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This report documents the lessons learned based on a review of the acquisition management practices used on the MLRS project. The report concentrates on the areas of competition and acceleration of the acquisition process. The study focuses on the success of the MLRS project in coping with problems and issues in the areas of technology, risks, business management, doubling, configuration management, test and evaluation, and international cooperation to include technology transfer.

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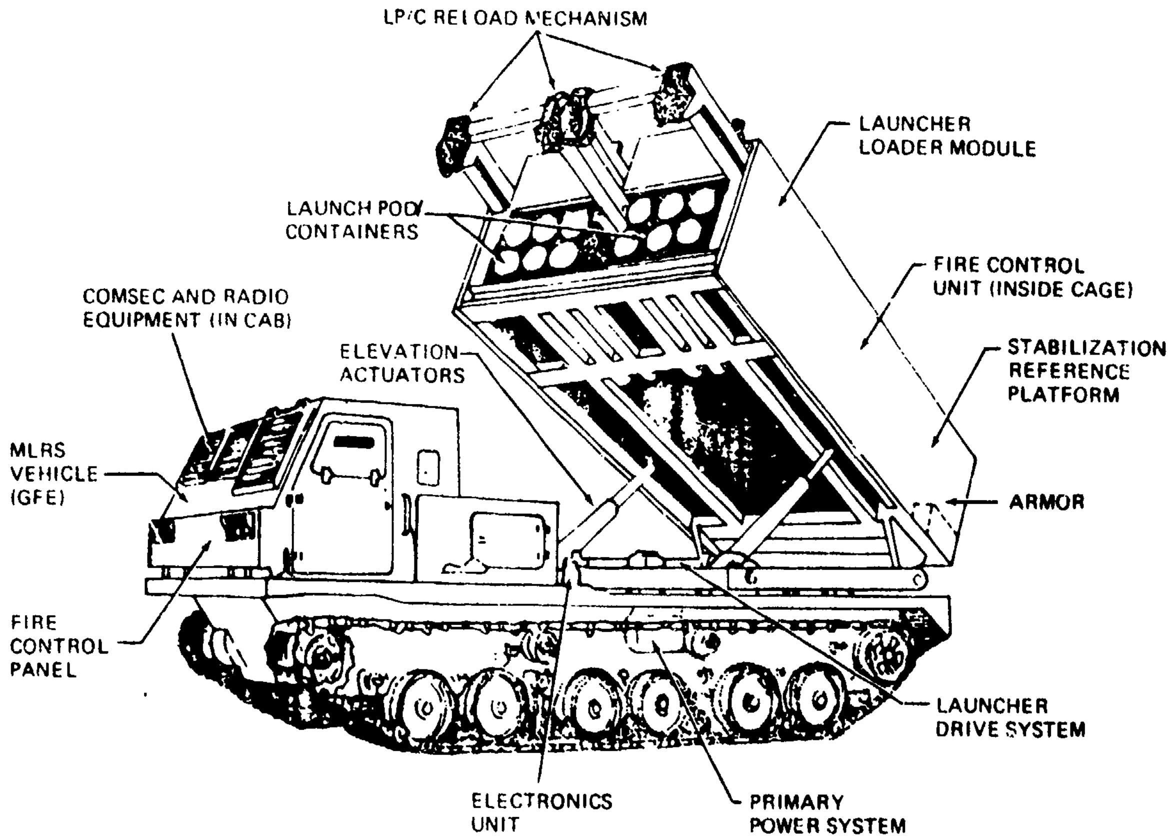

THE MULTIPLE LAUNCH ROCKET SYSTEM

FOREWORD

One of the factors in the successful management of any defense systems acquisition project/program might well be the application of lessons learned from previous projects. The best sources for lessons learned are generally the personnel from the material development commands, project management offices, contractors, and supporting service organizations. The team that prepared this report on the Multiple Launch Rocket System spoke with the personnel from these sources and recorded their observations and summarized the lessons learned for consideration by both present and future defense systems acquisition project/program managers and their staffs. The team realizes that, to be effective, the lessons learned must be well written, available to those who have a need to know, and applied on present or future projects/programs. Therefore, it is the hope of this team that its efforts, and the experience gained on the MLRS project, will be helpful to future defense systems acquisition project teams. If these teams learn from the things done correctly on the MLRS Project, and avoid the mistakes that have been made, the preparation of this report will have served a useful purpose.

The members of the team responsible for the preparation of this report are:

LTC Garcia E. Morrow, USA, DSMC Project Team Leader

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The team is grateful to the MLRS Project Manager, Colonel Monte J. Hatchett; the Deputy Project Manager, Mr. Lawrence R. Seggel; and the other personnel on the project team, as well as to the many Army and contractor

personnel, who provided the information and insights required to make this report of lessons learned possible.

It should be noted that this project was initially called the General Support Rocket System (GSRS) to identify its US Army mission. However, in November 1979, after the signing of the Memorandum of Understanding by the four participating nations, the project name was changed to the Multiple Launch Rocket System (MLRS), a generic title that eliminates its identification with a specific support mission. For the purposes of this study, the project will be referred to throughout as MLRS, except in the discussion of its history (Appendix B).

The information and data contained herein are based upon the input available up to the time of its preparation in July 1980. This report represents the observations of the study team and the government and industry program/project management teams associated with MLRS. The report should not be construed to represent the official position of the Defense Systems Management College, the US Army, or the MLRS Project Office.

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FIGURES

FIGURES (CONT'D)

EXECUTIVE SUMMARY

A. BACKGROUND. This report was prepared in response to an original request from the Assistant Secretary of the Army (Research, Development, and Acquisition). The Deputy Chief of Staff for Research, Development, and Acquisition, through the Chief, Policy, Plans, and Management Division, tasked the Defense Systems Management College to document the lessons learned during the acquisition of the Multiple Launch Rocket System (MLRS) under development by the US Army Missile Command at Redstone Arsenal, Huntsville, Alabama. The lessons were to cover the period from initial conception of the system to initiation of the Maturation/Initial Production Phase.

B. PURPOSE. The purpose of this study was to document the lessons learned based on a review of the acquisition management practices used on the MLRS project. For the most part, the study team concentrated on those areas which were impacted by the use of competition and acceleration of the acquisition process. The study focuses on the success of the MLRS project in coping with problems and issues in such areas as basic technology, technical risks, business management, doubling (formerly known as concurrency), configuration management, test and evaluation, technology transfer, and international cooperation.

C. FINDINGS AND PRESENTATION.

1. The MLRS project has demonstrated that the Army can achieve system acquisition performance, cost, and schedule goals on an accelerated multinational project. The study team identified five basic factors which have contributed to the success of the MLRS project to date.

- o Close adherence to the policies established by the Office of the Secretary of Defense in the 5000. - Series of directives and instructions.

- Good concept definition and statement of user requirements
- Innovative planning and effective management of the competition
- Continuing Army support of the MLRS project because of the universal recognition of the need for the system
- Continuity of key civilian personnel

2. The review of the acquisition management practices used on the Army MLRS project revealed that numerous lessons could be learned in such areas as acquisition strategy, business and technical management, integrated logistics support, and multinational project management. The following is a synopsis of the principal lessons learned contained in the report.

- Contractor innovation in system design can be achieved by providing basic concepts and objectives of the weapon system rather than detailed specifications
- Established rank-ordered source selection criteria should be included in the Request for Proposal. Models used to evaluate these criteria should also be provided the contractors
- The risks incurred by using Government Furnished Equipment must be weighed against potential cost, schedule, and performance benefits
- System Design-to-Unit-Production-Cost goals should be consistant with the Reliability and Maintainability goals
- Project cost and schedule goals are more likely to be realized when changes to user requirements are minimized
- Increased emphasis must be placed on Configuration Management during an accelerated project
- The Configuration Control Board for a multinational program should include members from each participating nation
- Emphasis should be placed on keeping all staff levels informed of the unusual nature of system test and evaluation during an accelerated project
- Project managers, who are developing systems requiring additional support facilities, should be cognizant of the five-year planning cycle for NATO programs and/or the military construction funding cycle

- There is a definite need to "institutionalize" the methods and procedures for establishing and administering multinational programs

- It is imperative that Memorandums of Understanding translations be prepared by highly qualified professional/technical translators familiar with the jargon of defense agencies

D. CLOSING REMARKS. The MLRS Study Team recognizes that there are numerous challenges to be faced throughout the remainder of this project. Issues such as procurement quantities, second source strategy, integrated logistics support management, and system costs should be examined after DSARC IIIa in order to complete the history of lessons learned from the MLRS project.

I. INTRODUCTION

A. Genesis of the Multiple Launch Rocket System (MLRS) Project. An analysis of the massive Warsaw Pact forces arrayed against the NATO forces in Europe indicates a critical need for an additional highly responsive field artillery weapons system capable of delivering a heavy volume of counter-fire in a very short time. The requirement is most urgent during "surge" periods, when targets appear in such numbers that they threaten to overwhelm the capacity of conventional tube artillery units to attack them.[1]

B. System Description.

1. General. The MLRS, a multiple launch rocket system, is designed to supplement cannon weapons available to US division and corps commanders for the delivery of a large volume of fire power in a very short time against critical, time-sensitive targets. Three different types of rocket warheads are in development. The dual-purpose improved conventional submunition warhead will provide an all-weather, indirect fire capability to attack the enemy's indirect fire weapons, air defense systems, and light material and personnel targets. The scatterable-mine warhead will provide a capability to delay, impede, and assist in the destruction of the enemy's massive armored maneuver force, especially at ranges beyond the delivery capabilities of cannon artillery. The anti-armor terminal guided warhead will provide for an additional capability to attack and destroy armored targets through the delivery of an effective point-hit armor defeating round. Other warheads such as smoke and binary chemical, may be explored for use with this system.

2. Operational Concept. The operational concept envisions use of the "shoot and scoot" technique. The system is designed for quick reaction and

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1/ The Nunn-Barlett Report to the Committee on Armed Services, United States Senate, "NATO and the New Soviet Threat," 24 January 1977; provides a discussion of the inadequacy of NATO fire power.

consists of a Self-Propelled Launcher Loader (SPLL), two disposable pods (each containing six rockets), a fire control system, and an azimuth and position-determining system. Rockets are loaded in the launch pods at the factory, shipped and stored in the pods, and fired from the pods (see Figure I-1). Fuze settings are accomplished automatically by the fire control system. The carrier is a derivative of the Infantry Fighting Vehicle (IFV) and uses the same engine, transmission, and other mechanical systems. The body is unique to MLRS and includes a cab from which a three-man crew can perform all firing operations. The MLRS mission sequence is shown in Figure I-2.

3. Support.

a. The overall MLRS system has been designed with logistical support requirements as a primary consideration. A minimum number of support personnel will be required. The rockets will be shipped and stored as complete rounds in their own Launch Pod/Container (LP/C) with little maintenance required. The LP/Cs will be capable of outside storage during combat. Resupply vehicles, complete with on-board material handling equipment, will be organic to each fire unit.

b. The MLRS logistical requirements have been examined and initial results show that additional ammunition, transportation, and combat support units will be required. These requirements have been included in the Army's FY 82-86 Program Force. MLRS will have the advantage of requiring fewer personnel to move a specific amount of ammunition tonnage than conventional tube artillery requires.

