOL facility would be responsible for their own perimeter security, but defense of the facility would be performed by a designated component of the GCE.

## NOTIONAL EAF/BARE BASE GROUND DEFENSE FORCE

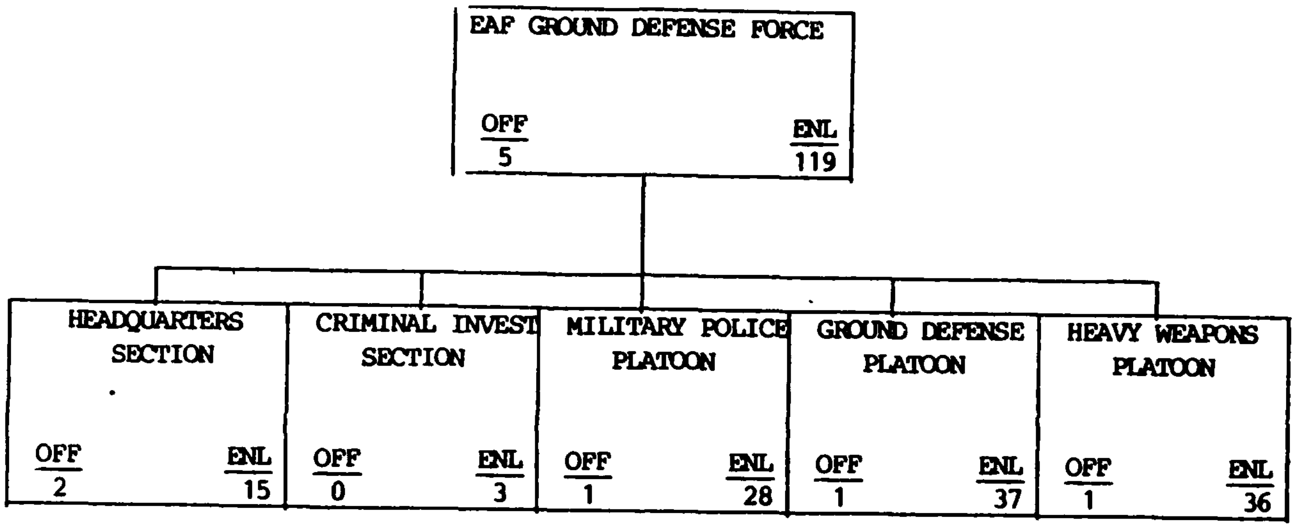



TABLE 11-2

## EAF GROUND DEFENSE FORCE HEADQUARTERS

| TITLE | GRADE | MOS | OFF | ENL |
|---|---|---|---|---|
| Ground Defense Commander | MAJ | 9910 | 1 | |
| Security Officer | CAPT | 5803 | 1 | |
| Security Chief | Msgt | 5811 | | 1 |
| Messenger/Driver | PFC | 5811 | | 2 |
| | SECTION TOTAL | | 2 | 3 |
| **S-1 SECTION** | | | | |
| Personnel Chief | Ssgt | 0193 | | 1 |
| Personnel Clerk | Cpl | 0121 | | 1 |
| | SECTION TOTAL | | | 2 |
| **S-2/S-3 SECTION** | | | | |
| S-3 Chief Infantry Opns | Msgt | 5811/0364 | | 1 |
| Intel Specialist | Ssgt | 0231 | | 1 |
| NBC Defense Specialist | Sgt | 5711 | | 1 |
| Radio Supervisor | Sgt | 2531 | | 1 |
| Wire Supervisor | Cpl | 2512 | | 1 |
| Admin. Clerk | Cpl | 0151 | | 1 |
| Messenger/Driver | Pvt | 0311 | | 1 |
| | SECTION TOTAL | | | 7 |
| **S-4 SECTION** | | | | |
| Logistic Operations Chief | Ssgt | 0431 | | 1 |
| Ammo Tech | Cpl | 2311 | | 1 |
| Maint Management NCO | Cpl | 0411 | | 1 |
| | SECTION TOTAL | | | 3 |
| | HEADQUARTERS TOTAL | | 2 | 15 |

TABLE 11-3

## CRIMINAL INVESTIGATION SECTION

| TITLE | GRADE | MDS | OFF | ENL |
|---|---|---|---|---|
| Criminal Investigator | Ssgt | 5821 | | 1 |
| Criminal Investigator | Sgt | 5821 | | 1 |
| Admin. Clerk | Lcpl. | 0151 | | 1 |
| | SECTION TOTAL | | | 3 |

## MILITARY POLICE PLATOON

| TITLE | GRADE | MDS | OFF | ENL |
|---|---|---|---|---|
| MP Officer | LT | 5803 | 1 | |
| MP Chief | GySgt | 5811 | | 1 |
| MP | Sgt | 5811 | | 3 |
| MP | Cpl | 5811 | | 6 |
| MP | Lcpl | 5811 | | 6 |
| MP | Pfc | 5811 | | 12 |
| | SECTION TOTAL | | 1 | 28 |

TABLE 11-4

## GROUND DEFENSE PLATOON

| TITLE | GRADE | MDS | OFF | ENL |
|---|---|---|---|---|
| **PLATOON HEADQUARTERS** | | | | |
| PLATOON COMMANDER | LT | 0302 | 1 | |
| PLATOON SERGEANT | GySgt | 5811/0369 | | 1 |
| DRIVER/RADIO MAN | CPL | 5811/0341 | | 1 |
| GRENADIER/RIFLEMAN | LCPL | 5811/0311 | | 1 |
| RIFLEMAN/RADIOMAN | LCPL | 5811/0311 | | 1 |
| | SECTION TOTAL | | 1 | 4 |
| **DEFENSE SQUADS 3/PLT** | | | 3 Each | |
| Squad Leader | SGT | 5811/0311 | | 1 |
| Fire Team 2/Squad | | | 2 Each | |
| FIRE TEAM LEADER/RADIOMAN | CPL | 5811/0311 | | 1 |
| GUNNER 26 MM BUSH MASTER | CPL | 5811/0311 | | 1 |
| GRENADIER MACHINE GUNNER | LCPL | 5811/0311 | | 1 |
| GRENADIER, RIFLEMAN (M203) | PFC | 5811/0311 | | 1 |
| AUTOMATIC RIFLEMAN/DRIVER | PFC | 5811/0311 | | 1 |
| | SECTION TOTAL | | — | 33 |
| | PLATOON TOTAL | | 1 | 37 |

TABLE 11-5

## HEAVY WEAPONS PLATOON

| TITLE | GRADE | MDS | OFF | ENL |
|---|---|---|---|---|
| PLATOON HEADQUARTERS | | | | |
| PLATOON SERGEANT | GySgt | 5811/0369 | | 1 |
| AMMO TECH | CPL | 2311 | | 1 |
| AMMO MAN/DRIVER | PVT | 0311 | | 1 |
| | SECTION TOTAL | | | 3 |
| 81 MM MORTAR SECTION | | | | |
| Section Leader | Sgt | 5811/0341 | | 1 |
| Ammo Man/Driver | Pfc | 5811/0311 | | 1 |
| 81 MM MORTAR SQUAD 4/SEC | | | | 4 Each |
| Squad Leader | Cpl | 5811/0341 | | 1 |
| Gunner | Lcpl | 5811/0341 | | 1 |
| Asst. Gunner | Pvt | 5811/0341 | | 1 |
| | SECTION TOTAL | | | 14 |
| HEAVY MACHINE SECTION | | | | |
| Section Leader | SSgt | 5811/0369 | | 1 |
| Ammo Man/Driver | Pvt | 5811/0331 | | 1 |
| HEAVY MACHINE GUN SQUAD 2/SEC | | | | 2 Each |
| HEAVY MACHINE GUN TM 2/SQD | | | | 2 Each |
| Team Leader/Gunner | Cpl | 5811/0331 | | 1 |
| Gunner/Drive | Lcpl | 5811/0331 | | 1 |
| | SECTION TOTAL | | | 10 |
| ASSAULT SQUAD | | | | |
| Squad Leader | Sgt | 5811/0351 | | 1 |
| ASSAULT TEAM 4/SQD | | | | 3 Each |
| Dragon Gunner | Cpl | 5811/0351 | | 1 |
| Asst. Gunner | Lcpl | 5811/0351 | | 1 |
| | SECTION TOTAL | | | 9 |
| | PLATOON TOTAL | | 1 | 36 |

TABLE 11-6

In the event the two VSTOL facilities were located outside the GCE's area of responsibility, but forward of the SELF and two bare bases, two alternative options are available to provide for their ground defense as follows:

- o Provide a separate appropriately sized security force for each VSTOL facility if they are located at an extended distance from a SELF or bare base.

- o Include the VSTOL facilities within the ground defense plan of the SELF or bare base if distance separating the airfields permit this option.

11.16 Concept of Ground Defense Force Operations. In a widely dispersed mode of deployment, each EAF configuration must plan to be self-sufficient in providing for its own ground defense against small scale hostile attacks. The dispersion of ACE assets over several airfield complexes will increase the pro-rata share of tenant activity personnel in the defense of each complex unless an alternative concept of ground defense is developed.

This alternative concept could be a single agency at each site with the primary responsibility to integrate, coordinate, and control perimeter security and perimeter defense needs at each airfield and the resources necessary to conduct the active ground defense activities within and outside the perimeters. The agency best suited to perform this function is the notional EAF Ground Defense Force previously discussed. This notional force is not conceived of as a new T/O organization. Rather, it could be task organized from existing MAF ACE law enforcement elements. The several security elements currently resident in a MAF ACE could combine their personnel and equipment resources, and with the necessary ground defense weapons, communications and mobility assets, could provide the command, control and communication, necessary to implement a cohesive rear area security and ground defense plan at each EAF and bare base.

11.16.1 Command Control and Communications. The proposed task organized EAF Ground Defense Force, displayed at Tables 11-2 through 11-6, has included in its organization a command and staff element with the capability to plan the EAF defense posture, evaluate the potential or actual threat to each facility, and coordinate the individual EAF/bare base response to the threat.

The notional EAF Ground Defense Force headquarters should function as a separate staff element responsible to the EAF/bare base commander for the law enforcement, perimeter security/defense, and ground defense activities unique to each airfield complex.

The EAF Ground Defense Force's control of all aspects of EAF security and ground defense could be effected by a special EAF radio communications net backed up by wire communications linking perimeter security positions with the EAF Ground Defense Force headquarters. In addition, the headquarters could control its operating ground defense elements by radio, and net with both adjacent rear area installations and designated ground combat and combat support elements to coordinate the EAF ground defense with the total Force Rear Area Security Plan.

11.16.2 <u>Ground Defense Equipment</u>. Compared to the defensive posture the EAF must assume, and the size of the EAF configurations that will have to be defended, the current T/E's of the ACE law enforcement/security elements are inadequate to perform the task of defending the EAF from ground attack. The equipment inventory of an EAF Ground Defense Force must enable it to accomplish the following tasks with a minimum number of personnel.

- o Conduct aggressive patrols at a distance from the EAF.
- o Occupy key terrain, establish blocking positions on avenues of approach, and conduct continuous day and night surveillance around the EAF perimeter.
- o Attack and destroy small size enemy forces.
- o Disrupt or delay squad or platoon size enemy forces.
- o Prevent or disrupt direct and indirect fire attacks against the EAF as far from the perimeter as possible.
- o Concentrate forces rapidly to repel an enemy force that threatens to penetrate the EAF perimeter at any point.

This list of ground defense responsibilities, required of each EAF Ground Defense Force, suggests a heavy emphasis should be placed on supplying each unit with weapons capable of delivering a high volume of concentrated fire, and the mobility assets to enable the limited number of personnel in each force to deploy rapidly inside and outside the EAF/bare base perimeter.

11.16.3 Weapons Systems. A major consideration in selecting weapon systems an EAF Ground Defense Force would need is the volatile nature of EAF support facilities and ACE aircraft that would be concentrated at each site. The EAF bomb dumps, fuel storage facilities, and densely packed, fueled aircraft constitute an operational hazard in themselves.

Weapons systems employed in such an environment must be capable of delivering a high voume of concentrated, well controlled fire to resolve a hostile threat as rapidly as possible. These weapons should be mounted on or carried in mobile platforms that can move rapidly from point to point on or outside the EAF perimeter.

Among candidate weapon systems that would provide an EAF Ground Defense Force the lethality and effective firepower its ground defense missions demand, the following systems are deserving of consideration:

- o 40 MM Grenade Launcher, M203 - Effective against infantry accompanying armored vehicles. Forces the enemy to disperse and the vehicles to "button up" thereby making them more vulnerable to anti-tank weapons. Has a point target range of 200 meters, and an area target range of 350 meters. Fires HE duel purpose; CS; star parachute; star cluster; and ground smoke munitions.
- o 40 MM Grenade Machine Gun, MK19 - Effective for point suppression of lightly armored vehicles, prepared positions, helicopters, and troops. Delivers a high volume of fire that can suppress personnel and vehicles at great distances without revealing its position. The MK19 cannot be detected by ear beyond 300 meters. It can hit a moving target at 800 meters, a stationary point target at 1000 meters, and an area target at 2400 meters. Fires HE and HE dual purpose ammunition not interchangeable with the 40 MM M203 rounds.
- o 25 MM M242 Bushmaster Cannon — Suited for a variety of ground vehicle, air defense, and mobile platform operations. The M242 meets the EAF ground defense force needs for battlefield reliability and combat effectiveness for infantry fire suppressive support and defense against armor and helicopters. It is the main weapon for the Light Armored Vehicle (LAV) selected by the U.S. Marine Corps. The M242 has a rate

of fire that includes single shot, 100, 200, and 475 rounds/minute (with motor interchangeable).

- Anti-tank/Assault Weapon - The M47 Dragon command to line-of-sight, one kilometer range system is currently in the Marine Corps inventory. Two candidate replacements include the fire-and-forget capable RATTLER and TANK BREAKER man portable anti-armor/assault weapons system (MAAWS). These advanced development systems will fire a shaped charge warhead missile designed to engage armor, helicopters or low performance aircraft, and field fortifications. The fire-and-forget feature allows the gunner to engage other targets while the missile guides itself to the target.
- Stinger Portable Anti-Aircraft Missile - A man portable air defense system (MANPADS) employing an infra-red seeking missile that enables a Marine to engage effectively low altitude, high speed jet, propeller driven, and helicopter aircraft. A U.S. Roland missle pod carrying four Stinger rounds has been developed which houses four Stinger missiles in a standard size Roland launch tube.
- 50 Cal Machine Gun M85 - A dual purpose ground and air defense weapon capable of delivering a high volume of accurate fire. In the pedestal mounted mode, on a mobile platform, it can provide an additional air defense capability.
- 81 MM Mortar - Delivers fire at ranges up to 4,600 meters. Has the capability to provide coverage of all approaches with HE, White Phosphorous, and illumination rounds producing 500,000 candlepower covering an area of approximately 1500 meters in diameter. The indirect HE fire capability provides the EAF the ability to engage enemy forces in defiladed positions, while illumination of the EAF complex and adjacent terrain is an essential support capability during periods of poor visibility and during an attack on the EAF.
- M18 Claymore Mine - Used as a defensive weapon to protect approaches to the EAF or used effectively in ambush actions. Provides a fragmentation blast of 700 steel ball projectiles to 100 meters in a 60 degree arc in front of the mine by command or bobby trapped detonation.
- M72 Light Antitank Weapon (LAW) - An effective weapon for EAF ground defense personnel to employ in the dismounted mode against enemy armor, trenches, or hardened targets. Has a maximum range of 1000 meters,

but, effective target engagement range is 200 meters for stationary targets and 150 meters for moving targets.

Complementing these heavy weapons systems would be the standard T/O infantry weapons normally included in the T/E of all Marine forces, i.e., M-16 rifle, pistols; hand and smoke grenades; etc.

11.16.4 Mobility Assets. The EAF ground defense force requirements for mobility assets include those vehicles necessary to perform the law and order and military police functions at each EAF, e.g. M151 Utility Trucks, and AN/GRC Series radio vehicles for convoy and traffic movement control. In addition, the ground defense force should be a mobile force mounted on Light Armored Vehicle (LAV's) or other suitable armored vehicles designed for the defense role. This mobile capability is needed to:

- o Serve as weapon system platforms for both ground and air defense systems.
- o Enable the defense force to conduct frequent patrols and establish strong popints at a distance from and on all sides of the EAF.
- o Allow continuous surveillance and investigation of terrain surrounding the EAF.
- o Expedite rapid concentration of fire power and personnel at the point of a hostile threat to any part of the EAF.
- o Permit the transportation and periodic altering of barrier, obstacle, and surveillance system patterns around the EAF.

11.16.5 EAF Ground Defense Force Planning and Training. Essential to the proper employment of the ACE's current security elements in their expanded role as a task organized EAF Ground Defense Force would be the prior planning and coordination that occurred in peacetime for contingency deployment. Prior preparation would involve identifying personnel to perform the various functions in their role as members of an EAF Ground Defense Force; procuring and using equipment that will be employed in the EAF ground defense role, and reviewing contingency plans to determine what size EAF Ground Defense Force would have to be task organized for each mission.

Part of the coordination process involves discussion of the EAF Ground Defense Force concept, capability, and plan of action or deployment with the other major elements of a MAF level MAGTF, including the GCE and FSSG, to ensure they are aware of and will be prepared to render necessary support to ground defense of EAF's or bare bases installed in an AOA.

Major command post and field exercises involving MAWS or subordinate elements present valuable opportunities to test the feasibility of task organizing current MAW law enforcement/security elements into an EAF Ground Defense Force. Such practical training will enable MAW law enforcement/security elements to resolve operational, administrative, and material deficiencies before they are committed to combat. In addition, such training opportunities will support the transition of MAW security personnel from their purely law enforcement duties to their additional role as an EAF Ground Defense Force in future contingencies.

11.17 Summary. The standard deployment of an ACE to a single EAF complex immediately to the rear of a GCE, with the inherent defensive capability a concentration of ACE resources at one site provides, may no longer apply in future contingencies. A widely dispersed series of EAF's needed to accommodate the size of the MMROP MAF ACE will require each airfield complex to provide for its own rear area security and ground defense needs with that share of the total ACE resources tenanted at each EAF.

Whatever configuration the future law enforcement and security organization of the MAW takes, modifying its organization, revising its concept of operations, and augmenting its equipment inventory for contingency operations, these MAW elements can be task organized to provide each SELF and bare base both a law enforcement and a nucleus EAF Ground Defense Force capability. Such a force can be formed from manpower assets consisting of 15 officers and 357 enlisted Marines.

Equipment assets required include both direct and indirect fire weapons; mobility assets, such as the LAV; and a radio and wire communication system to tie in the perimeter security and ground defense forces of the EAF with a EAF Ground Defense Force Headquarters responsible to the EAF commander for the security and ground defense of the EAF.

Planning and training for a transition of MAW law enforcement/security sections from a peacetime garrison type military police/criminal investigation function to an EAF Ground Defense Force structure at each EAF and bare base deployed is essential. It will minimize the trauma usually associated with establishing a rear area defense posture after deployment of MAW elements into an objective area and will provide the MMROP MAF ACE a ground defense capability vital to accomplishment of its primary mission — air support of the MAGTF.

CHAPTER XII

ORGANIZATIONAL CONCEPTS

12.1 General. Any review of organizational concepts related to the EAF system must include consideration of the operational, maintenance, and supply support responsibilities and the personnel resources required to perform each task. This Chapter will trace the evolutionary changes that have occurred in each functional area since the inception of the EAF System, identify the present organizational relationships and responsibilities, discuss alternative organizational concepts, and provide recommendations for standardization within each MAW.

The first step in the review is to trace the historical factors that have led to the present organizational relationships. A major contributor has been the evolution of the maintenance support process.

12.2 Maintenance/Material Support Evolution.

12.2.1 Maintenance Support. When the expeditionary airfield equipment was initially procured, the concept of maintenance employed to support it was compatible with the Aviation Maintenance and Material Management System (3M) that was then coming into being in the Naval aviation community. However, the EAF system, at the time of its incorporation under 3M, was not provided with even the most rudimentary of maintenance guidelines.

Normally, under 3M, an aeronautical equipment being introduced is subjected to intense engineering analysis to determine and prescribe specific preventive and corrective maintenance actions to be accomplished at specified intervals or when required. The adaptation of the EAF, then called SATS, under 3M was accomplished without this analysis. In effect, the word was "to get set up and operating". As a consequence, maintenance of the EAF equipment initially evolved into performing corrective maintenance on an "as required" basis, and preventive maintenance tasks were developed as the need was recognized.