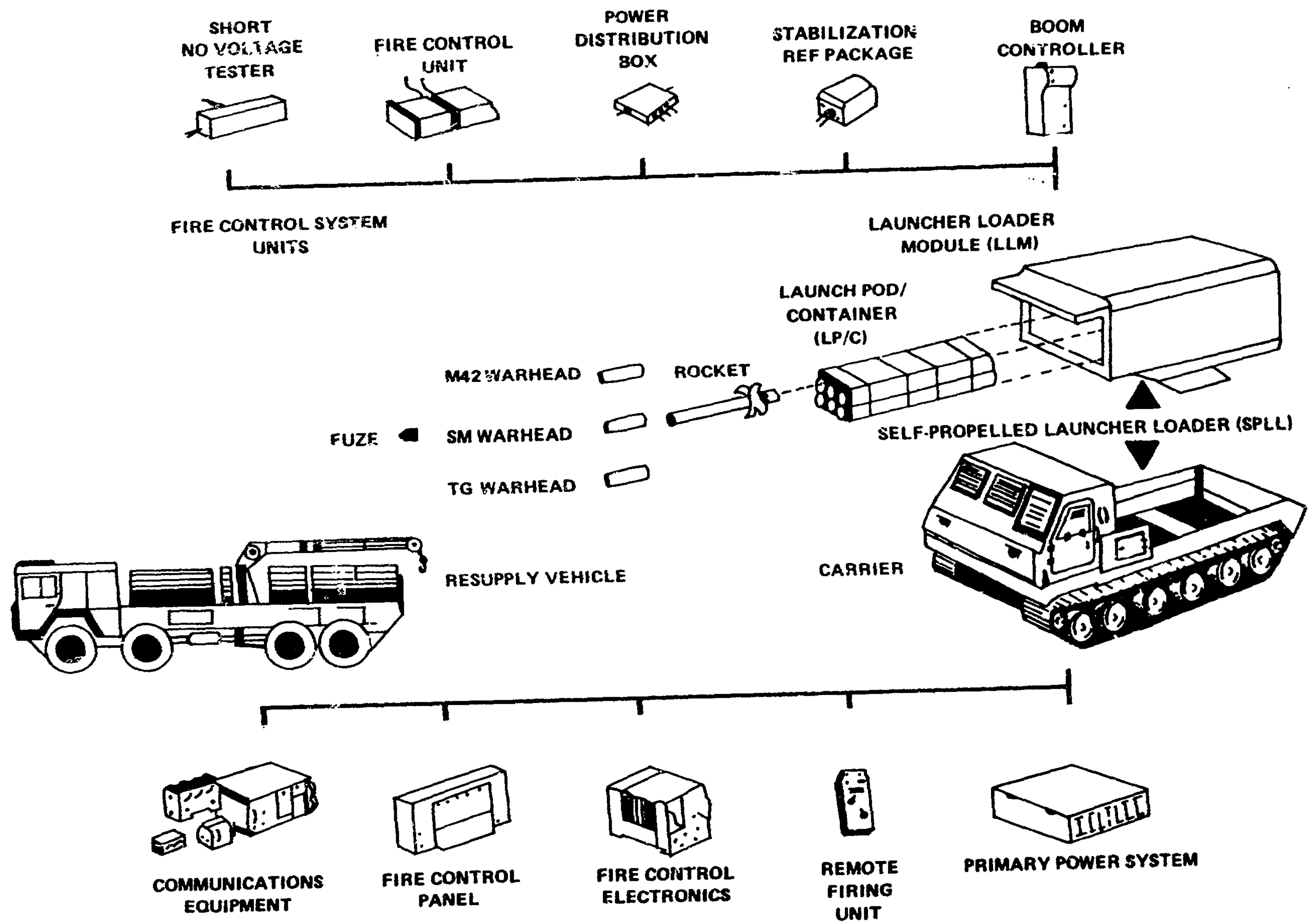

FIGURE I-1 MLRS SYSTEM COMPONENTS

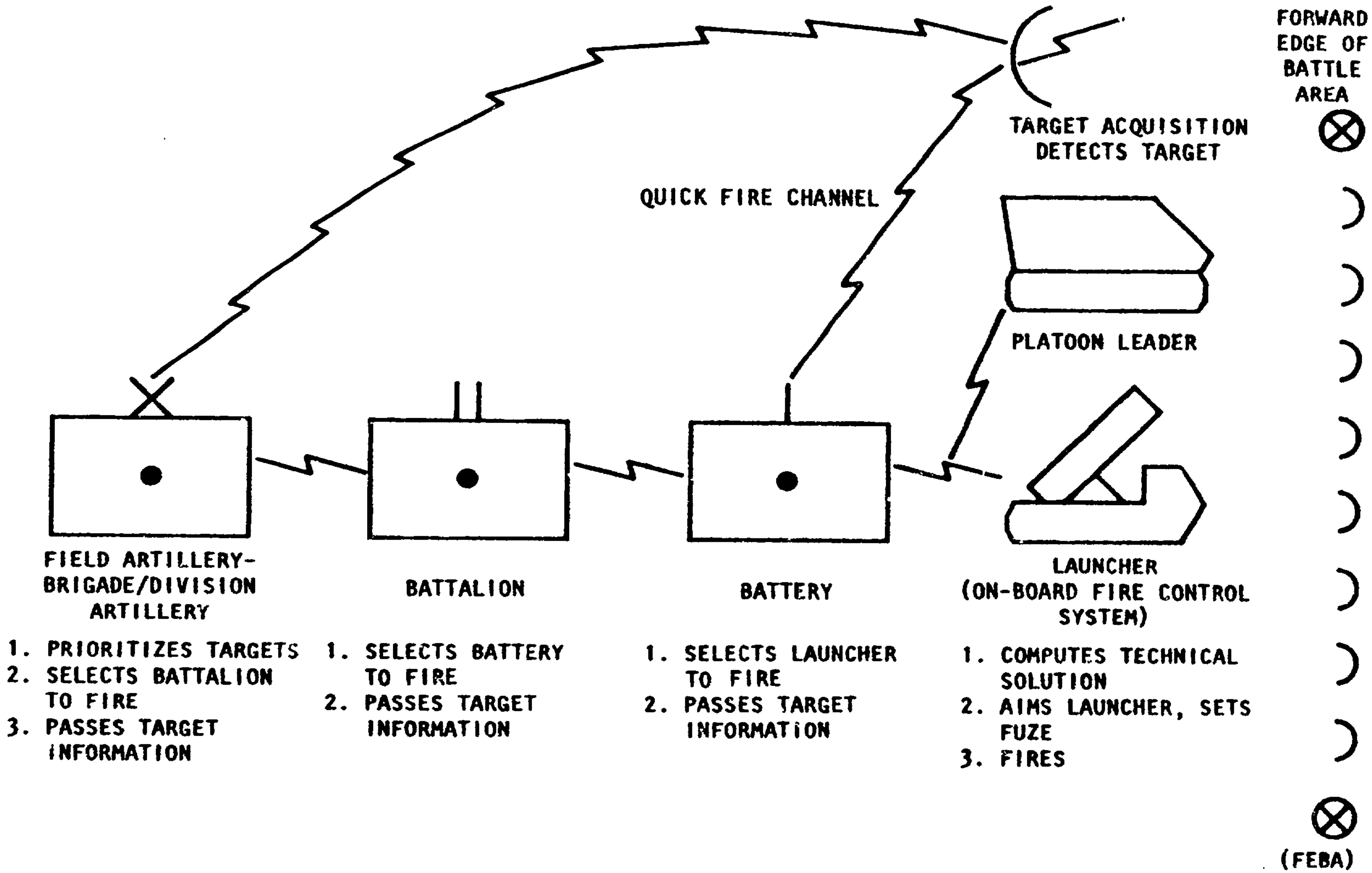

FIGURE I-2 MLRS MISSION SEQUENCE

II. PROJECT STRATEGY

A. Overall Plan

1. In a memorandum to the Secretary of the Army, dated 14 February 1977, the Secretary of Defense (SECDEF) authorized the Army to proceed with development of the MLRS with the M42 dual-purpose submunition warhead. The Secretary of Defense also directed the Army to continue to study ways to accelerate production and to give high priority to standardizing the weapon system, or to making it interoperable with the systems of key NATO allies. Figure II-1 outlines the instructions from the Secretary of Defense.

2. At a special ASARC on 1 April 1977, a program alternative was approved in response to the desire to accelerate the production program and establish an earlier IOC. This alternative was reviewed by representatives of the DSARC principals and was considered consistent with the direction contained in the 14 February 1977 memorandum. Staff representatives of the House and Senate Armed Services and Appropriations Committees were briefed on the alternative to ensure its consistency with Congressional views. The selected alternative provided for validation (advanced development) and options for full-scale engineering development, if required; or early production, if development risks were satisfactorily reduced during the Validation Phase.

3. Competition for the Validation Phase was initiated in September 1977 and two contractors (Boeing and Vought) were selected for the prototype development effort. Each contractor fabricated and tested three prototype launcher systems with associated flight test equipment and hardware. Upon completion of contractor and government Development Tests and an Operational Test (DT-I/OT I), four alternatives were available. These alternatives are shown in Figure II-2.

a. Alternative 1 - If the MLRS system and development hardware were sufficiently mature by the end of the Validation Phase, the program would

PROCEED WITH DEVELOPMENT OF BASIC SYSTEM

EVALUATE POTENTIAL TO DELIVER SCATTERABLE MINES

DEVELOP PLAN ON TERMINAL HOMING IN COMPLIANCE WITH CONGRESSIONAL GUIDANCE

STUDY WAYS TO ACCELERATE PRODUCTION

GIVE HIGH PRIORITY TO STANDARDIZATION/INTEROPERABILITY WITH NATO

FIGURE II-1 MILESTONE I SECRETARY OF DEFENSE DECISION MEMORANDUM, APRIL 1977

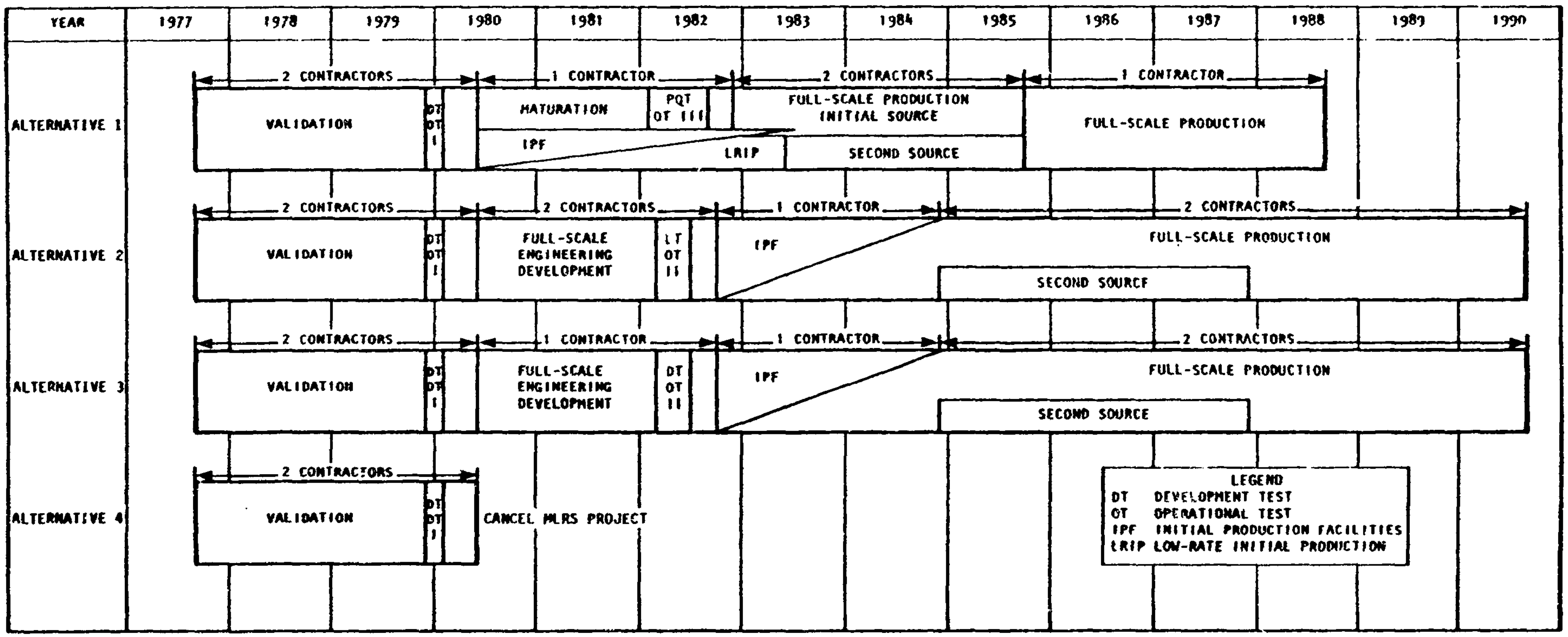

FIGURE II-2 DSARC III ALTERNATIVES FOR MLRS enter the Maturation/Initial Production Phase. The contractor for that phase would be selected from the two competing Validation Phase contractors by the source selection evaluation process.

b. Alternative 2 - If the Validation Phase testing demonstrated that the hardware and system design were not sufficiently mature to enter the Production Phase, this alternative would provide for entry into the Full-Scale Engineering Development Phase with both contractors.

c. Alternative 3 - This alternative maintained the same schedule as alternative 2, except that a single contractor would be selected from the two competitive Validation Phase contractors by the source selection evaluation process for entry into Full-Scale Engineering Development.

d. Alternative 4 - This alternative would cancel the MLRS project if it did not demonstrate potential to satisfy the operational requirement.

4. Alternative 1 offered the best approach because the hardware was proven to be mature and this method was the most economical. Further, it met both the DoD and Congressional objectives to reduce the time required to develop, produce, and deploy the system.

5. The Validation Phase test program was enhanced to ensure availability of test data to demonstrate that MLRS would meet the requirement for initial production as outlined in DoDD 5000.3, "Test and Evaluation".

6. All hardware scheduled for deployment will conform to the final production technical data package (TDP).

7. Figure II-3 reflects the major milestones. The customary Milestone II events are omitted because of the doubling (concurrency) during the Maturation and Initial Production Phase.

B. Acquisition Strategy

1. General. The acquisition strategy reflects the project manager's approach for accomplishing program goals. It includes the fundamental

MILESTONES	TARGET DATE
ASARC I MEETING	DEC 76
DSARC I MEETING	JAN 77
SPECIAL ASARC MEETING	APR 77
VALIDATION PHASE CONTRACT AWARDS	SEP 77
START DEVELOPMENT TESTS (DT) I	NOV 77
START OPERATIONAL TEST (OT) I	DEC 79
COMPLETE DT I/OT I	FEB 80
ASARC III MEETING	APR 80
DSARC III MEETING	MAY 80
MATURATION/INITIAL PRODUCTION PHASE CONTRACT AWARD	JUN 80
PRODUCTION QUALIFICATION TEST/OT III	SEP 82
ASARC IIIA MEETING	OCT 82
DSARC IIIA MEETING	NOV 82

FIGURE II-3 MLRS PROJECT BASELINE MILESTONE technical and business management techniques that will provide coherent integration of all aspects of program management. At any stage in the acquisition process, the strategy addresses the entire remaining life of the program; that is, the achievement of the program goals. The acquisition strategy is dynamic and tailored to the needs of the program. As the program progresses, the project manager reviews the strategy and either reaffirms or revises it.[1]

2. MLRS Acquisition Strategy. The MLRS acquisition strategy emphasizes competition, international cooperation, accelerated development, an intensive design-to-cost effort, and provisions for system growth potential.

a. Competition

(1) Formal source selection was held amidst the competition in 1977 to select two prime contractors for a competitive Validation Phase.

(2) Development and fabrication of prototypes and scored testing was accomplished between the two competing contractors to facilitate selection of a prime contractor for the Maturation/Initial Production Phase.

(3) A second source contractor will be chosen and qualified using the TDP while the prime contractor is producing the first four increments of rockets. The first buy from the second source will be a small "educational" quantity, and, if successful, it will be followed by the exercise of an option for a much larger quantity. An award will be made to each source (initial and second) for the FY 85 buy, based on cost considerations.

(4) In FY 86, a rocket buy will be awarded following a multiple-year buy-out competition. To satisfy US needs, this award is expected to be in excess of 200,000 rockets.

b. International cooperation. Under the provisions of the Memorandum of Understanding (MOU), the MLRS project is being conducted as a

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1/ "Guide for the Management of Joint Service Programs," DSMC, May 1980 cooperative development. The MOU provides for technology transfer of the production capability to the European partners in the project who are in the early stages of planning a European production consortium. This transfer may allow the European consortium to compete for some US production rockets once the consortium has been established and qualified. It should be noted that selection of a program alternative other than Alternative 1 (Maturation/ Initial Production) would have adversely affected the European partners, especially the United Kingdom, which is dependent on the early fielding date of the MLRS as a replacement for its 175mm gun. It was considered likely that the European partners would have either delayed their production plans or dismissed their plans entirely if Alternatives 2 or 3 had been chosen.

c. Accelerated Development. The acquisition strategy utilizes the flexibility allowed by DoDD 5000.1, "Major System Acquisitions," and Office of Management and Budget Circular A-109 "Major Systems Acquisition," to reduce the time required to develop and field a major weapon system. This is accomplished through the use of doubling between completion of the Validation Phase and the start of the full-scale production. In this case, doubling essentially eliminates the Full-Scale Engineering Development phase.

d. Cost-Effective Design. The MLRS project team has been committed to demonstrate a cost-effective design. To ensure this, design-to-cost principles, as outlined in DoDD 5000.28, "Design to Cost," have been an integral part of the MLRS development effort. Conceptual development was characterized by use of Cost and Operational Effectiveness Analyses (COEA). During development, specific contractual Design-to-Unit-Production-Cost (DTUPC) goals were set for the rocket, launch-pod/container, and launcher loader. Design trade-off studies were performed by the contractors using Life Cycle Cost (LCC) as the measure of effectiveness.

e. Growth Potential of System. A modular approach was used in the system design. Thus the rocket launcher will be capable of delivering several different warheads, e.g., those containing scatterable mines, terminally-guided submunitions, binary munitions, smoke, etc. Also, the fire control system will be capable of handling several different software programs.

f. Figure II-4 depicts the MLRS Acquisition Strategy.

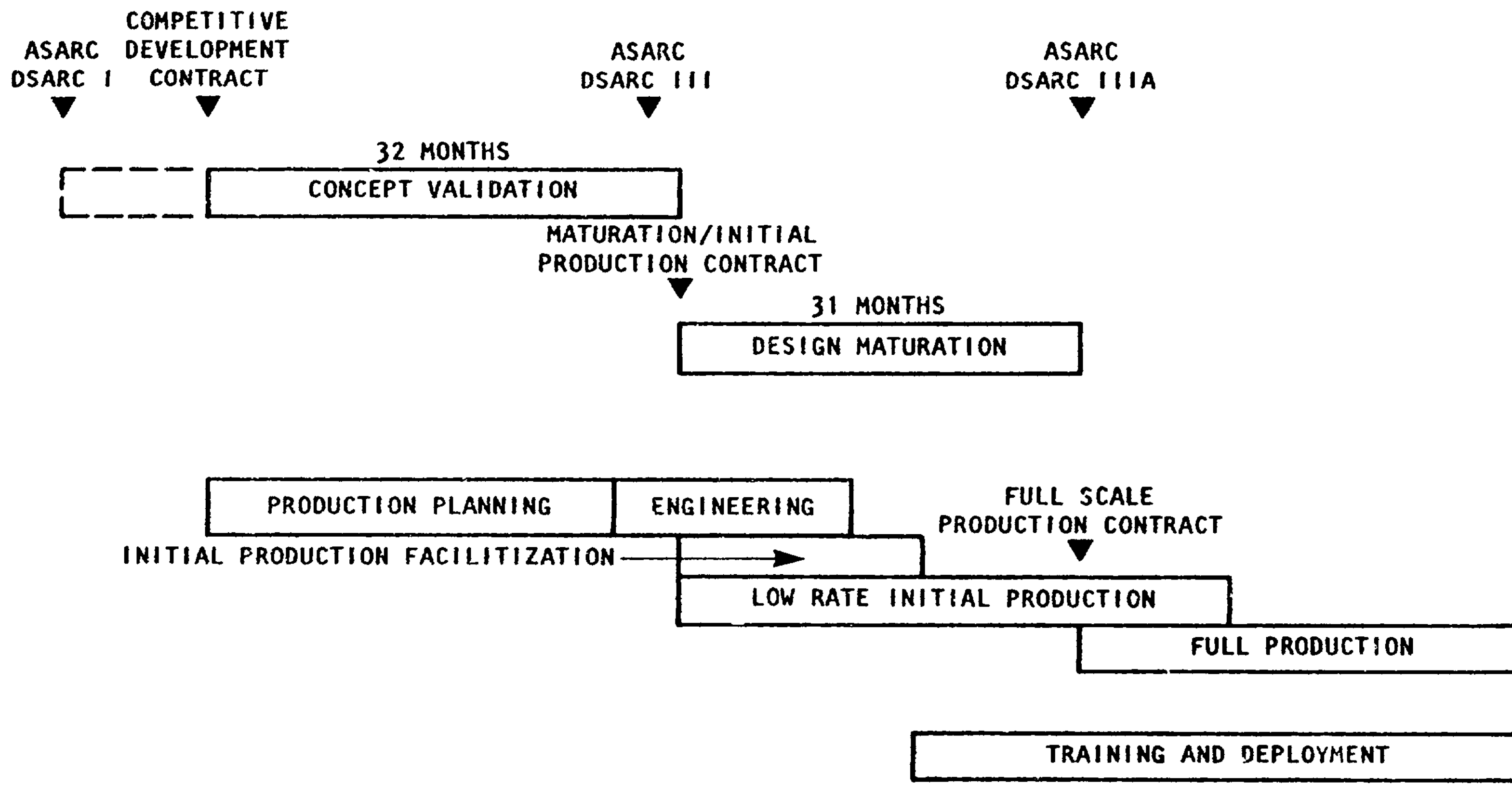

FIGURE II-4 MLRS ACQUISITION STRATEGY

III. PRINCIPAL LESSONS LEARNED

A. Introduction

This Chapter presents the principal lessons learned--up to June 30, 1980--from the study of the MLRS project. For background information and additional observations, the reader is referred to Appendices E thru K. Appendix E presents the observations of the members of government and contractor program/project teams associated with the MLRS project. Appendices F thru K present background information and the observations of the MLRS study team in the following areas of project management:

1. Business Management
2. Technical Management
3. Configuration Management and Technology Transfer
4. Test and Evaluation Management
5. Integrated Logistics Support Management
6. International Program Management

B. Principal Lessons Learned

1. Business Management

a. Competition

(1) Government cost and schedule goals for the MLRS are being achieved partially as a result of the competitive environment.

(2) The principal lessons learned from implementation of the MLRS acquisition strategy of fostering competition, include the following:

- Project management should establish rank-ordered source selection criteria that cover all major project objectives. These criteria should be included in the Request for Proposals (RFP) and should not be altered during the competitive phase(s) of a project.
- The contractors should be told the basic concepts and objectives of the weapon system rather than given detailed specifications. This approach encourages contractor innovation in system design.

- o In a competitive environment, the establishment of separate and discrete teams within the project management office to deal with each competing contractor decreases the potential for technology transfusion and improves coordination among the project management office, the contractors, and other government commands and agencies.

- o When ammunition cost-effectiveness is part of the source selection criteria, the government should provide each contractor with the simulation model that will be used to evaluate the ammunition cost-effectiveness of his system.

- o Government control of R&D cost in a competitive environment can be achieved if the competing contractors will agree to cost ceilings and to fund any excess costs they may generate during the competition. MLRS benefited from having two qualified contractors competing for the promise of a lucrative production contract for the winner.

b. Contracting and Source Selection

(1) The MLRS acquisition strategy included the use of contracts to separate the project efforts and phases.

(2) The principal lessons learned from the contract and source selection activities of the MLRS project, include the following:

- o Use of GFE, particularily in a competitive project, must be carefully weighed against the potential risks.

- o The merit of including award-fee provisions in a contract that contains DTUPC goals is questionable for either a competitive concept validation or engineering development (design maturation) contract.

- o The Source Selection Evaluation Board should be formed nine to twelve months prior to receipt of proposals to permit participation in the selection of the Source Selection Plan.

c. Cost Management

(1) The MLRS project team established a goal early in the project to design-to-cost. In an effort to achieve this commitment, an intensive DTUPC program was established and LCC trade-off analyses were performed by the contractors and the MLRS team.

(2) The principal lessons learned from the MLRS cost management effort include the following:

- o Reasonable DTUPC goals should be established as early in a project as possible and not later than go-ahead for full scale development.

- o Establishment of multiple DTUPC goals, that is, one for each of the major hardware elements of the system, may not be practicable when trade-offs among the elements have to be addressed.

2. Technical Management

a. The technical management approach of the MLRS project took into account the reasons for failures of earlier similar systems, innovation that might come from the competing contractors during the Concept Validation Phase, the use of state-of-the-art technology, and the use of GFE.

b. The principal lessons learned from the MLRS technical management approach include the following:

- o During the Concept Definition Phase, there should be a thorough analysis of the lessons learned from previous concepts and designs of similar systems.

- o Project cost and schedule goals are more likely to be maintained when changes to user requirements are minimized.

- o A continuing good rapport between the project manager and the TRADOC Systems Manager (TSM) tends to ensure less turbulence on the project.

3. Configuration Management and Technology Transfer

a. The need for disciplined and innovative Configuration Management (CM) procedures was recognized early in the project.

b. The principal lessons learned from the MLRS project configuration management and technology transfer activities include the following:

- o The establishment and vigorous adherence to CM procedures is essential to project success from a technical, cost, and schedule viewpoint, especially in an accelerated project.

- The assignment of at least one person to CM during the Concept Definition Phase is vital to the early success of a project.

- The establishment of carefully conceived support agreements and Interface Control Documents (ICD) between government agencies is essential to the attainment of project objectives.

- Government control to the TDP elements should be limited to the development specifications during concurrent development and production programs until establishment of the product baseline and acceptance of the first production item.

- The Configuration Control Board (CCB) for a multinational program should include members from each participating nation.

- The Memorandum of Understanding (MOU) with participating nations should specify US Project Office approval authority of Engineering Change Proposals/Request for Deviations/Request for Waivers on the TDP.

4. Test and Evaluation Management

a. The test and evaluation plan was tailored to the unique requirements of an accelerated project. The results provided reasonable assurance to the decision-makers that the MLRS project was ready to move into the Maturation/Initial Production Phase.

b. The principal lessons learned from the management of the MLRS test and evaluation activities include the following:

- The unique test and evaluation requirements of a competitive and accelerated project should be satisfied through the effective use of Test Integration Working Groups.

- In an accelerated project the importance of keeping all staff levels informed of the unusual nature of the system test and evaluation program should be emphasized.

5. Integrated Logistics Support Management

a. The MLRS Integrated Logistics Support Plan (ILSP) provides key logistics milestones for maintenance, training, manning, publications, and facilities. The accelerated acquisition schedule for MLRS, and the fact that it was primarily an "add-on" system, complicated the logistics support planning for fielding of the system.

b. The principal lessons learned from ILS management include the following:

- Deployment of "add-on" systems require support facilities not normally available in the using commands, e.g., barracks, maintenance areas, and ammunition storage areas. Project managers who are developing systems requiring these additional support facilities, should be cognizant of the five-year planning cycle for NATO programs and/or the military construction funding, as well as the long lead time required for the acquisition of real estate in foreign countries.

- Working groups should be established to enhance the information flow among user, technical and logistics personnel.

6. International Program Management

a. The MLRS project team was instructed by the SECDEF early in the acquisition cycle to give high priority to the establishment of MLRS as a multinational cooperative program. This was successfully accomplished and a four-nation MLRS MOU was negotiated.

b. The principal lessons learned from the MLRS project in the multinational arena include:

- There is a definite need to "institutionalize" the methods and procedures for establishing and administering multinational programs. The central role of the US government should not be overlooked in the development of such procedures.

- The possibilities for misunderstandings because of language differences and long lead time involved in obtaining Department of State approval of translations of MOUs has shown that it is imperative that the translations be prepared by highly qualified professional technical translators who are familiar with the jargon of defense agencies.

- Currently, all classified material being transferred to the European MLRS partners must be staffed through the Assistant Chief of Staff, Intelligence (ACSI). This procedure is time-consuming. A procedure, that permits expeditious transfer of project data to European partners on a need-to-know basis, is needed.

IV. CLOSING REMARKS

A. As of the date of preparation of this report (July 1980), the MLRS project had satisfied the Milestone III requirements and entered the Maturation/Initial Production Phase. The lessons learned to date evolved from a study of past events, actions, decisions, and guidance, as the project successfully advanced to completion of the Validation Phase. The MLRS study team recognizes that there are a number of challenges to be faced throughout the remainder of this project. The approaches taken to meet these challenges may result in the identification of new lessons learned. These challenges include:

1. Application of project strategies for the Maturation/Initial Production Phase.

2. Successful completion of design maturation prior to full-scale production.

3. Development and application of procedures for competition and selection of a second production source.

4. Procurement quantities authorized/funded and impact, if any, o. second source strategy and rocket production costs.

5. Project cost/management control.

6. Integrated logistics support management/deployment issues.

7. Availability of MLRS subsystems, supporting systems, and software for OT-III and IOC.

   a. Battery Computer System (BCS).

   b. Platoon Leader's Digital Message Device (PLDMD).

   c. TACFIRE.

   d. Artillery and Mortar-Locating Radars (FIREFINDER)

e. Heavy Expanded Mobility Tactical Truck (HEMTT) and Heavy Expanded Mobility Ammunition Trailer (HEMAT).

f. M42 Submunitions.

g. XM-455 Fuze.

h. Field Artillery Meteorological Acquisition System (FAMAS).

i. Electronics Quality Assurance Test Equipment (EQUATE).

8. OT-III.

9. ASARC/DSARC IIIa.

10. Congressional/DoD directions and redirections.

11. Application of the TDP in competition and in the multinational arena.

12. International program arena.

a. Schedule management.

b. FRG warhead development.

c. Contract management.

d. Financial management.

e. Production management.

f. Congressional/DoD directions.

13. The effect of IFV project schedule, cost, and performance on the MLRS project.

B. These and other issues that arise during the remainder of the project should be examined after DSARC IIIa in order to complete the history of lessons learned from the MLRS project.

APPENDIX A

PROJECT ORGANIZATION

The following MLRS organization charts are shown in this appendix.