A keystone of the 3M system today is the specification of echelons of repair and the identification of skill fields required at each level. The 3M concept, in effect, provides for repair/maintenance at the lowest possible echelon at which it is economically feasible to accomplish and at which the requisite skills are available. The EAF system was incorporated without definition of those repair echelons and/or delineation of skill requirements. The same personnel responsible for the operation of the system were required to maintain it, and they continue to do so today.

To compound the problems of the EAF community, 1973 budget year considerations resulted in the transfer of the EAF from the 3M system (with three maintenance echelons) to the Marine Corps Maintenance Information and Material Management System (MIMMS) which mandates five echelons of repair. Because previous actions had concentrated the maintenance skills and tasks at only one echelon, this change had a negligible effect. However, it did serve to create confusion as to what procedures were actually in effect. In one instance, a duplicative effort (adhering to partial 3M and partial MIMMS procedures) was followed. Further, supply support problems were compounded because the Marine Corps supply system was not a "registered user" of some EAF system parts.

Another factor in maintenance of the EAF equipment has been its utilization. The EAF system is essentially contingency oriented, and a major portion of the system's equipment and matting assets are packaged and stored to be broken out for contingency operations. Peacetime utilization of the EAF system is generally limited and consists primarily of pilot familiarization and training. Use of all of the EAF contingency assets during exercises is limited because installation times and lift constraints generally preclude employment of the entire system. It must be recognized that this utilization consideration will probably present a continuing problem in the definition of specific echelons of maintenance and establishment of firm levels of supply.

The factors cited in the evolution of EAF maintenance practices have generated several problem areas. Most pressing among these are:

- The absence of clearly defined echelons of repair and the lack of commonality of the supporting structure among the major commands to facilitate establishment of those repair echelons which are identified.

- The presence of shortfalls in maintenance technical documentation such as Maintenance Manuals, Illustrated Parts Breakdowns (IPBs), and Maintenance Requirement Cards (MRCs).

- No formal delineation between operator/maintenance tasks and, further, no delineation of maintenance tasks into what are appropriately preventive maintenance or what are appropriately corrective maintenance.

- The lack of identification of discrete skills to accomplish specific maintenance tasks, and a concomitant requirement to compensate through increased utilization of technical representatives in the field.

The description of how the EAF function is organized within each MAW and the Brigade is outlined below. It is based on discussions with EAF cognizant representatives in HQMC, in each MAW, and in the Brigade.

Shown below are the present parent organizations within each major command, those having various functional responsibilities, and the reasons established for assignment of those responsibilities.

Concurrent with the evolution of the present system of EAF maintenance support has been the migration of the EAF maintenance responsibility to diverse parent organizations within the Marine Aircraft Wing structure. When first established, the EAF capability was assigned to the Marine Air Base Squadrons (MABS) of the tactical aircraft groups of each Wing. Subsequently, Developmental Bulletin No. 1-65 prescribed the temporary assignment of EAF personnel during peacetime from the MABS of the tactical aircraft groups to the MABS of the Marine Wing Support Group (MWSG) for standardization of training and more efficient personnel utilization. A MABS is no longer a part of the MWSG organization and with this dissolution, the EAF responsibility has tended to be assigned to various units within the individual Wings and custodial responsibility, as well as supply support for contingency assets vested in one tactical group of the Wing.

Another factor that has impacted on the assignment of the operational and custodial responsibilities has been the restructuring of combat service support (CSS) missions, functions and organizations in divisions, aircraft wings, and the FSSGs. This has resulted in an understandable period of turbulence as new support concepts were formulated and tested, tables of equipment were reorganized, and logistic support procedures were revised to accommodate the new CSS structure at all levels. It was inevitable that, during this period of significant change in the Marine Corps CSS structure, a degree of diversity in organization and employment concepts would occur and be tolerated while system development progressed to its ultimate structure. The EAF system and organization did not escape this turbulence in the active force structure.

12.3 1st MAW.

12.3.1 Functional Responsibilities.

- Personnel (MOS 7011) - Until recently, the EAF personnel were consolidated in the MWHS-1. A change has occurred, which consolidated the EAF assets and the Aircraft Recovery Technician (MOS 7011) into the Wing Engineer Squadron (WES) of MWSG-17.

- Custodial Responsibility - The allowance of EAF equipment is being accounted for by the WES.

- Supply Support - Day-to-day support of the EAF equipments is provided by the Group Supply Department, MAG-36.

- Maintenance Support - Organizational and intermediate maintenance of EAF equipment is being accomplished by the aircraft recovery technicians. Maintenance beyond their capability is being performed by either the Wing Transportation Squadron (WTS) or the WES.

12.3.2 Rationale for Assignment.

- Geographic location of units.

- o Better utilization of EAF personnel by consolidation.

- o Closer proximity to support equipment (i.e., trucks, engineer support equipment)

12.4 2D MAW.

12.4.1 Functional Responsibilities.

- o Personnel (MOS 7011) - All are assigned to MABS-14, Bogue Field.

- o Custodial Responsibility - The allowance of EAF equipment is located at Bogue Field and accountability of the equipment is with MABS-14.

- o Supply Support - Support of the EAF function at Bogue Field is provided by the Group Supply Department, MAG-14. There are, however, three supply personnel located at Bogue Field. They prepare requisitions for submission to Group Supply and maintain/control repair parts that are required for day-to-day operations.

- o Maintenance Support - Organizational and intermediate maintenance of EAF equipment is performed at Bogue Field by the Aircraft Recovery Technicians (MOS 7011). Maintenance beyond the capability of the 7011 is accomplished by maintenance contact teams from either the WTS or WES, of MWSG-27.

12.4.1 Rationale for Assignment.

- o MABS-14 is supporting an expeditionary airfield operation at Bogue Field.

- o Better utilization of personnel by consolidation.

12.5 3D MAW.

12.5.1 Functional Responsibilities.

- Personnel (MOS 7011) - All are assigned to Headquarters Squadron Marine Wing Support Group-37. Personnel are provided to support EAF operations at Twenty-Nine Palms, California.

- Custodial Responsibility - EAF assets have been consolidated and are accountable at Marine Wing Support Group-37.

- Supply Support - Support of day-to-day requirements are provided by the Group Supply Department, MAG-11. Item requisitions are submitted by Wing Support Group-37 EAF personnel to MAG-11, Group Supply. They monitor requisition status and provide this information to the EAF personnel.

- Maintenance Support - Organizational and intermediate maintenance on the EAF equipment is accomplished by the Aircraft Recovery Technician (MOS 7011). Maintenance actions beyond the capability of EAF personnel on such items as the diesel retrieval engine are provided by the WTS or WES.

12.5.2 Rationale for Assignment.

- Better utilization of personnel by consolidation.

- Located in the same organization where maintenance and other support can be provided.

12.6 1st Marine Brigade.

12.6.1 Functional Responsibilities.

- Personnel - Aircraft Recovery Technicians (MOS 7011) are assigned to MABS-24.

- Custodial Responsibility - EAF equipment allocated to the 1st Marine Brigade is assigned to MABS-24 for accounting purposes.

- Supply Support - Support of EAF equipment is provided through the Group Supply Department, MAG-24. Day-to-day requirements are generated by the EAF personnel, and operating levels of repair parts are maintained within MABS-24.

- Maintenance Support - Organizational and intermediate maintenance is being performed by the Aircraft Recovery Technician (MOS 7011). Maintenance beyond this capability is being provided by Det B, MWSG-17 or H&MS-24.

12.6.2 Rationale for Assignments.

- Aircraft Recovery Technician (MOS 7011) assigned as per T/O.

- Supported by only a detachment of MWSG-17.

12.7 Material Support Evolution. Development of material support procedures responsive to the EAF have generally been subjected to the same type convulsions experienced during the evolution of its maintenance practices. The primary difficulty has been the failure to establish a comprehensive maintenance concept as a basis for determining the provisioning requirements and ultimately, the Supply Support Plan. Under normal aviation acquisition procedures, a provisioning determination is made prior to a system being introduced. That determination considers maintenance requirements, echelons of repair being supported, location of organizations in which the equipment will reside, length of the supply pipeline required, equipment turnaround time requirements, and desired supply response time. Once provisioning is accomplished, a Primary Supply Inventory Control Point (PSICP) is designated with Supply Distribution Points (SDP) established, as necessary, to provide a wholesale outlet in proximity to a retail supply outlet.

Another factor compounded the problem in that supply support responsibility for the system was shifted from the Aviation Supply Office (ASO), Philadelphia to the Branch Aviation Supply Office (BRASO), Lakehurst after the initial provisioning was accomplished. BRASO has cognizance over shipboard catapult and arresting gear equipment and utilizes allowance documentation unique to those equipments, such as Coordinated Shore-Base Material Allowance List (COSMAL), as opposed to the Aviation Consolidated Allowance List (AVCAL) found in the Marine Aircraft Wing. In addition, the Equipment Identifier Codes (EICs) present in the BRASO documents cannot be related to the Work Unit Codes (WUCs) found in Aviation 3M documentation. The shift of the inventory management responsibility has also resulted in some confusion over material cognizance.

Under a properly operating maintenance/supply support system, allowance documentation derived from the provisioning process is subjected to continual revision once the system is fielded. Maintenance/supply usage data flows to cognizant inventory managers to justify these revisions. As indicated in the section describing the evolution of the EAF's current maintenance practices, no usage/maintenance action reporting system is in effect. The supply support being provided does not accurately reflect the nature of EAF peacetime utilization, nor does it accurately reflect contingency requirements. As recently as 1979, EAF maintenance and material managers developed the first Table of Allowances for the system based upon their estimates of requirements. This has subsequently been followed by promulgation of Allowance Parts Lists (APLs) and a Stock Number Sequence List (SNSL). However, none of the lists have been validated under a full time EAF operational scenario.

Symptomatic of these supply related problems are:

- o Unvalidated allowance documentation.
- o The absence of usage data because no channels are available for data flow.
- o The procurement of repairables and consumables by exception, based upon a manually calculated baseline.
- o The existence of "goodie lockers" containing unauthorized stocks of spares.

- The utilization of some parts designated for contingency support to accommodate day-to-day operations.
- The utilization of periodic requirements reviews, (i.e., semi-annual maintenance material managers' conference) as the primary method of seeking adequate stock.
- The migration of cognizance for the majority of EAF material to the PSICP at BRASO to facilitate management while cognizance for some resides at the NAVAIRSYSCOM level.
- The necessity to provide unprogrammed funding to respond to unforcasted requirements.