1. Overall Organization for MLRS (Fig. A-1).

2. MLRS Project Office Organization at MICOM (Fig. A-2).

3. FVS Program Organization for MLRS (Fig A-3).

4. FMC Organization for MLRS (Fig. A-4).

5. US Army Armament Research and Development Command Organization for MLRS (Fig. A-5).

6. Harry Diamond Laboratories Organization for MLRS (Fig. A-6).

7. Vought Corporation Organization for MLRS (Fig. A-7).

8. Boeing Aerospace Company Organization for MLRS (Fig. A-8).

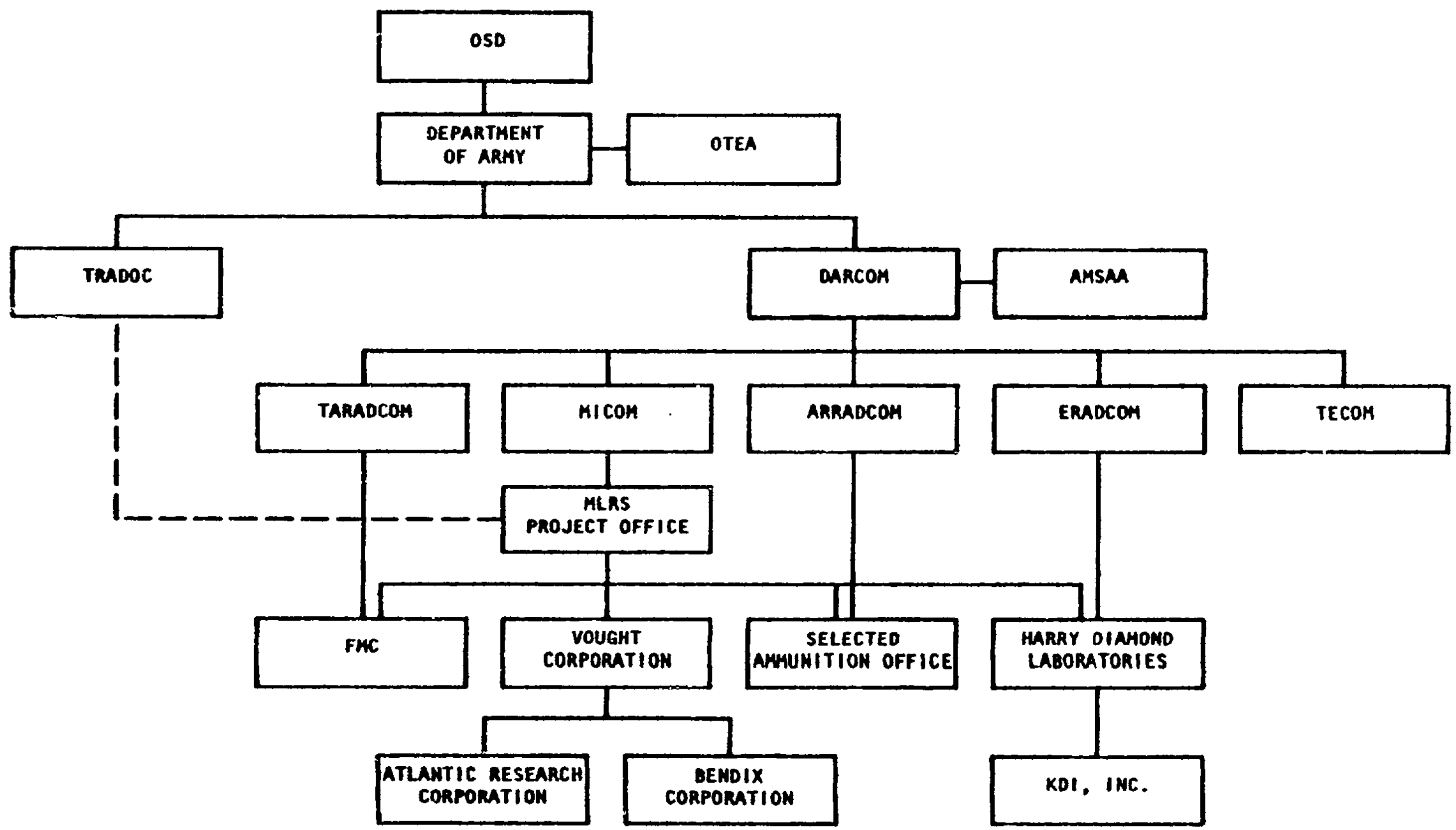

FIGURE A-1 OVERALL ORGANIZATION FOR MLRS

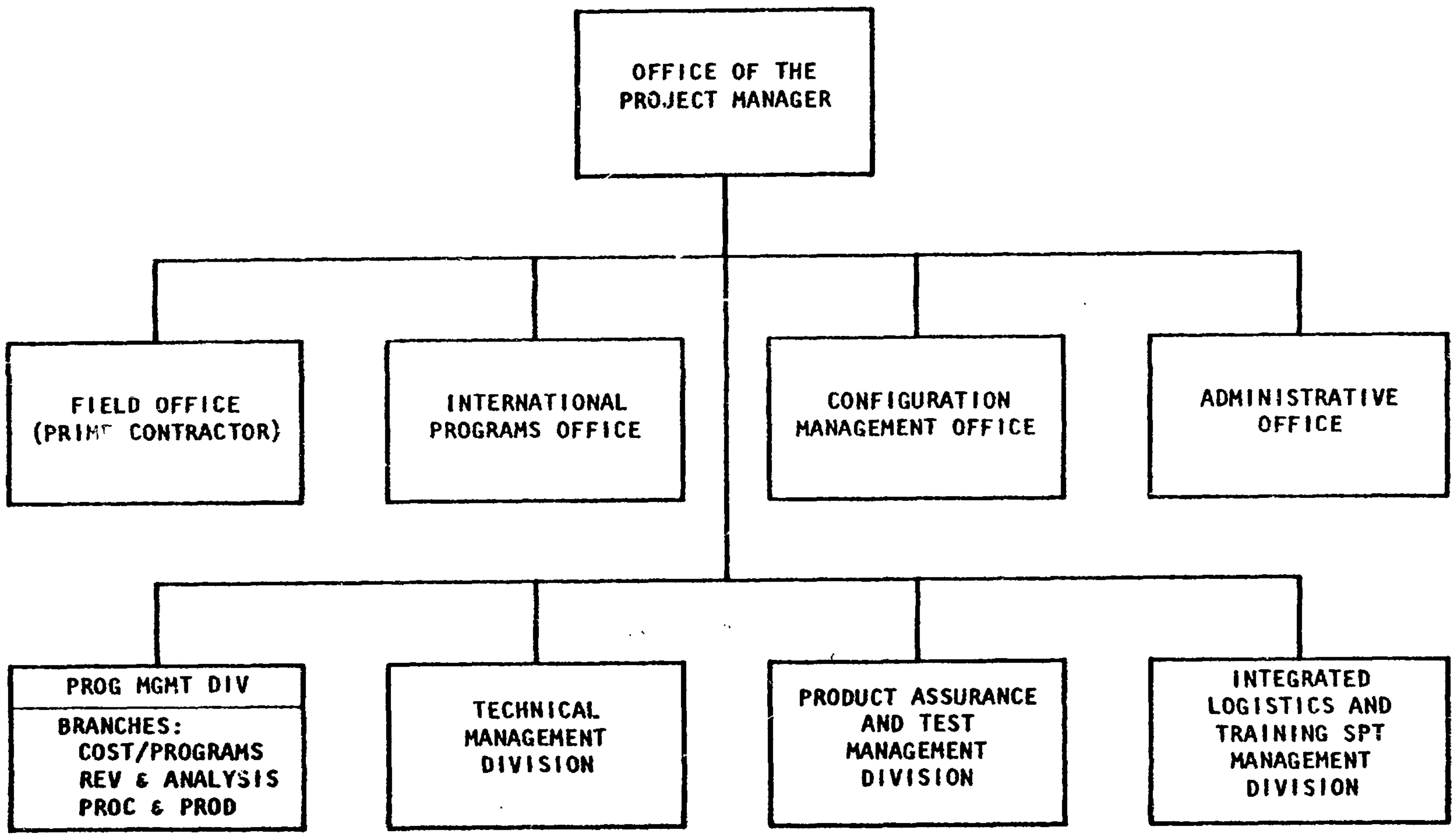

FIGURE A-2 MLRS PROJECT OFFICE ORGANIZATION AT MICOM

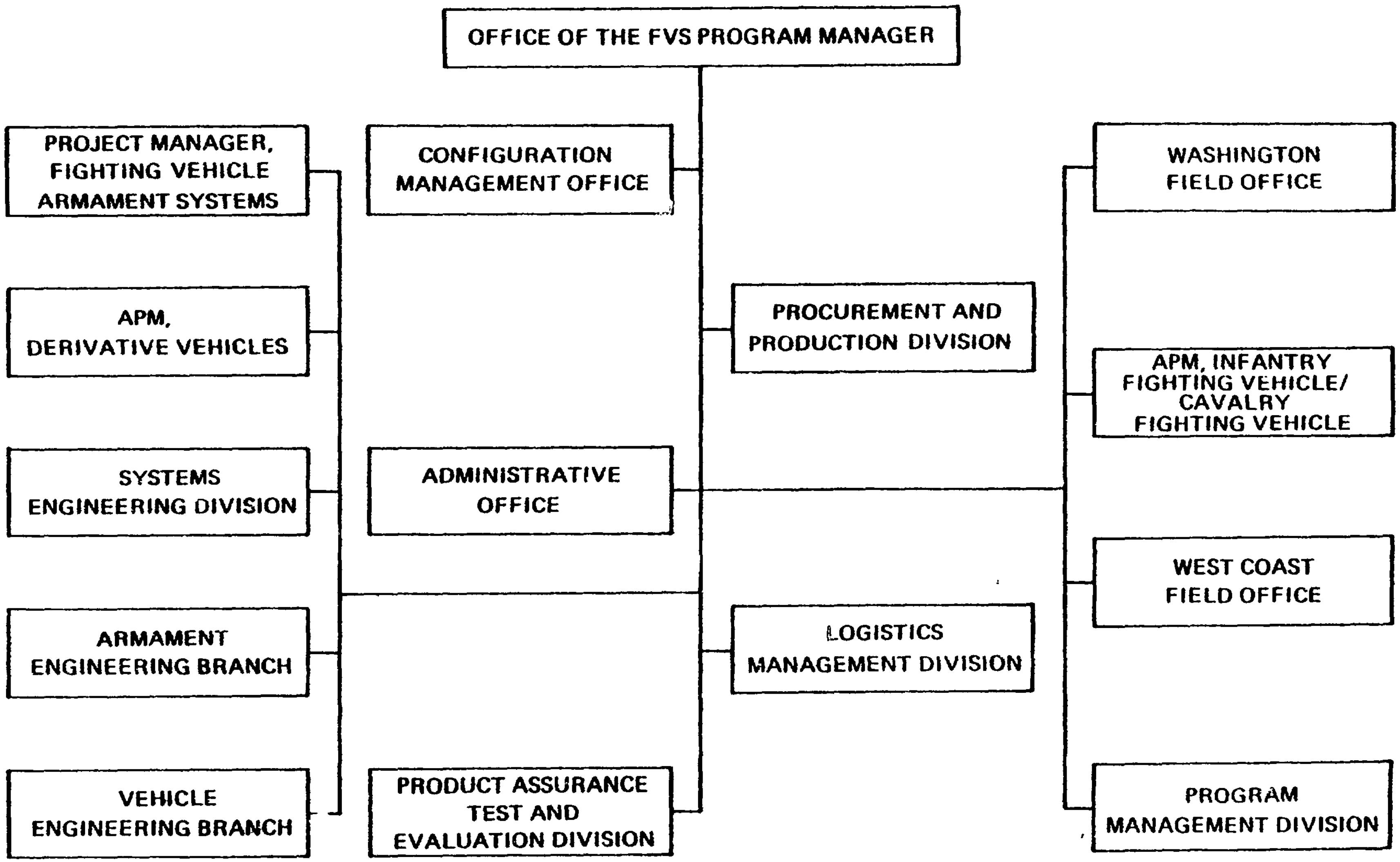

FIGURE A-3 FVS PROGRAM ORGANIZATION FOR MLRS

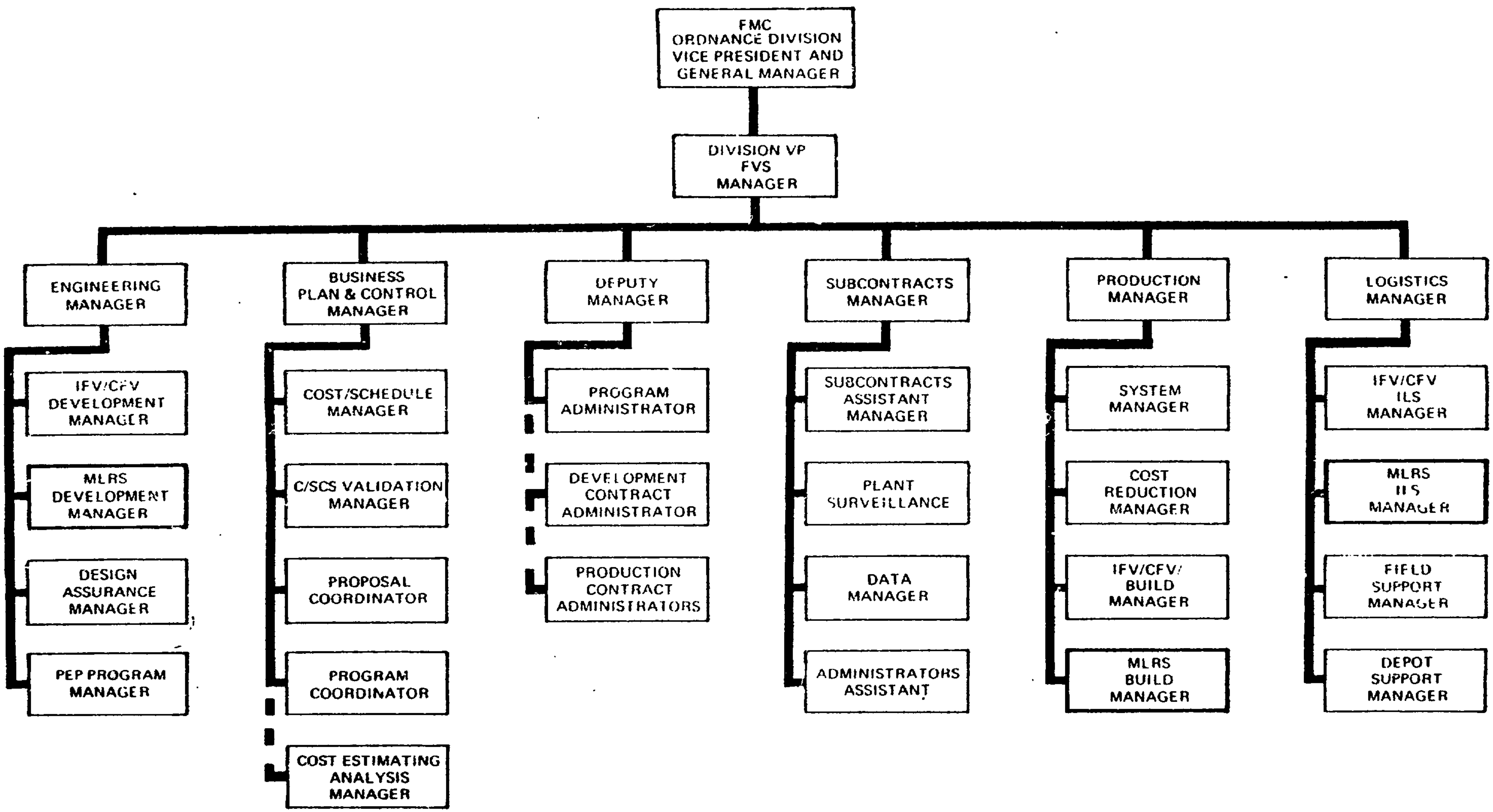

FIGURE A-4 FMC ORGANIZATION FOR MLRS

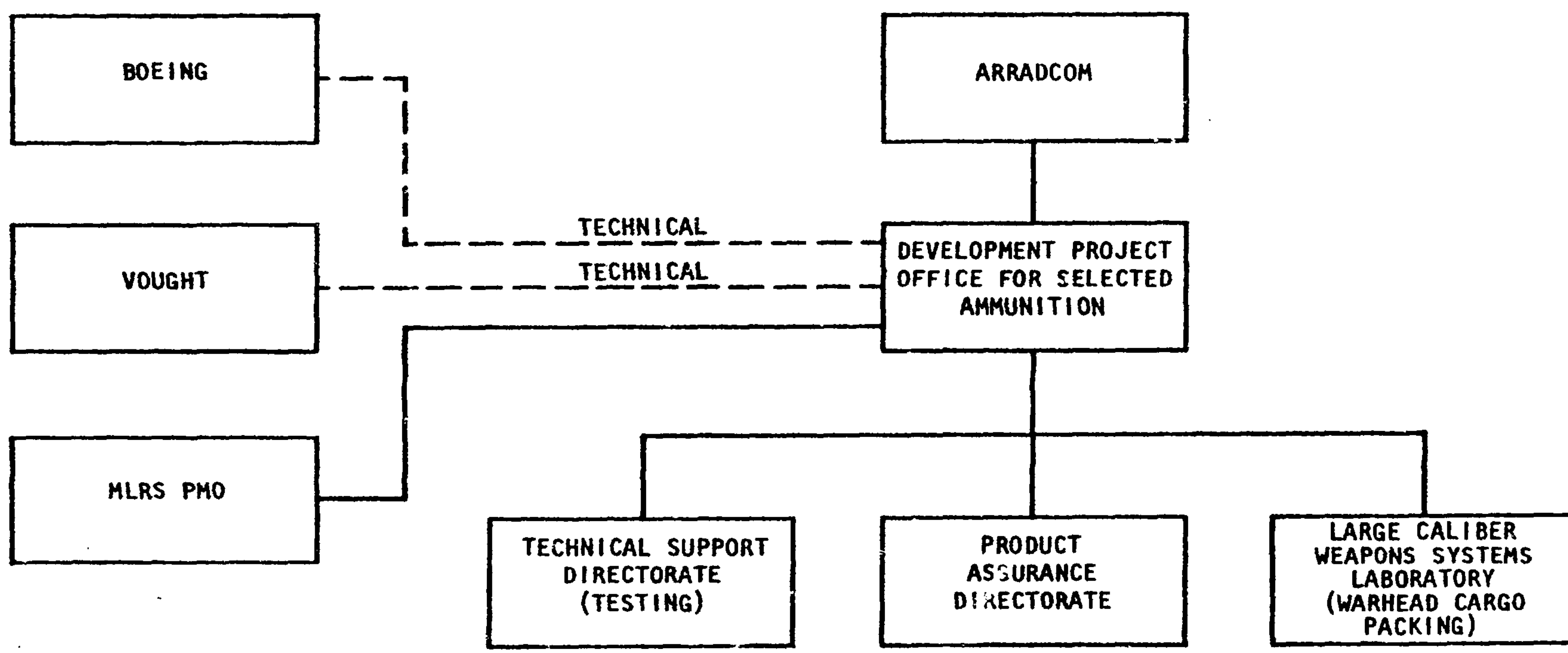

FIGURE A-5 US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND ORGANIZATION FOR MLRS