Resolution of problem areas in supply support are contingent upon resolution of problem areas in establishing commonality of parent organizations, and documenting maintenance requirements.

12.8 Expeditionary Airfield Project Officer Actions. EAF Project Officers at NAVAIRSYSCOM have attempted to cope with the EAF system's complexities and unique characteristics over the years. To some extent, all have been frustrated in their efforts. In the beginning of 1981, the EAF Project Officer conducted an analysis in order to ascertain the scope of the EAF problem areas and to initiate actions to correct them. The report which was produced recommended that steps be initiated to:

- Reincorporate the EAF system under the aegis of the Aviation 3M system.
- Develop maintenance plans which reflect present day concepts and procedures.
- Review the operation and procedures of the existing supply support system.
- Develop a supply support plan accommodating the revised maintenance requirements.

Subsequent to receipt of the analysis, the EAF Project Officer has, in addition to the actions recommended above, initiated the following:

- Reinstituted funding cognizance and management for the EAF System under Navy auspices.

- The development of a 10-Year System Acquisition Planning Document.
- The development of an updated EAF Equipment/Configuration Catalogue.
- Revision of the standard maintenance plan format to accommodate the contingency nature of the equipment.
- Preparation of work unit codes in anticipation of reincorporation under the 3M system.
- Preparation of a revision to the OPNAVINST 4790.2B series to reflect reincorporation of the EAF system under 3M and concentration of EAF unique management requirements in a separate section of the instruction.
- Preparation of NAMP Desk Top Procedures Guide, unique to the EAF, but, incorporating the provisions of the OPNAV instruction.

Based upon the several considerations indicated in the foregoing sections, the Study Team next evaluated the potential organizations to support the EAF system.

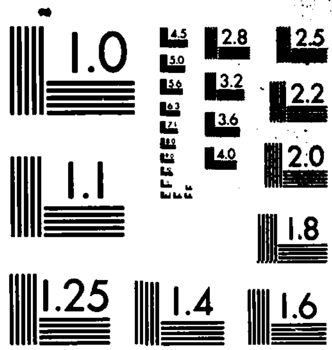
12.9 Scope of the Analysis. In order to ascertain the most efficient, effective, and economically feasible structure within the Wing for support of EAF resources, the requirements unique to the EAF system were first defined (those presently existing and those derived from other portions of this study). Second, an evaluation of only those organizations within the wing which are capable of meeting all or a portion of the requirements was conducted. Third, a comparison of the organizational capabilities was made. Last, subsequent to identification of the organization (in the context of the evolving employment concept), proposed adjustments to the structure were identified and discussed.

12.10 EAF Requirements Definition. EAF requirements are defined as follows:

- A capability and the requisite skills/personnel to interface with the Navy aviation supply system.
- A capability and the requisite skills/personnel to interface with the 3M system to collect, record, report, and analyze appropriate maintenance data.
- Equipment, or accessibility to it, to permit the two interfaces outlined above.

AD-A165 967 ON THE DEVELOPMENT OF AN OPERATIONAL CONCEPT FOR THE MARINE CORPS EXPEDIT. (U) MARINE CORPS DEVELOPMENT AND EDUCATION COMMAND QUANTICO VA 17 DEC 85 3/3

UNCLASSIFIED F/G 1/5 NL




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

- The development of a 10-Year System Acquisition Planning Document.
- The development of an updated EAF Equipment/Configuration Catalogue.
- Revision of the standard maintenance plan format to accommodate the contingency nature of the equipment.
- Preparation of work unit codes in anticipation of reincorporation under the 3M system.
- Preparation of a revision to the OPNAVINST 4790.2B series to reflect reincorporation of the EAF system under 3M and concentration of EAF unique management requirements in a separate section of the instruction.
- Preparation of NAMP Desk Top Procedures Guide, unique to the EAF, but, incorporating the provisions of the OPNAV instruction.

Based upon the several considerations indicated in the foregoing sections, the Study Team next evaluated the potential organizations to support the EAF system.

12.9 Scope of the Analysis. In order to ascertain the most efficient, effective, and economically feasible structure within the Wing for support of EAF resources, the requirements unique to the EAF system were first defined (those presently existing and those derived from other portions of this study). Second, an evaluation of only those organizations within the wing which are capable of meeting all or a portion of the requirements was conducted. Third, a comparison of the organizational capabilities was made. Last, subsequent to identification of the organization (in the context of the evolving employment concept), proposed adjustments to the structure were identified and discussed.

12.10 EAF Requirements Definition. EAF requirements are defined as follows:

- A capability and the requisite skills/personnel to interface with the Navy aviation supply system.
- A capability and the requisite skills/personnel to interface with the 3M system to collect, record, report, and analyze appropriate maintenance data.
- Equipment, or accessibility to it, to permit the two interfaces outlined above.

- An organizational framework which will provide for the establishment of a multiechelon maintenance hierarchy.

- An organizational framework which will facilitate access to repair echelons external to the EAF's organic echelons.

- An organizational structure which will facilitate employment and installation of the EAF by providing access to external engineering support.

12.11 Candidate Wing Organizations. The organizations within a Marine Aircraft Wing possessing all or a partial capability to meet the requirements above are:

- The Marine Air Base Squadron (MABS) of the Marine Aircraft Group (VF/VA).
- The Headquarters and Maintenance Squadron (H&MS) of the Marine Aircraft Group (VF/VA).
- The Marine Air Traffic Control Squadron (MATCS) of the Marine Air Control Group (MACG).
- The Wing Engineer Squadron (WES) of the Marine Wing Support Group (MWSG).

12.12 The Analysis. The analysis considers the current mission of each organization, its logistic capabilities, and evaluates its requirements under the present concept of employment. In each case, extracts have been taken from the current Tables of Organization (T/Os) and Tables of Equipment (T/Es) at Headquarters, U.S. Marine Corps.

12.12.1 Marine Air Base Squadron (MABS).

12.12.2 Marine Aircraft Group Structure. Figure 12-1 depicts the structure of a Marine Aircraft Group (MAG) and the organizational relationship of the MABS to the MAG. There are a total of twelve MABS (one in each aircraft group) in the three active Wings/Brigades.

MAG VF/VA ORGANIZATION RELATIONSHIPS

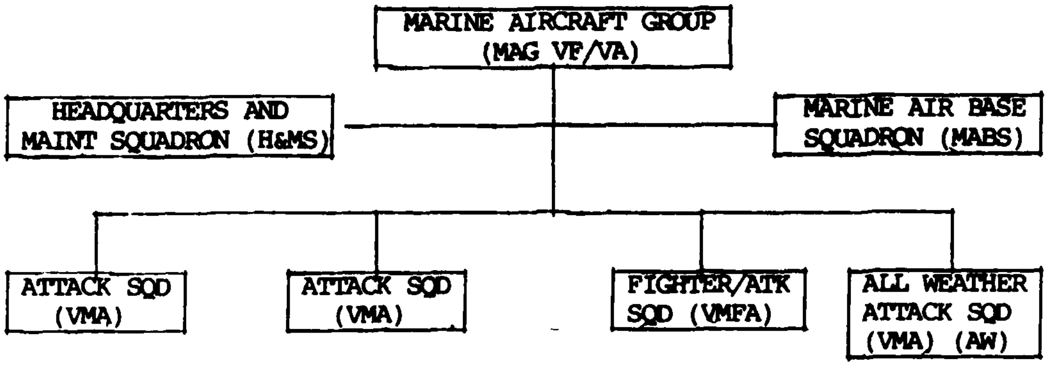



FIGURE 12-1

12.12.3 MABS Mission. Provide airbase facilities and services (except airfield construction) for the Marine Aircraft Group or supplement the airbase facilities and services, provided by a station or facility, when based thereon.

12.12.4 Logistic Capabilities.

- Maintenance.

  Perform 1st echelon maintenance on all assigned equipment; 2nd echelon on assigned infantry weapons; 3rd echelon on organic communication-electronics equipment, less single side-band.

  Provide 3rd echelon support for communications-electronics equipment organic to the Group, less avionics, single side-band.

- Supply.

  Perform supply and fiscal functions required for squadron operations. The MABS is structured, staffed, and equipped to perform ancillary tasks associated with the operation of an air facility (i.e., base operations, crash/fire/rescue, weather service, and aircraft recovery).

All of the above services would be required in support of a VSTOL facility or larger type expeditionary airfield, and the ability of the MABS to provide them under all circumstances must be accepted.

The relevant issue is whether, under the employment concepts, the MABS can accept responsibility for the operation, supply support, and maintenance of the EAF system itself. Analysis of the mission statement, the T/O, and the T/E clearly indicate that the MABS has an extremely limited capability to provide the full range of support required.

The functional skill capabilities required by the EAF for operation and maintenance is vested in the Aircraft Recovery Technician (MOS 7011) who is responsible for both operating and maintaining the EAF system. This particular MOS is assigned only to the MABS. The skill requirements inherent in the maintenance functions require expertise in hydraulics, electrical, pneumatics, avionics, and diesel mechanics. Experience has shown that these technicians generally expand their expertise in these areas to compensate for the lack of other personnel with the requisite skills within the squadron. The depth of maintenance currently being performed by the Recovery Technicians ranges up to 4th echelon. Although this has contributed to improved operations and increased readiness of the system, it has also tended to severely distort the supply support and maintenance requirements. It also leaves unanswered the question of which organization is responsible for 3rd and 4th echelon maintenance of the system.

Recent actions by the Naval Air Systems Command in conjunction with the Marine Corps have reverted EAF funding from the Marine Corps to the Navy, and action has commenced to reincorporate the EAF system under Navy's Aviation Supply and Maintenance and Material Management system. The personnel assigned to the MABS supply section carry a ground supply MOS (3043) and are neither trained nor experienced in the intricacies of the Navy aviation supply procedures/systems. There are no maintenance analysts (MOS 6047) trained in 3M procedures allocated within the T/O. The computer capability (U-1500) and the software packages for both the aviation supply and 3M systems are resident at the Marine Aircraft

Group level. There are no engineering personnel assigned and, of course, no engineering equipment provided for in the T/E.

To optimize EAF Maintenance/Supply requirements would require the addition (or substitution) of personnel trained in the Naval Aviation Supply System (MOS 3072), in maintenance analysis (MOS 6082), and selected engineering skills/ equipment to provide a self-contained capability within the MABs to operate the EAF and ensure that it is adequately supplied and maintained. Although the supply and maintenance analysts' skills are available at the Group level, it is essential that they be assigned in adequate numbers at the using unit level to ensure effective support, particularly when deployed/in combat.

12.13 Headquarters and Maintenance Squadron (H&MS).

12.13.1 Organization. Figure 12-1 also depicts the organizational relationship of the H&MS within the Marine Aircraft Group. Its mission and capabilities are discussed below.

12.13.2 H&MS Mission. Perform tactical, logistical and administrative support for units attached to the Marine Aircraft Group.

12.13.3 Logistic Capabilities.

o Maintenance.

Perform 1st echelon maintenance on all organic equipment and 2nd echelon maintenance on assigned infantry weapons.

Performs organizational and intermediate maintenance on assigned aircraft and support equipment.

Performs intermediate maintenance on assigned aircraft and support equipment of supported aircraft squadrons.

Provides direct support of tactical squadrons assigned to the Marine Aircraft Group.

Screens and repairs of aeronautical materials in need of rework, test, or check (Condition Codes B&E).

- Supply.

Performs supply and fiscal functions requires for Group operations.

As cited above, the H&MS provides a range of administrative, supply, and maintenance support functions to the Group Headquarters and assigned squadrons. It does not have the personnel assets/skills or equipment required to operate and maintain the EAF components.

The Aircraft Maintenance Department is staffed, in part, by personnel with MOS' 60XX and 64XX who possess the skills to maintain airframes, hydraulics, power plants, avionics, communications, electrical systems, and ground support equipment. Certain of these skills are required for maintenance of the EAF components; however, none are sufficiently transferrable to meet the total requirements for operating the system (i.e., MOS 7011, Aircraft Recovery Technician).

The Aircraft Maintenance Department is also staffed with Maintenance Data Analysts (MOS 6047) skilled in the 3M system.

The H&MS T/O incorporates the Group Supply Department which includes an Aviation Supply Support Center (MOS 3072), A U-1500 (UYK-5) computer, and the Shipboard Uniform Automated Data Processing - End Use (SAUDP-EU) supply and financial software which permits interaction with the Naval Aviation Supply System.

The squadron does not possess EAF related engineering skills or equipment.

In summary, the H&MS has the required aviation supply support and 3M system capabilities but lacks the skills required to operate and fully maintain the EAF system/components. It would require the addition of Aircraft Recovery Technicians (MOS 7011), selected engineering MOS', and equipment to accord the H&MS the capability to properly operate, support, and maintain the EAF.

12.14 Marine Air Traffic Control Squadron (MATCS). Figure 12-2 depicts the structure of the Marine Air Control Group (MACG) and the organizational relationship of the MATCS within the Group.

MACG ORGANIZATION RELATIONSHIPS

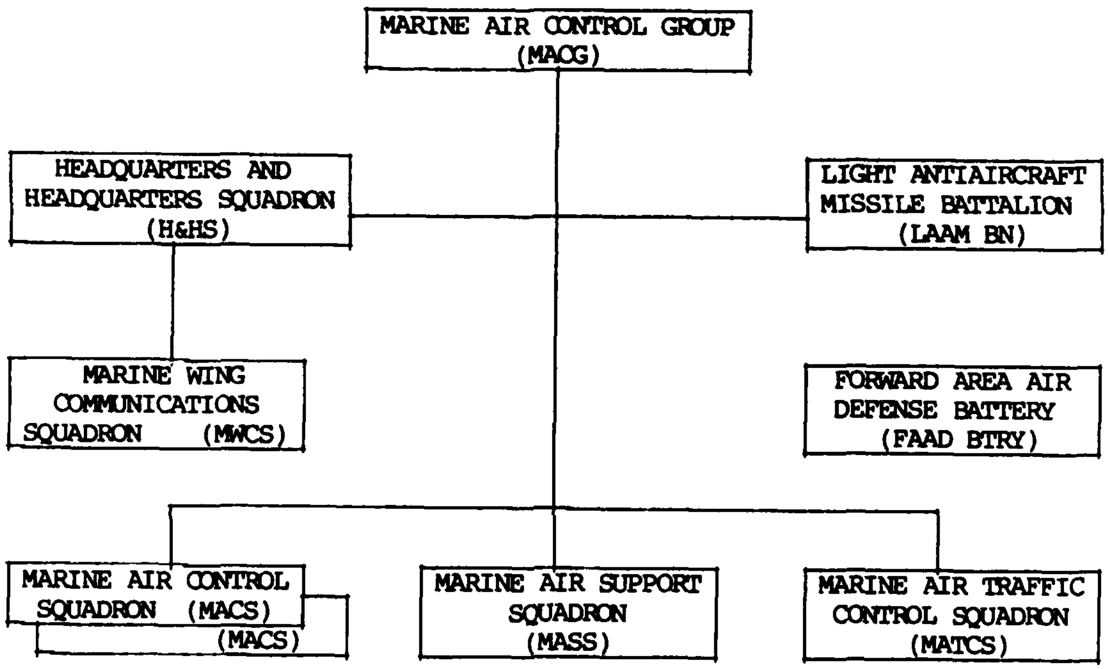



FIGURE 12-2

12.14.1 MATCS Mission. Provide continuous, all-weather air traffic control services for expeditionary airfields and remote area landing sites as part of the Marine Air Command and Control System (MACS) in support of the Fleet Marine Force (FMF).

12.14.2 Logistic Capabilities.

o Maintenance.

Provide 1st through 4th echelon maintenance on all assigned Navy furnished equipment.

Provide 1st and 2nd echelon maintenance on all assigned Marine Corps furnished equipment, except motor transport, which is limited to 1st echelon.

- Supply.

Perform Marine Corps supply and fiscal functions required for squadron operations. Requires Group support in Shipboard Uniform Automated Data Processing - End Use Navy supply functions.

The MATCS is organized, staffed, and equipped to provide continuous Instrument Flight Rule/Instrument Meterological Condition (IFR/IMC) services simultaneously to three independent and geographically separated expeditionary airfields and seven remote area landing sites. It does not, however, have the personnel or equipment required to operate and/or maintain the EAF system.

The squadron is not staffed to and does not employ the Naval aviation supply and 3M systems.

The Maintenance Department is primarily staffed with MOS 59XX, Radar and Communication-Electronic Technicians who are capable of maintaining selected EAF components (i.e., the FLOLS, Airfield Light and Marking System, and Short Range Communication System).

Neither the T/O nor the T/E provide for the engineering skills and/or equipment needed to support the EAF. Aircraft Recovery Technicians and engineering personnel and equipment would have to be included in the T/O and T/E in order for the MATCS to assume responsibility for the EAF system.

12.15 Wing Engineer Squadron (WES). Figure 12-3 depicts the structure of the Marine Wing Support Group and the organizational relationship of the WES within the group.

MWSG ORGANIZATIONAL RELATIONSHIP

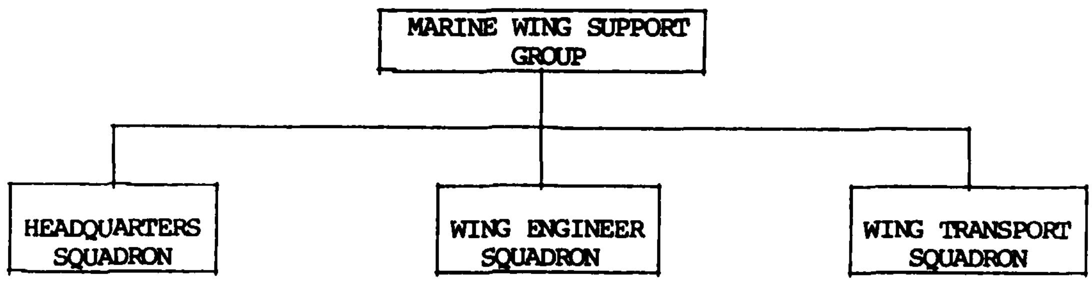



FIGURE 12-3

12.15.1 WES Mission. Provide engineer services support for the MAW and assigned units and to provide engineer organizational maintenance for elements of the Wing.

12.15.2 Logistic Capabilities.

- Maintenance.

  Perform 1st echelon maintenance on all assigned equipment. Perform 2nd echelon maintenance on engineer organizational equipment and assigned infantry weapons, less optical equipment.

  Provide 2nd echelon maintenance support on motor transport and engineer equipment for Wing units.

  Provide expedient/minor repair of existing airfields runways/taxiways.

- Supply.

  Provide organic supply support.

The squadron Supply Department is staffed with ground peculiar MOS and cannot ensure satisfactory interaction with the Navy aviation supply system.

The significant EAF support capability provided by the WES lies in its engineer construction/installation capability and the limited maintenance resources available to support the EAF.

12.16 Summary Evaluation of Selected Units' Capability to Provide Required Support. Figure 12-4 is a matrix that depicts the relative capabilities of the four units discussed in the preceding sections to operate the EAF system and/or provide the required supply, maintenance, and engineering support. As shown, none of the four units possess the five capabilities required to install, operate, supply, and maintain the EAF system.

12.17 Operational Capability. Only the MABS is presently allocated the personnel trained/skilled in the operation of the EAF system and/or its components (i.e., Aircraft Recovery Technicians). There are no MOS/skills in the remaining three units that can perform the function of the Recovery Technician and thus, the remaining units would require alterations to their T/Os to incorporate the Recovery Technicians needed to man and operate the components.

12.18 Naval Aviation Supply Support and Computer/Software Capabilities. Both the H&MS and MATCS are staffed with MOS 3072 and have ready access to the requisite computer/software. However, only the H&MS possess a 3M capability. The MABS and MWSG have reasonable access to the computer/software but are not staffed with the skills to employ them. Addition of MOS 3072 to the MABS would supplement the operational capability (MOS 7011) it now possesses, but it would still lack other requirements (e.g., 3M capability). Addition of MOS 3072 to the MSWG would still leave the unit deficient of all other skill requirements except those within the engineer field.

12.19 3M Capabilities. An analysis of all four units under consideration indicates that while all have reasonable access to computer software support, only the H&MS possessess a 3M capability. The MABS, MWSG, and MATCS would require minimal augmentation of personnel with the appropriate 3M skills to perform this function for the EAF.