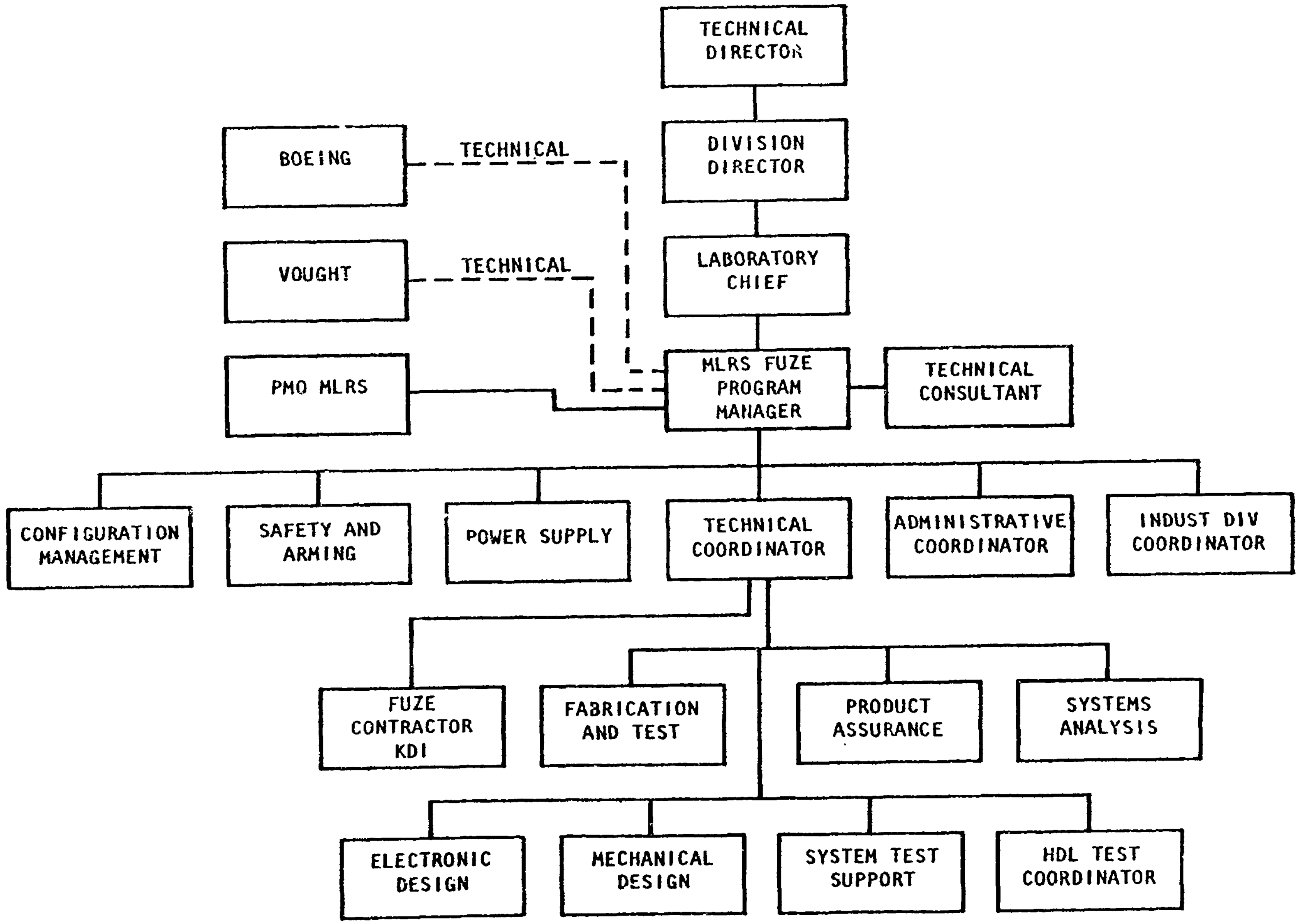

FIGURE A-6 HARRY DIAMOND LABORATORIES ORGANIZATION FOR MLRS

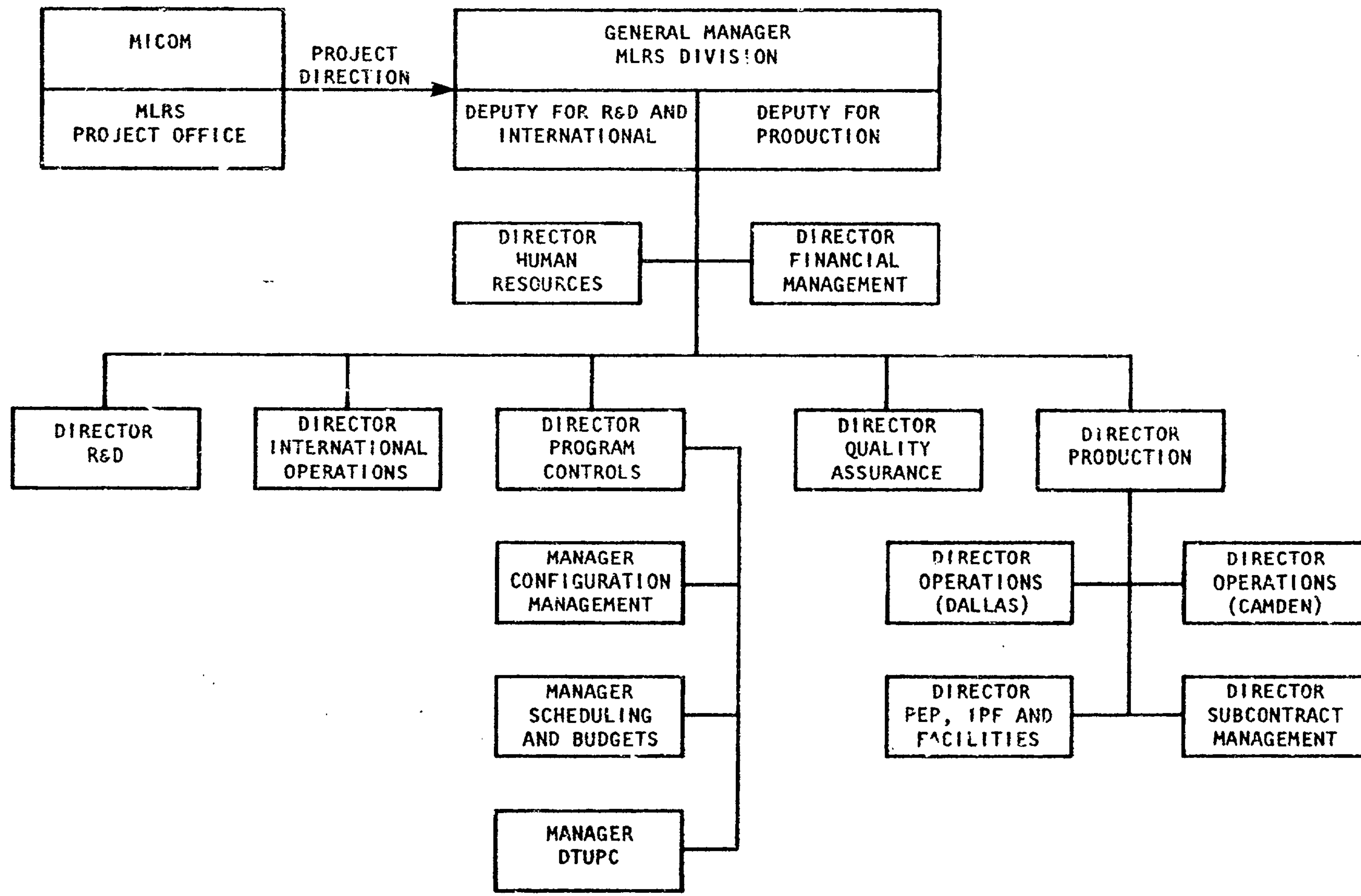

FIGURE A-7 VOUGHT CORPORATION ORGANIZATION FOR MLRS

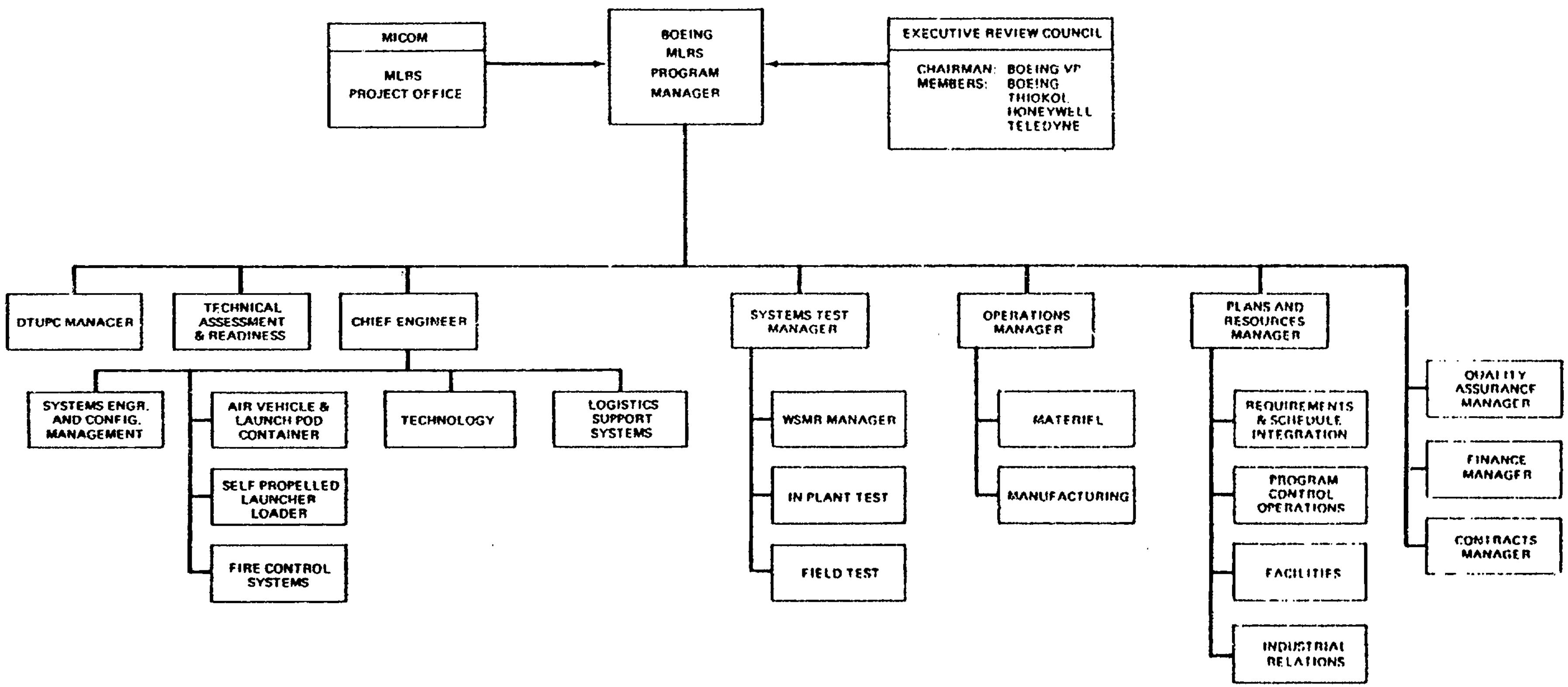

FIGURE A-8 BOEING AEROSPACE COMPANY ORGANIZATION FOR MLRS

APPENDIX B

HISTORY OF THE MLRS PROJECT

1. 1974 PRINCIPAL EVENTS

In February, a US Army Training and Doctrine Command (TRADOC) Joint Working Group was established to assess the need for a General Support Rocket System (GSRS) with a counter-fire mission. This working group accomplished the preliminary technical review and cost estimate.

2. 1975 PRINCIPAL EVENTS

a. In September, the Department of the Army (DA) approved a letter of agreement for a GSRS and directed the formation of a Special Study Group (SSG). The SSG mission was assigned to the US Army Field Artillery School.

b. In November, the SSG was established to define the GSRS characteristics and to conduct a concept definition study that included (COEA). The SSG study of possible GSRS concepts included a review of French and German technology.

3. 1976 PRINCIPAL EVENTS

a. Early on, the Army Missile Command (MICOM) was convinced of the need for a non-nuclear, saturation-type, multiple-launch, free-flight battlefield system as a supplement to cannon artillery. Therefore, during the first week of March, MICOM's Advanced Systems Concepts Office announced the award of five concept definition study contracts to industry--totaling $885,000--for concepts leading to the development of a simple, rugged, reliable, general support artillery rocket system.

b. The Concept Definition Phase contracts were awarded to Boeing Aerospace Company, Emerson Electric Company, Martin-Marietta Corporation, Northrup Corporation, and Vought Corporation. Each contractor was tasked to perform a four-month study and to outline technology approaches for developing the rocket system. Both life cycle and program cost estimates were to be included in their proposed approaches. The desirability of a low unit cost system was emphasized by MICOM.

c. On 14 July, the GSRS Project Office (Provisional) was established and Colonel Kenneth S. Heitzke was named the Project Manager Designee. Col. Heitzke had been acting in this capacity since 16 January 1976. From the start, the Project Manager Designee (who reported directly to the MICOM Commanding General) received full assistance of the MICOM functional organization staffs in carrying out the project mission. The mission of the Project Office (Provisional), as stated in the MICOM Permanent Orders, was to "coordinate all interim planning and assume direction and control of work and associated system resources in all phases of development, procurement, production, distribution, and logistical support involved in bringing the GSRS to its initial operational capability."

d. On 22 July, Lawrence R. Seggel, formerly of the Advanced Systems Concepts Office of MICOM, was appointed Deputy Project Manager. The personnel strength in the Project Office at that time was five.

e. In September, Col. Heitzke and Mr. Bobby D. Richardson, Chief of the GSRS Technical Management Division (a member of the project team since 26 February), visited the Federal Republic of Germany (FRG) to meet with Herr Peter Runge, Herr Sitterberg (Runge's deputy), and other personnel from Messerschmitt-Bolkow-Blohm. The FRG representatives indicated that the FRG would like to become a partner in the GSRS program.

f. On 1 November, the Commanding General, TRADOC, approved the report of the SSG. The report contained an evaluation of the studies submitted by the contractors and the selection of the study having the most cost and operationally effective solution for accomplishment of the GSRS mission. This solution is referred to as the best technical approach in following chapters.

g. In November, a draft Decision Coordinating Paper (DCP) was submitted to the Department of the Army and the Office of the Secretary of Defense (OSD). About the same time, both the Congress and the Ford Administration began to show an interest in the GSRS project.

h. On 8 December, the Army Systems Acquisition Review Council (ASARC) I determined that the GSRS project was ready to enter the Validation Phase.