12.20 Engineer Personnel/Equipment Capabilities. Only the MWSG possesses significant engineering capability. It does not, however, have the capability to independently accomplish the extensive engineering effort needed to install the larger EAF systems, (i.e., the VSTOL facility, VSTOL airbase, the Expeditionary Airfield (EAF), and the Strategic Expeditionary Landing Field

| | UNIT | | | |
|---|---|---|---|---|
| REQUIRED CAPABILITIES | MABS | H&MS | MATCS | WES |
| 1. Staffed with personnel trained/skilled in operation of EAF function. | Yes A/C Recovery Technician (MOS 7011) | Limited to 60XX + 64XX | Limited to 59XX | No |
| 2. Staffed with personnel trained/skilled in management of Naval Aviation Supply System. | No | Yes | No | No |
| 3. Equipped with or have ready access to computer/software resources required by Naval Aviation Supply System. | Yes | Yes | Yes | Yes |
| 4. Staffed with personnel trained/skilled in management of 3M System. | No | Yes | No | No |
| 5. Staffed/equipped to provide required engineer support. | No | No | No | Yes |

MATRIX OF ORGANIZATION CAPABILITIES

FIGURE 12-4

(SELF). That capability is resident in the Engineer Support Battalion, FSSG and is reflected in its mission and tasks.

The MWSG does have limited resources to assist in the EAF construction/-installation effort and to maintain the system once established. Although a requisite engineering capability could, with a relatively heavy cost in terms of people/equipment, be allocated to one of the other three units previously discussed, there is little or no rationale for doing so. These units do not require the engineering capability to perform other assigned functions and, unless their missions were altered significantly, the engineer assets would be predominantly employed in support of the EAF system. In view of the mission/tasks of the MWSG, it would not be feasible to transfer the assets from that unit to any of the other three units evaluated.

12.21 Conclusions and Rationale. It is clear from the preceding, compressed evaluation that none of the units reviewed is thoroughly suited to operate, support, and maintain the EAF. The problem is not, however, limited to the EAF. Instead, it is representative of a larger and more complex issue that has confronted and continues to confront the Marine Corps, i.e., what organization is most capable of meeting these combat service support requirements that are unique to a Marine Aircraft Wing. There are arguments of merit that suggest that the functions and assets required to perform them should be within the FSSG and other arguments that support retention of the function and assets within the MAW. The issue itself is well beyond the scope of this study, however, even a cursory review of the salient points as they relate to the EAF clearly establish the need to consolidate the combat service support functions within the MAW pending resolution of the broader issue involving possible consolidation within the FSSG.

Consolidation within the MAW should increase the effectiveness, efficiency, responsiveness and flexibility of support with concurrent economies of resources. The primary alternatives appear to be:

- o Consolidation within the MWSG.
- o Consolidation within a single MAB.
- o Creation of a new organization.

In essence, the second and third alternatives are closely related as creation of a single MAB would, in effect, be creation of a new organization. Again, that level of approach is beyond the scope of this effort, but, as a first step towards consolidation, it is proposed that the EAF functions, personnel, and equipment be incorporated within the T/O and T/E of the MWSG.

The MWSG is the primary organization for providing combat service support to the MAW combat units both in garrison and when deployed. The EAF is a combat service support function and, when employed, is provided to a range of MAW units and not those normally associated with only one MAG. Thus, the capability to provide the function should not be resident in individual fixed wing MAGs, but, in the one organization that has responsibility to provide combat service support to the entire Wing.

As cited earlier, the MWSG is composed of three squadrons: Headquarters, Transportation, and Engineer Squadrons. It is proposed that the T/O and T/E of the Engineer Squadron be modified to incorporate the aircraft recovery personnel now resident in each fixed wing MAG. A consolidation of this type should ultimately lead to personnel economies and it is estimated that there could be an average personnel savings of 7 to 10% in each MAW and the 1st Marine Brigade.

Those savings could be used to offset the need to establish the capability to employ and manage both the Aviation Supply and 3M Systems within the MWSG (MOS's 3072 and 6047). Initially, it is estimated that it will require a minimum of four MOS 3072 and one MOS 6047.

The individual EAF facilities can be supported by assigning appropriately structured detachments from the MWSG on an as required basis. The size of the individual detachment will be a function of the condition of the components, the state of training of the aircraft recovery personnel, environmental conditions, base loading and anticipated sortie rate.

12.22 Summary. The evolutionary changes in the EAF system maintenance and supply support procedures throughout the past several decades have been characterized by a lack of planning, funding, and consistency. The lack of direction in both the areas of maintenance and supply has, inter alia, led to the situation that prevails today, i.e., a lack of standardizaiton between the wings in regards to which unit is assigned operational and custodial responsibility for the system.

The deficiency has been long recognized and both NAVAIR and CMC have recently initiated a series of actions designed to overcome the problems being encountered. The Study Team applauds those actions and believes that, if carried out on a timely basis they will do much towards curing selected ills within the EAF program.

The Study Team believes that an additional action would also be most helpful, i.e., to assign the responsibility for installing, operating, and maintaining the EAF system to the WES, MWSG. To perform those functions, the aircraft recovery eprsonnel within the various MABS of the fixed wing MAGS should be consolidted in the MWSG along with a limited number of aviation supply personnel and 3M maintenance analysts. The proposed consolidation will place the EAF system in the organization best suited to perform the combat service support functions and obtain certain economies of resources.

CHAPTER XIII

4TH MARINE AIRCRAFT WING

13.1 General. In order to "provide employment options for 4th Marine Aircraft Wing (MAW) EAF units during mobilization of reserve forces," it is necessary to:

- Define the Reserve Forces and their employment roles during mobilization.
- Define "EAF units".
- Define employment options.

13.2 Reserve Forces. The 4th Marine Aircraft Wing (MAW) forms a major portion of the Marine Corps' Reserve Component which is maintained to provide the trained units and qualified individuals required to bring the Operating Forces and Supporting Establishment to full wartime capability upon mobilization. The active Reserve Component is divided into two categories:

- Ready Reserve. The primary source of units and individual manpower upon mobilization comprised of:

  (a) Selected Marine Corps Reserve (SMCR).
  The SMCR consists of units which can be structured to form a balanced Division Wing Team (DWT) and individuals who are not members of units, but, who are preassigned to mobilization billets which must be filled on or shortly after M-day.

  (b) Individual Ready Reserve (IRR).
  The IRR consists of individuals who have served recently in the active forces or SMCR units and have some period of time remaining on their military obligation. The IRR also includes individuals who have completed their obligated service but have agreed to continue to serve in the Ready Reserve.

- Standby Reserve. Consists of members of the Reserve Component other than those in the Ready or Retired Reserve.

13.3 Employment Roles for Active Reserve Components. In implementing mobilization, the most probable employment roles for the active Reserve Component, as cited in the MMROP and the MPLAN, are:

- SMCR.

  (a) Provide trained units to selectively augment the Active Force in order to field three MAFS at full wartime structure.

  (b) Provide trained units to reinforce the Active Force in order to fill three MAFS at full wartime structure.

  (c) Provide a MAB or, if augmentation/reinforcement is not ordered, a fourth Division/Wing Team.

  (d) Provide a nucleus for reconstitution of a fourth Division, Wing, and FSSG.

  (e) Provide trained Individual Mobilization Augmentees to fill mobilization billets.

- IRR and Standby Reserve. The prime source of individual fillers to fill shortfalls in active and reserve units and to expand the supporting base.

13.4 EAF Units. In the First Interim Study Report the units of immediate interest were identified as those possessing an EAF capability and air defense units which would have utility in defense of an EAF. In subsequent discussions with Marine Corps representatives it was determined that the evaluation should be limited to those units containing Aircraft Recovery Sections staffed with personnel with MOS' 7002 and 7011 and having custodial and operational responsibilities for the various components of the EAF system.

At the present time, the Aircraft Recovery Sections with a T/O strength of 1 officer and 37 enlisted are located in the Marine Airbase Squadron in each Reserve fixed wing Marine Aircraft Group. Details as to actual personnel strengths and EAF component assets available within the 4th Marine MAW are addressed in subsequent paragraphs.

Limiting the evaluation of those units with a distinct and direct EAF function appeared to be most responsive to the tasking, while inclusion of additional units, e.g., LAAM Battalions would have unnecessarily broadened the assessment beyond the intended scope of the SOW and potentially distorted the assessment.

13.5 Employment Option. In view of the mobilization priority of units and individuals cited in paragraph 13.3 above, it was determined that "employment options" should be those which might be reasonably assigned to Reserve "EAF units" subsequent to their arrival at their respective Stations of Initial Assignment (SIA), and prior to their subsequent deployment — if such deployment occurs.

13.6 Evaluation. Any evaluation of the employment of EAF units during mobilization must incorporate both a theoretical and a "real world" approach. The theoretical view should consider those options available if the 4th MAW were staffed with adequate numbers of EAF personnel and possessed a full array of EAF components. The "real world" assessment has to consider the staffing and equippage as it exists today.

13.7 Theoretical Evaluation. Under the conditions of adequate staffing and a full array of components there appear to be three Reserve "EAF unit" employment options which merit consideration:

- o Integrate the personnel into the Active Force units and place the EAF components into contingency assets.
- o Maintain the Aircraft Recovery Section and components for potential deployment with the 4th DWT.
- o Use 4th MAW EAF personnel to provide a CONUS based training capability to provide training for both EAF personnel and new aircrews.

In terms of personnel assignment, the first option is consistent with the mobilization employment roles addressed in paragraph 13.3 above and is perhaps the most probable use of Reserve EAF assets. Under this option, integration may be effected by absorbing individuals into existing Active Force squadrons or by Reserve Squadrons/MAGS being phased into the Active Force structure. Since the three active MAWs possess an adequate array of EAF components, there does not appear to be a requirement for any one or more of those wings to absorb the 4th DWT assets. These Reserve assets would (if they existed) be best placed in contingency assets.

The second option is again consistent with the potential employment role, however, it is perhaps the least likely to occur since the greatest potential value to be gained from the majority of units would be through their integration into the Active Forces in the very early stages of mobilization.

The third and last option has both strong and weak points. The EAF facilities at both MCAGCC, Twenty-nine Palms, California and Boque Field, North Carolina have been declared as "deployable". However, it is not clear that either or both facilities will be or have to be deployed to meet Active Force requirements. If these EAF facilities are left in place, any training required by EAF personnel or new aircrews could be accomplished at either location. The 4th MAW Aircraft Recovery Sections could be assigned to operate and maintain those facilities until additional personnel could be trained to replace them, or until the 4th MAW units/personnel are required to deploy with Active Force units, or to form a portion of a mobilized 4th DWT envisioned under the second option. The 4th MAW EAF components could again be placed into contingency assets.