4. 1977 PRINCIPAL EVENTS

a. On 11 January, the Defense Systems Acquisition Review Council (DSARC) I met to review the project and determine its suitability to enter the Validation Phase.

b. On 14 February, the SECDEF approved program go-ahead and the plan to award competitive development to two contractors for the Validation Phase effort. A memorandum dated 14 February 1977, from the SECDEF to the Secretary of the Army directed that: (1) acceleration of the project be studied and, (2) discussions with the FRG and other interested NATO countries be conducted with the goal of gaining their participation in the project.

c. On 1 April, a special ASARC was held. At that meeting it was determined that the two winning contractors would each conduct a 29-month prototype development effort. It was also decided that the Production Phase would be accelerated, provided that development risks were satisfactorily reduced during the Validation Phase. This approach would advance the date of Initial Operational Capability (IOC).

d. On 11 April, Colonel Barrie P. Masters succeeded Col. Heitzke as Project Manager. Col. Heitzke was assigned as Chief of MICOM's (then called MIRADCOM) Advanced Systems Concepts Office.

e. On 13 April, requests for proposals for the Validation Phase were issued to thirty-one companies.

f. In April, the GSRS Project Office announced the following: (1) the Harry Diamond Laboratories fuzing system would be provided to the GSRS contractors as GFE, and (2) the Launcher Loader Module (LLM) would be mounted on a modified Mechanized Infantry Combat Vehicle (MICV) that was under development at the FMC Corporation plant in San Jose, California.

g. On 25-26 April, representatives of the United Kingdom (UK) artillery and development communities indicated that they would like to buy the GSRS if the development effort was successful.

h. On 23 May, the Source Selection Evaluation Board (SSEB) was formed for the purpose of evaluating the contractor proposals and selecting two contractors for the Validation Phase. The proposals were received on 31 May and negotiations were conducted with Boeing Aerospace Company and Vought Corporation on 22 and 25 July respectively.

i. On 17 June, the initial Project Manager Charter for the GSRS Project was issued. It stated that the project manager was responsible for the GSRS and ancillary equipment in accordance with DoD Directive 5000.1, "Major Systems Acquistion," Army Regulations 1000-1, "Basic Policies for System Acquisition" and 70-17, "System/Program/Project Management," and Army Material Command Regulation 11-16, "Program/Project/Product Management." The charter called for deprojectization of the GSRS Project Office in FY 84, provided that:

- Full scale production had been authorized
- The first field units equipped with the GSRS were operational
- There were no unusual engineering or support problems which would preclude support of the applicable item under another manager

According to the charter, the Project Manager-Selected Ammunition was to be funded by the GSRS Project Office for the devevelopment and acquisition of submunitions for the warhead.

j. On 14 July, the Special Assistant to the Chief of Staff, French Army, expressed a desire to explore cooperative development of the GSRS.

k. On 25 July, the GSRS Project Manager (in a memo from the Director, Defense Research and Engineering) was given responsibility for conducting all technical discussions on the GSRS with the FRG and other NATO nations. Further, the GSRS Project Manager was designated as the single DoD point of contact for the NATO standardization and interoperability effort in this area.

l. In August, the Integrated Logistics and Training Management Division was established within the GSRS Project Office. Then, in September, the Multiple Launch Logistics Working Group was formed. This group was composed of members from FRG, France, UK and US. Chairmanship was provided by the GSRS Project Office Integrated Logistics and Training Support Division.

m. On 16 September, competitive contracts were awarded for the Validation Phase. Boeing Aerospace Company received approximately $34M and Vought Corporation received approximately $30M to design, build, test, and demonstrate free-flight artillery rocket systems of their own design. Boeing was teamed with Thiokol Corporation for the solid propellant propulsion system and with Teledyne Systems Company for the fire control unit. Vought was teamed with Atlantic Research Corporation for the solid propellant propulsion system and with Bendix Corporation for the fire control unit. The contracts awarded for the Validation Phase (cost-plus-incentive-fee/award-fee) were to develop a prototype of the GSRS for use in the 1980s. Each firm was given 29 months to design and produce the prototypes for competitive evaluation. The winner of this competition was to receive a combined Maturation/Initial Production contract.

n. By 30 September, the GSRS Project Office staff had increased to 24 people (4 military officers and 20 civilians).

o. In the Fall, FMC was awarded a contract for development of the carrier for the Self-Propelled Launcher Loader (SPLL). The carrier was to be a modification of the Army's Infantry Fighting Vehicle (IFV), rather than the MICV as had been announced previously.

p. In early December, development testing was initiated at the White Sands Missile Range in New Mexico.

5. <u>1978 PRINCIPAL EVENTS</u>

a. In January, it was announced by the GSRS Project Office that the GSRS was being redirected by the US Army toward a standard NATO weapon system that could be coproduced; i.e., produced concurrently in both the US and Europe. Col. Masters indicated that the program redirection would require a 3-month extension of the Validation Phase; i.e. from 29 months to 32 months. The US and FRG signed a declaration of intent to develop and produce the common weapon system.

b. In late winter, during the field tests, a design flaw was discovered in the fuzing system. In March, to correct the problem, an in- depth analysis and redesign began. In November, following field testing, the Harry Diamond Laboratories (HDL) determined that the fuzes were ready for use in the prime contractor's scored test programs. At the close of 1978, it was suspected that although an adequate design was at hand, additional testing at high altitudes would be necessary to fully understand the power supply and to gain confidence that there were adequate design margins.

c. From 17-21 April, the first meeting of representatives from the US and three NATO nations, that eventually led to a Memorandum of Understanding (MOU), took place in Washington, D.C. A second meeting was held in London from 22-25 May. On 9 June, a Statement of Position for the GSRS program was signed by the representative of the four nations.

d. On 23 June, the scope of work was revised to incorporate new design requirements imposed as a result of the Statement of Position.

e. In the Fall, evaluations of several 10-ton trucks, considered as potential candidates for the resupply vehicle, were initiated at the Aberdeen Proving Ground in Maryland.

f. By 30 September, the GSRS Project Office staff had grown to 63 (9 military officers and 54 civilians).

g. In November, the first test models of the carrier were delivered by FMC to Boeing and Vought for system integration and testing.

6. 1979 PRINCIPAL EVENTS

a. In June 1979, Colonel Richard Steimle succeeded Col. Masters as the GSRS Project Manager.

b. In July 1979, the Memorandum of Understanding between the FRG, France, UK, and US was signed. The MOU stated that the GSRS hardware, except for the communications equipment, would be standard for the four nations.

c. On 16 November the name of the weapon system was changed from General Support Rocket System to Multiple Launch Rocket System in order to eliminate the specific general support role from the system title.

d. On 26 November, Boeing and Vought submitted their proposals for the Maturation/Initial Production Phase contract.

e. From November 1979 to April 1980, an independent evaluation committee of approximately 100 members reviewed the Boeing and Vought proposals.

f. In December, operational testing was initiated.

7. 1980 PRINCIPAL EVENTS

a. In January, Colonel Monte J. Hatchett succeeded Col. Steimle as MLRS Project Manager.

b. On 19 March, negotiations for the Maturation/Initial Production Phase were held with both Boeing and Vought.

c. On 7 April, best and final offers were received from both companies. The proposals were considered responsive to the requirements in the Request for Proposals (RFP).

d. In April, the ASARC III met and determined that one contractor should be selected to proceed into a Maturation/Initial Production Phase.

e. In May, Vought was announced as the prime contractor for the Maturation/Initial Production Phase contract. The fixed-price incentive contract was for $20.7 million.

f. On 27 May, the DSARC III met, and on 27 June, as a result of SECDEF approval of the DSARC recommendations, funding obligational authority for the Maturation/Initial Production Phase was received by the MLRS Project.

g. By the end of May, there were 96 people in the MLRS Project Office (10 military officers, 74 civilians, 8 Europeans, and 4 people on temporary assignment).

APPENDIX C

PROJECT PLAN BY PHASE

1. Validation Phase

a. During the Validation Phase, two competing contractors and the Army conducted developmental and operational tests to examine the feasibility of the MLRS hardware design and the potential of that design to satisfy system requirements in a cost-effective manner. Validation testing demonstrated that technical risks had been minimized. Analysis will be utilized during the Maturation/Initial Production Phase to show that the design has the growth potential to meet the full reliability and performance requirements. The US Army Materiel Systems Analysis Agency (AMSAA) conducted an independent evaluation of the development tests and the US Army Operational Test and Evaluation Agency (OTEA) conducted an independent operational test and evaluation. The two prime contractors, Boeing and Vought, were tasked with system development and integration responsibilities which included design, fabrication, and testing of the MLRS hardware, and development of supporting documentation. The government was responsible for providing the XM445 fuze, the MLRS carrier and the M42 submunitions. Figure C-1 shows the schedule of Validation Phase events.

b. The Validation Phase test program was designed to provide data from two competing systems to: (1) determine the degree to which each system met the contract requirements; and (2) to provide data for the Army's independent evaluation prior to ASARC/DSARC III. Objectives of the tests were to demonstrate system performance, and to determine technical risks associated with proceeding into the Maturation/Initial Production Phase. The test programs for both competing systems were similar and consisted of the following:

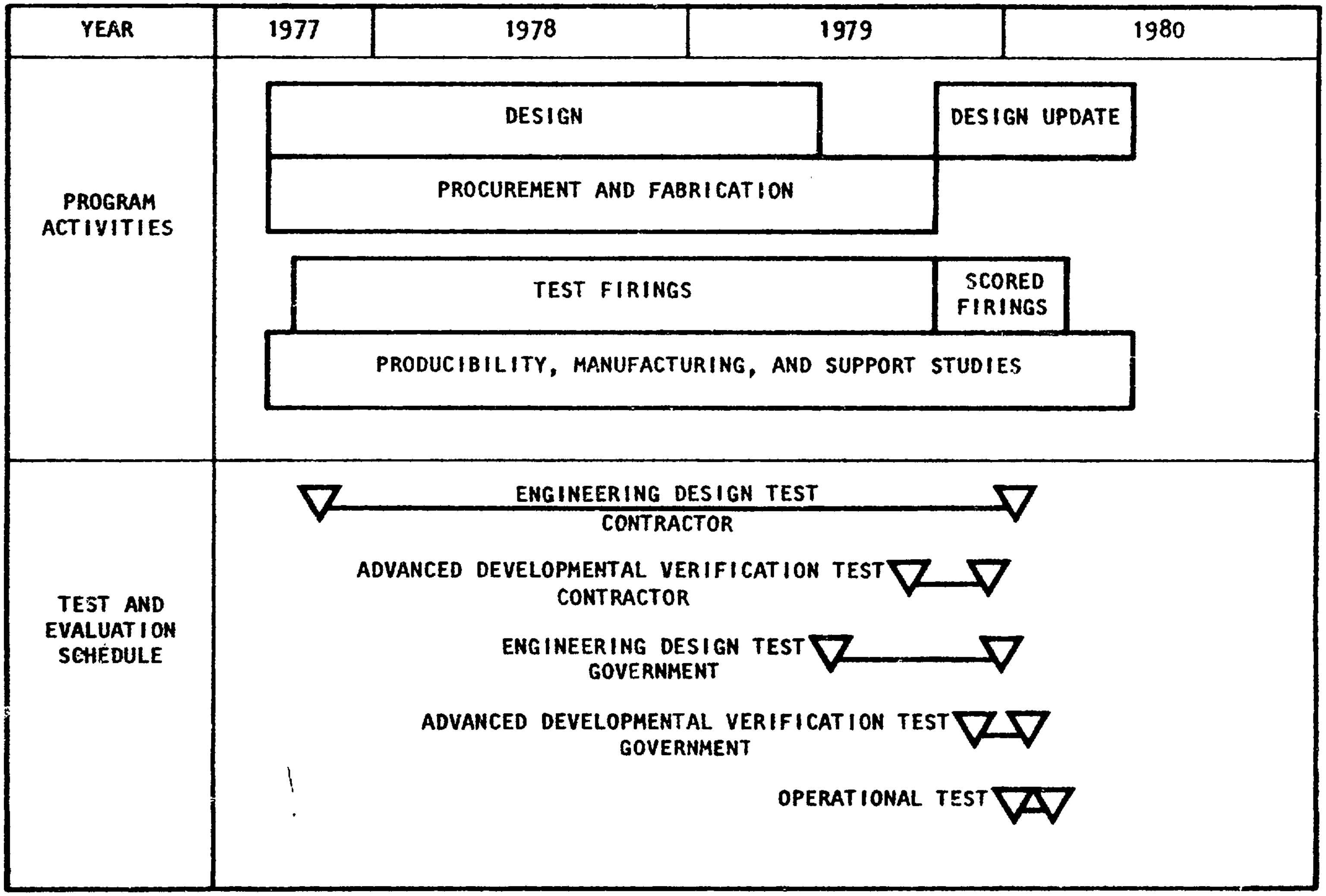

FIGURE C-1 VALIDATION PHASE SCHEDULE

- o Engineering design tests - contractor (EDT-C)
- o Engineering design tests - government (EDT-G)
- o Advanced development verification tests - contractor (ADVT-C)
- o Advanced development verification tests - government (ADVT-G)
- o Operational tests (OT)

c. The engineering development test program examined the performance and suitability of hardware designs. It included tests of components, subsystems, and systems to investigate the ability of the hardware designs to satisfy the requirements of the system specification in a cost-effective manner. The advanced development verification test program demonstrated that technical risks had been identified and economical solutions were available. Subsystems and systems tests verified that the design approach was capable of evolving into a rugged weapon system that could achieve the necessary reliability performance goals during the Maturation/Initial Production Phase. The Operational Test I (OT-1) program consisted of six weeks of testing. Data and associated analysis were collected for the ASARC/DSARC III meeting. The test program consisted of personnel training and selected testing, nonfiring exercises in a simulated tactical environment, and live fire exercises by typical user troops.

2. Maturation/Initial Production Phase

a. The MLRS project plan was based on the January 1978 DCP which showed that the Validation Phase tests provided sufficient assurance that the system would satisfy performance requirements after maturation. Such assurance was considered necessary before commitment to low-rate production, in parallel with full qualification of the system in natural and induced operational environments. The MLRS plan was considered responsive to the Congressional request to deploy the system in five years.

b. The Maturation/Initial Production Phase tasks shown on Figure C-2 represent a logical extension of the Validation Phase activities leading to full-scale production and deployment. Improving performance involves conducting sufficient flight tests under varying conditions to enable refinement of the firing algorithms so that they are consistent with the required system accuracy. The integration of the scatterable mine warhead and the terminally guided warhead will be conducted to assure compatibility with the basic system. The Validation Phase performance of the MLRS was not expected to meet the final performance requirements, but the system performance was expected to be indicative of its capability to achieve specific levels. During the Maturation/Initial Production Phase, the hardware design and documentation required to support full-scale production and deployment will be updated, and then qualified while low-rate production proceeds.

c. The Maturation and Initial Production Phase efforts will be carried out concurrently (see Figure C-2). The maturation effort includes continued design update, hardware fabrication, and completion of engineering and environmental testing initiated in the Validation Phase. The production effort will provide hardware for Production Qualification Testing (PQT) & OT III testing scheduled as part of the Maturation/Initial Production Phase efforts. Deliveries of production units will begin in January 1982 and will be completed in March 1984. The conclusion of PQT FDTE and OT-III will provide data to support the DSARC IIIa decision. Full-scale production by the prime contractor is scheduled to begin in January 1983.

d. The Maturation/Initial Production Phase test program will be conducted as shown in Figure C-3. Maturation testing involves development prototypes as well as initial production hardware. Force development Testing and Experimentation (FDTE) will be conducted using updated prototype hardware. Operational