It would appear that a combination of the first and third options is the preferred course. That is: integrate the required number of Reserve EAF personnel into Active Force units; use the remaining EAF personnel from the 4th MAW to operate and maintain the facilities at Twenty-nine Palms and Bogue Field; and place the 4th MAW's limited EAF components into contingency assets.

The "real world" situation and options pose a significantly different and limited picture. Data provided by the Marine Corps Development and Education Command (Letter DO3Y/SVK;avs over 3913/55-82-02 of 23 Feb. 84) established that the EAF capabilities within the 4th Marine Aircraft Wing are extremely limited. At the time that the letter was drafted, there were a total of ten 7002 Reserve Marine officers and thirty-one 7011's Aircraft Recovery men on active duty with the 4th MAW or serving in SMCR units. On the same date, there were six 7002's and ninety-two 7011's in the IRR subject to recall in times of mobilization.

Assuming that the personnel posture on 23 February 1984 is consistent with that existing over time in the Reserve Force, there are sufficient personnel to staff three Aircraft Recovery Sections, i.e., one in each of the fixed wing MAGS within the 4th MAW. Thus from a personnel standpoint, all of the three options, cited above, are applicable.

There are not, however, any complete EAF component sets within the 4th MAW. The Wing does not possess any AM-2 matting, lighting and marking systems, or communication systems. It does possess three M-21 Aircraft Recovery Systems and one FLOLS. Again, these limited assets are best placed in contingency assets.

13.8 Summary. Under both theoretical and "real world" conditions, the preferred personnel course of action or option would be to integrate the required number of Reserve EAF personnel into the Active Force units while retaining at least two Aircraft Recovery Sections to operate and maintain the EAF facilities at Twenty-Nine Palms and Boque Field.

Again, under both conditions, the 4th MAW EAF components are best placed in contingency assets.

CHAPTER XIV

# CONCEPT AND DOCTRINE EVALUATION

14.1 Introduction. The SOW requires an evaluation of conceptual/doctrinal matters in three specific areas:

- o Impact of new aircraft on the operational concept.
- o Organizational concept.
- o Conceptual alterations to accommodate the functioning EAF and ensure availability of support.

The first two conceptual areas have been addressed in Chapters V and VII respectively and will not be elaborated on further. Concentration in this chapter will be on the third requirement.

Initially, it was decided that the basic EAF concept should be evaluated to determine if it has retained its validity. As that evaluation progressed, and discussions were held with knowledgeable people, it became apparent that there was confusion as to what was the "true" EAF concept.

14.2 EAF Concept. Developmental Bulletin 1-65 and FMFM 5-1 use virtually the same language in describing the EAF concept. Both state:

- o "The EAF concept is a shore-based weapons support system which permits employment of landing force aircraft within effective range of ground forces."

That statement is expanded upon in the Developmental Bulletin 1-65 as follows:

- o "An EAF installation may be effected in incremental phases based on tactical conditions and may be altered or modified as conditions dictate."

- "In addition to carrier operations, air support will be possible from EAF installations situated near force beachheads, offshore islands or friendly areas in close proximity to ground action."

- "The characteristics of an operational EAF installation are influenced by site characteristics, numbers and types of aircraft programmed to operate therefrom and equipment required for installation and operation."

Careful reading of the above statements establish that they do not alter, modify, or expand the basic concept. Instead, they are more accurately described as "means" of implementing the concept.

The "confusion" regarding the concept was also fostered, to some extent by the belief that the operative concept is that which is contained in CMC letter ASL-40-mog 13800 of 1 December 1978, i.e., the "building block concept". Again, this "concept" should be perceived in its proper light, i.e., a definition of the system configuration and the means by which the basic EAF concept may be implemented. The Study Team has treated the building block concept in that aspect throughout.

There is another interesting perception that seems to prevail concerning the building block concept. In brief, it rests on the belief that the building block concept will, to the fullest extent possible, be followed in a lock-step fashion as the EAF facilities are developed within an AOA. That is, that each successively larger configuration will be created by expanding upon an existing facility. While under selected, ideal conditions, such a theoretical expansion may occur, it simply is not logical in the majority of cases either from an engineering or operational standpoint. It is more likely that each facility other than the forward operating sites and perhaps the 900 foot VSTOL facility will retain their initial configuration and not form a base for expansion to a larger configuration.

The Study Team determined that the basic EAF concept, as it appears in FMFM 5-1, retains its validity and that there are no alterations required.

There are, however, a set of concerns related to the manner in which the concept may be employed that merit comment. Those concerns are expressed in the following paragraphs.

14.3 Base Loading and Dispersion. The Study Team fully recognizes that the base loading or beddown scenario envisioned in the study has value and that it should not be interpreted as a preferred course of action. At worst, the Study Team experienced some difficulty in maintaining a balance between real world concepts and capabilities and those theoretical ones derived from the use of an ACE composed of 634 aircraft. However, the use of that size ACE had its merit. It has pointed out with clarity, the potential threat to the viability of the ACE and/or the EAF system from even a semi-sophisticated adversary with the capability to bring to bear a suite of conventional weapons.

Dense packing of aircraft, particularly in large numbers, for even limited periods of time, provides the enemy with an extremely lucrative target. Plans and operational practices must provide for reasonable protection of the costly and perhaps irreplaceble aircraft through:

- Increased dispersion of individual aircraft
- Increased numbers of EAF facilities to include use of unimproved sites
- Improved capability to camouflage
- Revetting
- Enhanced defense capabilities

The enhancements outlined above could, inter alia, lead to a significant increase in requirements for:

- AM-2 matting
- Other EAF system components
- Engineer support
- Fuel transfer and dispensing systems
- Defense forces

This could be a particularly costly investment in funds, personnel, equipment, and material. It also raises the question as to the need for and/or true value of providing each active MAW with the capability to develop and operate a full, five site, EAF system. That provision appears to assume that each MAW will have a simultaneous requirement to respond, as part of a MAF sized force, to geographically separated, worst case, contingencies, when, in point of fact, the most probable commitments in the future may well be those requiring a MAB size force.

The preceding suggests that each active MAW should not be allotted a full EAF system capability. Instead, it would appear that each MAW should be authorized a reduced capability based upon a comprehensive review of potential contingency requirements — or alternatively — that each Fleet Marine Force be authorized a full system capability, the majority of which would be retained in contingency assists and the remainder made available to the MAWs for training purposes.

Although not keyed to the above concerns, the inclusion of the two bare bases within the EAF system has acted to reduce the AM-2 matting requirements and the demands upon engineer construction effort. The planned employment of bare bases is totally supportable in view of their potential availability in the locales wherein Marine forces are most likely to be committed. There is, however, a need to initiate programs designed to take full advantage of the bare base "concept."

14.4 Bare Base Program. Research and development and procurement efforts should be directed towards those programs, and innovations which will permit rapid rehabilitation and/or expansion of those bare bases available in any contingency. In part, the requirement has already been recognized and is being acted on. The Navy/Marine Corps Airfield Damage Repair (ADR) Project Master Plan and the investigation into alternative methods of surfacing/resurfacing parking areas and taxiways are both cogent examples of the Marine Corps forward looking approach in this area.

There is a continuing need to seek innovative solutions to a range of other challenges posed by the EAF system to include the requirement for improved, lighter weight, and less complex components.

14.5 Component Replacement. The report on the "Development of a Ten Year EAF System Project Profile" of December 1983 concluded that the EAF components were generally satisfactory and all met their respective functional requirements. However, analysis indicated there was and is substantial room for improvement.

The AM-2 matting, M-21 Aircraft Recovery System, and the lighting and marking system require an extraordinary amount of strategic and tactical lift. Reduction in the cube and weight of each component would materially assist in alleviating the lift problem. The M-21 arresting gear is time consuming to install and relatively slow in operation. The field lighting system was designed to meet FAA specifications for operating a major commercial airport, is more complex and sophisticated than required, and has a stronger than desirable electronic signal. Modern technology applied to improving these components would substantially reduce the logistics burden of the EAF system and make it more responsive to the needs of the ACE. The Marine Corps, in conjunction with the other Services, is pursuing state-of-the-art technologies to improve the various components. Concurrently, it has also initiated a containerization analysis. Those efforts need to be continued, should be adequately funded, and should be "driven" to fruition.

The final issue which bears on conceptual matters is the SOW tasking to "provide recommended changes/modifications to the requirements stated in the reference documents ..." That has been accomplished throughout the report, and does not require a repetition here. However, the various doctrinal publications should be reviewed and, where appropriate, the statement of the EAF concept should be included and clarified, reference to the building block concept should be eliminated or placed in proper perspective, and the EAF mission statement should be inserted.

14.6 Summary. Two conceptual issues, i.e., impact of new aircraft on operational concepts, and organizational concepts have been addressed in separate Chapters.

A review of the existing EAF concept, with a view towards identifying conceptual and doctrinal alterations which are required establishes that the basic EAF concept as stated in FMFM 5-1 is valid, and does not require modification. It was determined, however, that there is a lack of understanding as to what is the EAF concept and at times, the "building block concept" is perceived as the EAF concept. Steps should be taken to make that distinction clear in the applicable publications. The building block concept is also misinterpreted at times and there is an additional need to clarify its application as a means of employing the basic EAF concept — or — to eliminate it entirely.

The Study Team has concerns relative to the dense packing of aircraft and proposes a series of options for reducing the potential threat of unacceptable losses from enemy action while at the same time recognizing the probable costs in additional resources associated with implementing the options. In order to provide the flexibility to accept one or more options, it was also proposed that the total EAF system currently authorized each MAW be reduced and/or the EAF assets assigned to the two Fleet Marine Forces.

The inclusion of two bare bases within the EAF system takes advantage of a degree of flexibility and enhanced capability not previously accomodated. That flexibility/capability should be expanded by pursuit of program which will provide the ability to bring the bare bases to an operational state at an accelerated rate.

Lastly, there is a requirement to seek out the state-of-the-art technology which will lead to improved matting, arresting gear, and lighting systems.

APPENDIX


FM 9-13, Ammunition Handbook

FM 10-69, Petroleum Supply Point Equipment and Operations, Headquarters, Department of the Army, Washington, D.C.; October 1977

FM 10-20, Organizational Maintenance Military Petroleum Pipelines Tanks and Related Equipments, Headquarters, Department of the Army, Washington, D.C.; May 1974

FM 10-107, Petroleum Pipeline and Terminal Operating Company, Headquarters, Department of the Army; April 1981

FM 10-207, Petroleum Supply Company, Headquarters, Department of the Army, Washington, D.C.; September 1979

TM-38-35-15/1, U.S. Marine Corps Technical Manual, Installation, Operation and Maintenance Amphibious Assault Fuel Systems (AAFS) and Tactical Air-field Fuel Dispensing System (TAFDS), Headquarters, U.S. Marine Corps, Washington, D.C.; October 1980

LFM 01, Doctrine for Amphibious Operations

LFM 02, Doctrine for Landing Forces

FMFM 03, Doctrinal Publications Guide

FM 5-100, Engineer Field Data

FMFM 5-7, Marine Aviation

FMFM 4-1, Combat Service Support for Marine Air-Ground Task Forces

FMFM 4-4, Engineer Operations

FM 5-34, Engineer Field Data

FM 5-20, Camouflage, Field Fortifications, and Organization of the Ground

FM 5-100, Combat Engineer Operations

FM 30-102, Opposing Forces Europe

FM 30-40, Handbook of Soviet Ground Forces

FM 90-14, Rear Area Combat Operations

FM 100-10, Combat Service Support

FM 101-1, Staff Officers Field Manual, Organizational, Technical and Logistic Data

TM 5-301/5-303, Army Engineer Functional Component Table and Drawings

AF Regulation 125-37, USAF Resource Protection Program

AF Regulation 207-11, Application of Ground Sensors to Physical Security and Air Base Defense

U.S. Air Force Manual 3-2, Tactical Bare Base Operating Manual

Tables of Manpower Requirements (T/O) Effective List, Headquarters, U.S. Marine Corps, Washington, D.C.; November 1983

N Series Table of Equipment (T/E), U.S. Marine Corps Fleet Marine Force Organizations, Headquarters, U.S. Marine Corps, Washington, D.C.; August 1983

JCS Pub 1, Department of Defense Dictionary of Military and Associated Terms

NAVFAC P-315, Naval Construction Force Manual

NAVFAC P-80, Facility Planning Criteria for Navy and Marine Corps Installations

NAVFAC P-405, Seabee Planners and Estimator's Handbook

NAVAIR 51-5EAA-2, Handbook, M-21 Expeditionary Aircraft Recovery System

NAVAIR 51-40ABA-14, Technical Manual, Portable Shore-based FRESNEL Lens Optical Landing System MK 8 Mod 0

NAVAIR 51-60A-1, Technical Manual, AM-2 Airfield Landing Mat and Accessories

NAVAIR 51-40ABA-7, Technical Manual, Lighting and Marking System for Expeditionary Airfields

NAVAIR 51-5A-3, Technical Manual, LEA-20 Lightweight Earth Anchor and Anchor Installation Tool Kit

NAVAIR 00-80R-14, NATOPS, U.S. Navy Aircraft Firefighting and Rescue Manual

NAVAIR 51-35-7, Technical Manual, Logistics Data Initial Staging Area to Field Installation Expeditionary Airfield, Naval Air Systems Command; June 1973

Technical Report SL-83-1, "Field Artillery Emplacements Development and Weapons Effects Evaluation," U.S. Army Engineer Waterways Experiment Station, Vickiburg, Mississippi; Masrch 1983

Technical Note N-1514, "EARTHWORK Construction In Support of A Marine Amphibious Force - A Case Study," Civil Engineering Laboratory, Port Hueneme, CA; January 1978

"Naval Construction Force Requirements In Support of a Marine Amphibious Force In an Amphibious Objective Area," Naval Facilities Engineering Command, Washington, D.C.; December 1981

Technical Memorandum, "Packaging of AAFS and TAFDS Fuel Equipment for Improved Storage and Logistics," Civil Engineering Laboratories, Port Hueneme, CA; November 1980

Final Report (Phase I) NAVY/Marine Corps Engineer and Construction Operations (1980-85), Volume III, Annexes C and D, Marine Corps Development and Education Command, Quantico, VA; August 1979

"Acquisition, Storage and Handling of Advanced Multipurpose Surfacing System (AMSS) Materials," Naval Civil Engineering Laboratory, Port Hueneme, CA; December 1981

"Marine Corps Program Quarterly Report," Naval Civil Engineering Laboratory, Port Hueneme, CA, First Quarter, FY 84

"Field Logistics System Status Report," Headquarters, U.S. Marine Corps (Code LME), Washington, D.C.; December 1983

Technical Memorandum M-53-83-01, "Simulated V/STOL-B Exhaust Blast Tests of Heat Resistant Pavement Material", Naval Civil Engineering Laboratories, Port Hueneme, CA; March 1983

Final Report, "Design and Installation of the Expeditionary Airfield," C.G. Force Troops, Pacific, Marine Corps Air Ground Combat Training Center, Marine Corps Base, Twenty-Nine Palms, CA; December 1976

Technical Note N-1660, "Development of High-Capacity Expedient Anchors for Shoreside Military Application," Naval Civil Engineering Laboratory, Port Hueneme, CA; March 1983

Technical Report, "Lime Stabilized Native Soil As A Base For Light Aircraft Pavement," U.S. Department of Transportation, FAA, Washington, D.C.; April 1981

Technical Report 79-28, "Utilization of Sewage Sludge For Terrain Stabilization In Cold Regions," U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Hanover, NH; August 1979

Technical Memorandum 53-79-6, "Fiberglass Reinforced Plastic Surfacing For Rapid Runway Repair," Naval Civil Engineering Laboratory, Port Hueneme, CA; April 1979

Technical Note, N-1676, "Plastic Composite Panel and Grid-Reinforced Soil Repair Method for Bomb Damaged Airfield Pavements," Naval Civil Engineering Laboratory, Port Hueneme, CA; August 1983.

Final Report ESL-TR-83-10, "Preliminary FRP Optimization Tests," Air Force Engineering and Services Laboratory, Air Force Engineering and Services Center, Tyndall AFB, FL; December 1983

Technical Note N-1553, "Multipurpose Expedient Paving System (MEPS) For Expeditionary Airfields - An Interim Report," Naval Civil Engineering Laboratory, Port Hueneme, CA; April 1979

Technical Note N-1578, "Fiberglass-Reinforced Rigid Polyurethane Expedient Pavement Subject To Simulated F-4 Aircraft Traffic," Naval Civil Engineering Laboratory, Port Hueneme, CA; May 1980

Final Report SA-85R-77, "Evaluation of the Advanced Multipurpose Surfacing System With the AV-8A Aircraft," Naval Air Test Center, Patuxent River, MD; November 1977

NAVSEA OP-5/1 Series, Ammunition and Explosives Ashore, Advanced Bases, Naval Sea Systems Command, Washington, DC

U.S. Marine Corps Mid-Range Objectives Plan for FY 1984-1993 (MMROP FY 84-93)(U), Headquarters, U.S. Marine Corps, Washington, DC; 29 April 1983

Marine Corps Mid-Range Threat Scenarios and Target List Studies (Phase II)(V), Headquarters, U.S. Marine Corps, Washington, DC; August 1981

OPNAV Note S8000, U.S. Navy (including Marine Corps) Non-Nuclear Ordnance Requirements (U), Volume II Air-to-Surface Ordnance, POM Update; Navy Department, Washington, DC; January 1982

"Guidances for Employment of the Transmitting Sub-aircraft Approach Control AN/TPN-30 Marine Remote Area Approach and Landing System (MRAALS), CG, Marine Corps Development and Education Command, Quantico, VA; June 1983

Technical Report 2328TR, "Bomb Crater Pavement Repair Test at NALF, Crows Landing," Naval Civil Engineering Laboratory, Port Hueneme, CA; July 1982

"JANE'S WEAPON SYSTEMS, 1982-83, Thirteenth Edition, Jane's Publishing Company, London, England

Woodward and Clyde Consultants, "Soil Stabilization for Expeditionary Airfields," prepared for Naval Air Engineering Center, Lakehurst, NJ; May 1982

Subcommittee Report, "Airfield Damage Repair," Joint Services Civil Engineering Research and Development Coordinating Group (JSCERDCG), Washington, DC; September 1983

Technical Memorandum 53-79-3, "Test Plan For Traffic Testing of An Expedient Airfield Pavement and A Rapid Runway Repair Concept," Naval Civil Engineering Laboratory, Port Hueneme, CA; February 1977

"Final Report of Phase I and Phase II, Expeditionary Airfield System Maintenance, Engineering and Supply Support Analysis," CACI, Inc.-Federal, Arlington, VA; April 1983

"Final Report on the Development of a Ten Year EAF System Project Profile," CACI, Inc.-Federal, Arlington, VA; December 1983

"Expeditionary Airfield Configuration Manual," Naval Air Systems Command, Washington, D.C.; January 1983

"Commodity Plans for Expeditionary Airfields," Naval Air Engineering Center, Lakehurst, NJ; June 1983

Marine Corps Capabilities Plan (V), Headquarters, U.S. Marine Corps, Washington, DC; March 1982

Maritime Prepositioning Operational Concept (W), Headquarters, U.S. Marine Corps, Washington, DC; May 1982

Final Report, "Rear Area Coordination Security and Defense (U)," prepared for CMC, HQMC by Stanford Research Institute, Palo Alto, CA; March 1970

CNO Memorandum Ser. 508F/C402099, Subj: Mobilization Aircraft Planning Data (U), Washington, DC; 9 September 1981

NAVAIR Notice C10340, Subj: U.S. Navy Aviation Fuel Consumption Factors (U); June 1983

Center for Naval Analysis Memorandum 83-3197/7 for Deputy Chief of Staff for Aviation, HQMC, Washington, DC; Subj: Estimate of Aviation Ammunition Class V(A); December 1983

Center for Naval Analysis Memorandum 84-3020/23 for Deputy Chief of Staff for Aviation, HQMC, Washington DC; Subj: Request for Ordnance Supply Data (U); January 1984

"Chemical Stabilization of Subgrade Soil for the Strategic Expeditionary Landing Field," Georgia Institute of Technology, School of Civil Engineering, Atlanta, Georgia, 30332; June 1983

Technical Note, N-1585, "Capability of Existing 6-Inch Bulk Fuel Delivery Systems to Transfer Fuel From Tankers 10,000 FT Offshore." Naval Civil Engineering Laboratory, Port Hueneme, California; August 1980

Technical Note, N-1582, "Influence of Overland Transfer Hose Size/ Number and Pump Set Choices on MARCORS Amphibious Assault Fuel Systems;" Naval Civil Engineering Laboratory, Port Hueneme, California; July 1980

END
DTIC
5-86