COMPLETE FULL-SCALE PRODUCTION TECHNICAL DATA PACKAGE

INCORPORATE FINAL DESIGN-TO-UNIT-PRODUCTION COST TRADES

IMPROVE PERFORMANCE (ACCURACY, REACTION TIMES, ETC.) AS NECESSARY

COMPLETE PRODUCTION ENGINEERING PLANNING

CORRECT VALIDATION PHASE DEFICIENCIES

QUALIFY HARDWARE FOR OPERATION IN NATURAL AND INDUCED ENVIRONMENTS

FINALIZE FIRING ALGORITHMS

DEVELOP TRAINING AIDS

DEVELOP REQUIRED NEW ITEMS SUCH AS AUTOMATIC TEST EQUIPMENT

FINALIZE PUBLICATIONS AND TRAINING MATERIALS

FINALIZE AND PROVE LOGISTICS AND MAINTENANCE PACKAGE

DEMONSTRATE RELIABILITY, AVAILABILITY AND MAINTAINABILITY (RAM) CHARACTERISTICS

INTEGRATE WARHEADS

FIGURE C-2 MATURATION/INITIAL PRODUCTION PHASE TASKS

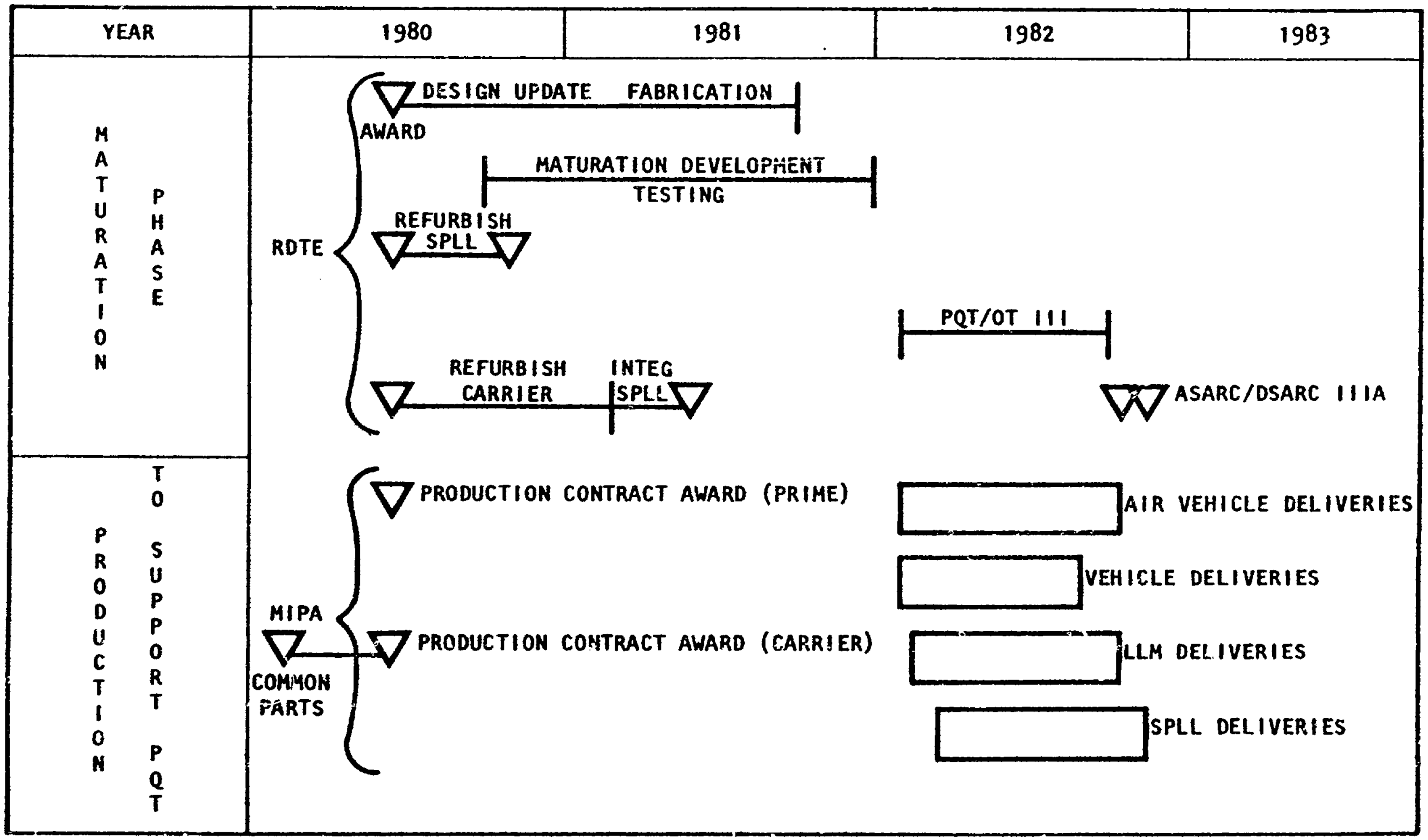

FIGURE C-3 MATURATION/INITIAL PRODUCTION PHASE SCHEDULE tests will be conducted using initial production hardware. Development Testing (DT) will be conducted using all components/subsystems which were not fully tested or qualified during the Validation Phase, as well as the components/subsystems that were developed during the Maturation/Initial Production Phase. Development tests will consist of two phases: (1) Maturation Development Tests, and (2) Production Qualification Tests. Developmental testing will be done jointly by contractor and government as opposed to independently. The contractor will prepare test plans for government coordination and approval, conduct tests at both contractor and government facilities, accommodate government test monitors as appropriate, and utilize independent or mixed contractor/government test crews as test conditions warrant. The contractor will conduct independent analyses of test data and provide data and reports to the government. The government will conduct an independent evaluation of the test results for use in ASARC/ DSARC IIIa decisions. A total of seven development prototype and twelve production SPLLs will be utilized for DT, FDTE, and OT tests to be conducted during the Maturation/Initial Production Phase.

e. The Initial Production Facilities (IPF) will be procured to establish the production capability necessary to produce the MLRS in accordance with the production baseline documentation released during the Maturation/Initial Production Phase. The IPF are to be acquired through a series of three or more successive fiscal year procurements. The first year procurement will include those IPF entities which are necessary to support the first production hardware buy. The second year procurement will include the remaining IPF entities that are necessary to establish an initial production capability. The third (and fourth, if required) will include all those remaining IPF entities needed to achieve the maximum production quantities and rates. The key procurement milestones are shown in figure C-4.

MILESTONES	TARGET DATES
CARRIER AND IFV COMMON PARTS CONTRACT AWARD	FEB 80
ASARC III MEETING	APR 80
MATURATION/INITIAL PRODUCTION CONTRACT AWARD - INITIAL SOURCE	APR 80/FEB 81/OCT 81
INITIAL PRODUCTION FACILITIES CONTRACT AWARD INITIAL SOURCE	APR 80/FEB 81/OCT 81
DSARC III MEETING	MAY 80
ASARC IIIA MEETING	OCT 82
DSARC IIIA MEETING	NOV 82
FULL-SCALE PRODUCTION DECISION	DEC 82
FULL-SCALE PRODUCTION CONTRACT AWARD - INITIAL SOURCE	DEC 82/OCT 83/OCT 84
EDUCATIONAL BUY CONTRACT AWARD - SECOND SOURCE	JUN 82/DEC 83/OCT 84
BUY-OUT COMPETITION AWARD	OCT 85

FIGURE C-4 PROCUREMENT MILESTONES SCHEDULE

3. Production Phase

a. Self-Propelled Launcher Loader (SPLL).

(1) The Production Phase includes acquisiton of three carriers with RDTE funds. The fabrication of these three carriers will be accomplished on production tooling and to production configuration. The special tooling design was funded in February 1980, concurrent with first IFV award. The carrier follow-on contracts were awarded at the same time. This allowed consideration of optional quantities or combined procurements of MLRS/IFV common components, rather than independent procurements. One month has been planned for delivery of the carrier to the prime rocket contractor. For the first 16 vehicles, one month has been allocated to convert the carriers to SPLLs. The time is driven by the Initial Operational Capability (IOC) date. With the delivery of the second procurement of carriers, a queue will be established at the prime contractor's site by requiring the delivery of two carriers per month for a four-month period. This queue will establish a two-month period for conversion of a carrier to a SPLL.

(2) The first production carrier will be retained at FMC for Production Verification Testing (PVT). The second through tenth carriers (SPLLs) will be allocated to the PQT and OT-III test programs. Eight of the nine SPLLs will be jointly used in the training program. The quality assurance effort will require use of the tenth SPLL. The tenth SPLL will also be used as a "shop queen" vehicle for modification work orders and other validations.

(3) The succeeding eighteen SPLLs will be devoted to the tactical deployment of the first two IOC batteries. For the US Army Europe deployment, a period of four months has been planned for shipping and fielding the batteries. A period of three months is planned for shipping and fielding the CONUS deployed batteries. The next five SPLLs (units 29-33) have been allocated to

the training base to supplement the prototype SPLLS. The 34th unit has been allocated to the maintenance training program at Redstone Arsenal. The remaining units will be allocated to tactical deployment.

(4) The baseline program includes the allocation of 234 tactical SPLLs, 12 training SPLLS, and 30 maintenance floats. The floats will be distributed to the individual batteries. Production for both the war reserves and prepositioned overseas unit sets will be handled as add-ons at the end of production.

(5) The production rate will be held to a minimum through the first two fiscal-year deliveries and then increased slightly to allow completion of the tactical fielding as scheduled.

b. Tactical Rocket Loading. The contract awards and rocket production schedules include the delivery periods and quantities for the baseline program. A baseline program rocket loading schedule was developed showing tactical rocket availability and the quantity allocated, and the sequence of loading for each tactical battery. The first two batteries will be partially loaded and backfilled to a full basic load of 972 rockets. The SPLL deployment dates precede the rocket loading dates until the beginning of FY 85. The production delivery rate for the rockets will not be sufficient to equip the deployed batteries with a full basic load early in the deployment plan. The war reserves will be delivered in late FY 84 after providing each deployed battery with its full basic load.

c. Resupply Vehicles and Trailers. A total of 480 vehicles with trailers will be required for the baseline program (468 tactical and 12 training). The allocation and deployment sequence will be the same as used for the SPLL. A shipping time of two months has been allocated for USAREUR batteries and one month for the CONUS batteries. A fielding time of one month is allocated for all deployments. The Heavy Expanded Mobility Tactical Truck (HEMTT) project office will acquire and test the vehicles to be used for the resupply vehicle. The Heavy Expanded Mobility Ammunition Trailer (HEMAT) will serve as the resupply trailer.

d. Production Rocket Deliveries.

(1) The first three low-rate production rocket deliveries will be received from the initial source in time to meet the IOC. Deliveries from the second source will be received over a three-year period. The production lead time planned for the initial rocket source contractor will be 20 months; the lead time will be reduced to 18 months for succeeding rocket deliveries. A production lead time of 24 months has been planned for the first rocket deliveries by the second source contractor. This will allow adequate time for facilitization and permit development of competition for the buy-out. Training rockets will be acquired from the initial source, and these deliveries will begin after deliveries of the low-rate production rockets have been completed.

(2) The quality assurance (fly-to-buy) requirements will be based on a production lot testing program. The program has been designed to determine production hardware compliance with the contract requirements prior to lot acceptance by the government. The definition of lot size will be determined by the contractor with government concurrence.

(3) The surveillance effort will utilize rockets that have been conditioned in four geographical areas: Europe, Alaska, Arizona, and the Canal Zone. A total of 114 rockets have been planned for the PQT tests and 198 for the OT III tests. These test programs have been planned for February through September 1982. The PVT test for the second source will require 114 tactical rockets between July and September 1984.

APPENDIX D

PROJECT REVIEWS AND REDIRECTIONS

1. Army System Acquisition Review Council Review/Redirections

   a. ASARC I, 8 December 1976: Determined that MLRS was ready to enter the Validation Phase and recommended project alternatives to the DSARC.

   b. SPECIAL ASARC, 1 April 1977: Recommended two contractors compete for the 29-month Validation Phase.

   c. ASARC III, April 1980: Recommended one contractor proceed into Maturation/Initial Production Phase.

2. Defense System Acquisition Review Council Review/Redirections

   a. DSARC I, 11 January 1977: Recommended that the SECDEF approve ASARC recommendation for an 84-month project. On 14 February, SECDEF instructed the Army to study ways to accelerate the project.

   b. DSARC III, May 1980: Recommended approval of ASARC recommendation to proceed into Maturation/Initial Production Phase.

   c. SECDEF Decision Memorandum, 9 August 1980: Authorized the project to proceed into Maturation/Initial Production Phase.

3. Congressional Reviews/Redirections

   a. FY 77: Provided $5M to MLRS, rather than the $1M requested, so that the project could be accelerated.

   b. FY 77: Culver-Nunn Amendment to Defense Appropriation Authorization Act directed services to minimize diversity of high consumption systems in the NATO alliance. The objective was to deploy MLRS as a standard or, at least, an interoperable weapon system.

   c. FY 78: Authorized basic funding with the understanding that development would not exceed five (5) years.

d. FY 78: Approved $16.322M reprogramming request to enhance accelerated schedule.

e. FY 79: Approved $7.995M reprogramming request to cover costs incurred in accommodating RSI-induced design changes without lengthening the schedule.

4. Other Redirections

a. 25 July 1977: DDR&E Memo directed that the MLRS PM assume single point management responsibility for international cooperative efforts.

b. October 1977: MLRS PM tasked by Army to assess impact of delivering AT-II scatterable-mines.

c. June 1978: Schedule revised to meet AT-II delivery requirement.

d. July 1978: The development project for terminally-guided warhead for MLRS initiated.

e. Early 1980: Decision to use EQUATE redirected the MLRS automatic test equipment program.

APPENDIX E

OBSERVATIONS BY PROGRAM/PROJECT MANAGEMENT TEAMS

During the course of this study, interviews were conducted with both military and industry program/project management teams. The following is a compilation of observations based on their experiences with the MLRS project.

1. MLRS Project Team at MICOM

a. The project manager's charter must afford maximum authority and flexibility. He must operate within the terms of the charter.

b. Development command management should use a "hands-off" policy after establishing the project manager's charter and approving the proposed acquisition strategy to be followed. When this is done the project office tends to function more smoothly.

c. A slow build-up of personnel at any level can handicap a project. The key project office personnel should be selected at the project outset, following allocation of spaces.

d. Personnel should be carefully selected for the project staff because they provide the principal key to success. However, it is better to leave a staff position temporarily vacant until a fully qualified person is found.

e. There should be continuity at the project manager/deputy project manager level. Continuity at the top level provides project stability. On the MLRS Project, there have been four project managers in a period of less than four years; however, there has been only one deputy project manager since the project office was formed. Also, the Chief of the Technical Management Division, the Chief of the International Programs Office, the Chief of the Procurement and Production Branch, and the Chief of the Program Cost Branch have been with the MLRS project since its inception.

f. Good communications should be fostered within the project office for it helps to ensure effective functioning of all operations.

g. Build a good esprit de corps among the personnel in the project office and the project will tend to run smoothly. This is particularly appropriate to the civilian personnel, who are most likely to stay with the project throughout its life.

h. To help ensure the success of a project, the division chiefs, the principal members of the project office management team, should be "well seasoned," strong in their convictions, and wholly dedicated to the success of the project.

i. The project manager should be a person who:

(1) Has schooling/experience in project management and knowledge of business and contracting. Experience is a particularly important asset on a large project.

(2) Is articulate and able to communicate effectively up and down the line and laterally.

(3) Will listen to the members of the project team.

(4) Spends more time with the people who have decision authority than with those who do not. This approach has some risks associated with it, but the future of a project may well depend upon the taking of these risks.

j. The development of an artist's concept of the weapon system should be accomplished early in the project because it is essential for good communications within the project office and with interfacing organizations.

k. Adequate funding should be obtained at the outset of a project. It is another key to a project's success.

l. A funding profile should be developed early in a project. Adherence to such a profile will contribute to the success of a project.

m. Regarding competition, it is essential that project management determine: (1) how long developmental competition is beneficial; and (2) when competition for production should be initiated.

n. The project office should use a "hands-off" policy in dealing with competing potential contractors after they receive the RFPs. A sample project office policy is at Appendix L.

o. Relative to testing, competing contractors for the production phase of a project should be told what the test objectives are. Then, it should be left up to the contractors to establish their test programs and schedules to meet those objectives in an orderly, timely, and cost-effective manner.

p. On an international project the size of MLRS, or larger, the project manager should be the principal negotiator; i.e., the chairman of the US negotiating team. The principal negotiators should be backed up by a team from the project office, experienced negotiators, international lawyers, and others who have an intimate knowledge of the project. If it is a NATO project, the team members should have an understanding of the NATO standardization/interoperability philosophy and policy.

q. Project managers should anticipate the possibility of project delays that may take place when dealing with the DOD, the Army Staff, the ASARC, and the DSARC.

r. The project should be supported by high-level management within the service, the Office of the Secretary of Defense, and the Congress. If it is, it will have "smoother sailing".

2. TRADOC/Fort Sill Office

a. The relationship between the TRADOC System Manager (TSM) and the Director, Combat Developments, US Army Field Artillery Center and School is very sensitive. The TSM depends on the Combat Developments Directorate for threat and system operational effectiveness data and must interface with the Field Artillery School. The Field Artillery School does not appear to understand the TSM's position.

b. For a multinational program, such as MLRS, the TSM office is understaffed. There are currently only four personnel authorized and assigned.

c. The TSM and the project manager should work as a team. A feeling of mutual trust must exist between the two managers.

d. The TSM, as the user's representative, should be a member of the team that negotiates a multinational MOU.

e. The testing of a multinational system should be an integrated effort involving all of the nations who are parties to the MOU.

3. <u>FVS Program Office</u>

a. FVS Program Team.

(1) The early decision by the IFV Project Office to retain management responsibility for configuration control of the MLRS carrier provided maximum tank/automotive commonality between the MLRS and the IFV.

(2) FMC, which produces both the IFV and the MLRS carrier, has been confronted with the problem of limited flexibility in scheduling the production of the MLRS carrier because the MLRS project manager has incrementally funded carrier procurement.

(3) Because the MLRS carrier is a derivative vehicle of the IFV and is provided as GFE, the responsibility for development of field manuals, technical manuals, and skill qualification tests is the responsibility of the MLRS project team. This may create problems in fielding the system.

(4) Although the MLRS is a multinational program, FMC was not made a party to the negotiation of the MOU. Proprietary rights may preclude transfer of the full TDP for the MLRS carrier to the European nations. Separate technology transfer negotiations will be required for the MLRS carrier TDP.

b. FMC Project Team.

(1) The MLRS carrier contract for the Validation Phase was well written and manageable.

(2) The MLRS carrier manufacturing and delivery schedules for the Validation Phase were realistic.

(3) The MLRS planning for the Validation Phase was well conceived.

(4) Communications between the project team members at Warren, Michigan and San Jose, California have been effective.

(5) During the Validation Phase, it was necessary for top management to direct most of its attention to the IFV, which is more complicated than the MLRS carrier to produce. Therefore, the MLRS carrier had little direct surveillance. This procedure worked well where the vehicle components were identical, but created continuous difficulties where the components were unique to the MLRS. Special attention by top management to problems associated with long lead items required for the MLRS carrier would have been beneficial.

(6) Comparatively few people were assigned to the MLRS project at the San Jose facility during the Validation Phase because of the commonality of the power train and suspension components between the IFV and the MLRS carrier.

(7) During the Validatio[illegible]ase, FMC prepared all of the interface control drawings between the carrier and the Vought and Boeing launcher designs to eliminate any need for Vought and Boeing to meet. This permitted FMC to make a common interface arrangement for each competing contractor. All of the interface problems between the carrier and the competing launchers were resolved quickly.

(8) During R&D, funding for the MLRS carrier was realistic. No pleading for funds was required nor was there a need to cut corners on the

project. The funding placed realistic limits on the project scope of work, and the number of personnel that could be assigned to the project.

(9) Only a few government personnel were authorized to communicate with FMC regarding the MLRS carrier during the Validation Phase. This reduced the amount of time devoted by the contractor for responding to questions by the government.

4. <u>Vought Corporation Project Team</u>

a. The government tends to go overboard on competitiveness. Constant competition leads to development of an adversary environment among the competitors.

b. Fielding a good system at IOC requires teamwork between the contractor and the project management team. The "hands-off" policy of the MLRS project team during competition precluded a free exchange of technical information between the government and the contractors. Consequently, this approach had a negative impact on configuration management.

c. It is difficult to avoid technical leveling in a project such as the MLRS. Vought started concept development efforts on a free rocket system in 1970. Boeing started concept development in 1976. Prior to the MLRS competition these contractors had freely exchanged technical data.

d. The constraints and restraints caused by following the ASARC and DSARC procedures preclude the rapid fielding of new weapon systems. Consequently, the cost of fielding a system is also increased. It was the feeling of the Senior Vice President and General Manager, MLRS Division, that the Army has the capability to deploy its weapon systems faster and cheaper if the Congressional and DoD environment would permit it.

e. The production planning for MLRS is well documented and the production facilities have been tailored to achieve the unit cost specified in the contract. However, management of the current contract is being diluted by second source competition requirements and system configuration changes.

5. Boeing Aerospace Company Project Team

a. From the beginning of the MLRS project, cost was recognized as a principal driver.

b. The MLRS did not require any state-of-the-art advancements by Boeing during the Concept Development Phase. The problem from the beginning of the project was how to integrate known technology into a low-cost system. Selection of the suspension and power train components, originally designed for the IFV, appeared to offer a cost-effective solution.

c. During contractual negotiations, industry contracting personnel should report directly to the company project manager rather than to their parent functional organization.

d. The MLRS project team prepared a clearly worded, easily understood Validation Phase RFP.

e. The Validation Phase was, for the most part, well managed by the MLRS Project team.

f. The requirement to incorporate NATO involvement made it necessary to give the competing contractors additional time and funding for the Validation Phase. These were authorized by the MLRS Project Manager.

g. Although Boeing made significant input to the initial draft of the Memorandum of Understanding for the MLRS Project Office, the MLRS Project Office did not include the competing contractors in discussions with representatives of industry in Europe. Boeing, although not called upon, was ready and willing to participate in these discussions at no extra cost to the project.

h. During the Validation Phase, the activities of the MLRS project team took on the appearance of the performance characteristics of full-scale engineering development. For example, additional integrated logistics support requirements were introduced and there were indicators that the DSARC II and III might be held concurrently. Then, the DSARC II requirement was dropped in favor of DSARC III. This meant that Production Readiness Reviews would be required, although there were no additional monies available for that purpose.

i. The MLRS Project Office should have appointed special teams to deal with each competing contractor -- rather than a single team for both -- during the Validation Phase.

j. Boeing and Vought had a problem with the fuze (government-furnished equipment) during the Validation Phase. The problem -- one involving poor quality control -- could have doomed the MLRS project. It would have been better to have made each contractor responsible for the design or purchase of the fuze, rather than to furnish it as GFE. The need to work through the MLRS Project Office to resolve the fuze problem caused unnecessary delays and administrative problems. Further, the close attention of the MLRS project team to the fuze problem, meant that these people could not give sufficient time to other problems, such as basic rocket accuracy, that required attention.

k. When the MLRS project team discovered the Validation Phase contracts were going to exceed costs, the team asked the contractors to agree to specific ceilings. The contractors did so. Thus, the project continued at a reasonable cost; however, each competing contractor had to make a large investment to complete its obligations in the Validation Phase.

l. The latitude given the competing contractors to develop their own test programs during the Validation Phase was a good idea.

m. Although Boeing rocket tests were conducted at the White Sands Missile Range in New Mexico, the analyses of test results were conducted at Seattle, Washington. The analysts should have been located at the test site. If they had been so located, the flow-time for the analyses and implementation of solutions would have been shorter.

n. The RFP for the Maturation/Initial Production Phase was clear, concise, and easily understood.

o. The Army did not inform competing contractors for the Maturation/Initial Production Phase of the weighting that would be placed on each of the nine criteria used in the selection process. It would have been helpful to the contractors if the project office had done so. Boeing concentrated on the production of a low-cost system, rather than on performance which, as it turned out, was given more weight.

p. The Army debriefing, following selection of the contractor for Maturation/Initial Production Phase, was good.

q. The Army did well in conceiving, laying-out, and operating the MLRS project, even though there were four project manager changes in a relatively short period. The continuing strong leadership of the Deputy Project Manager (a civilian), and those in key positions within the MLRS Project Office (also civilians), ensured continuation of the project -- without lapses in leadership or direction -- as project manager changes occurred.

r. Competition forces companies to put their "best foot forward." On the MLRS, the Army got a good deal.

s. Boeing corporate management did not fully recognize the importance of the MLRS project until well into the Validation Phase. The desire of Boeing to manage a good Army project was an objective before the company entered the Concept Development Phase; however, there was not, at that time, a full commitment by management at the corporate level.

t. At Boeing, there is no formal process designed to pass on lessons learned from a project/program to those who will be managing future projects/programs. A memorandum is issued to managers at the next level describing the successes and failures. The Boeing project/program managers make an effort to discuss acquisition strategies with personnel in the company's contracts and proposals organization.

APPENDIX F

BUSINESS MANAGEMENT

1. Competition

a. Background.

(1) The MLRS project team has made, and plans to continue with, extensive use of contractor competition. In 1977, concept definition study contracts were let by the Special Study Group (SSG) to five firms. Following identification and approval of the best technical approach, competition for the Validation Phase was conducted; Vought and Boeing were selected. At the completion of the 32-month Validation Phase the Vought Corporation was awarded a contract for low-rate production, facilitization, and design maturation (continued engineering development). More competition is planned to: (a) obtain a second source for rocket production, and (b) select either the prime contractor or the second source for the buy-out.

(2) Competition During the Validation Phase.

(a) Schedule. The Validation Phase schedule, established in the initial contract, included the various reviews and tests. Each contractor knew what had to be delivered (3 prototype systems) and when they had to be provided. In addition, as discussed earlier, each contractor knew the performance evaluation criteria and their ranking.[1/]

(b) Costs. The rockets and LP/C costs represent over 70% of the MLRS system investment costs. The SPLLs contribute approximately 15% to the costs. Realizing this to be so, and knowing that ammunition cost-effectiveness was a principal criterion in the selection process, the contractors focused on rocket costs. The result was that each contractor came in under the government's cost goal for their part of the rocket (motor, airframe, and

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1/ See Appendix M for a description of these criteria.

dispenser). Figure F-1 traces the contractor's rocket cost estimates during the Validation Phase. Each contractor also bettered the government goal for the LP/C costs. Figure F-2 shows the LP/C cost estimates. However, because of the emphasis on reliability, the contractor's SPLL costs are nearly double the government goal. Figure F-3 shows the SPLL cost estimate growth. Figures F-1 thru F-3 show costs in 1980 constant dollars and are the figures used by the MLRS project team for the DSARC III presentation. The DTUPC estimates by each contractor assume that the procurement quantities will be produced by one contractor at the indicated production rates. The baseline cost estimates shown are the government base values used for budgeting purposes. They represent estimates for the total buy and assume a ten percent margin for contingencies and liabilities applied to the average of the two contractor's DTUPC values. The MLRS project office used a 91% cumulative average learning curve to develop the predicted unit cost by fiscal year production lot size. Both contractors met the total system cost goal; however, they did make trade-offs among the subsystem goals. The MLRS team estimates that as a result of these trade-offs and competition, a net savings of about three-hundred million dollars (constant 1978 dollars) could be realized on the project.

(c) Evaluations. The Source Selection Evaluation Board (SSEB) scored each offerer's proposals and past performance against the criteria described in a Source Selection Plan (SSP). The scores were then provided to the Source Selection Advisory Council (SSAC) for further analysis and application of SSAC weights. The SSAC weights were not divulged to the SSEB; therefore, only individual criteria scores were presented in the SSEB evaluation results.

(d) Performance. The MLRS project team has demonstrated the capability of the system to meet -- or the growth potential to reach -- the required performance goals.[2]

2/ Based on results of DT-I/OT-I. See Appendix I.

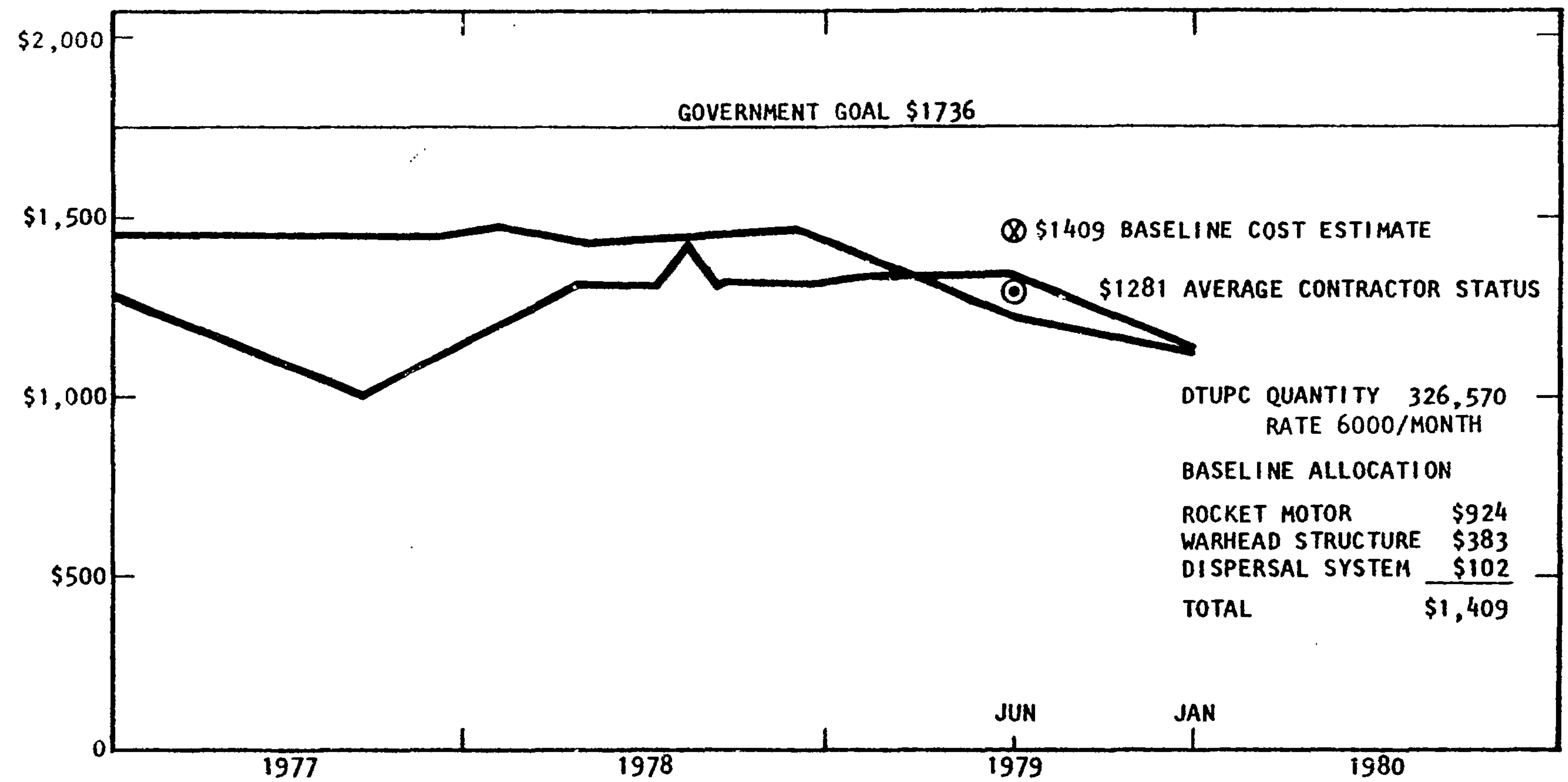

FIGURE F-1 ROCKET COSTS (1980 CONSTANT $)

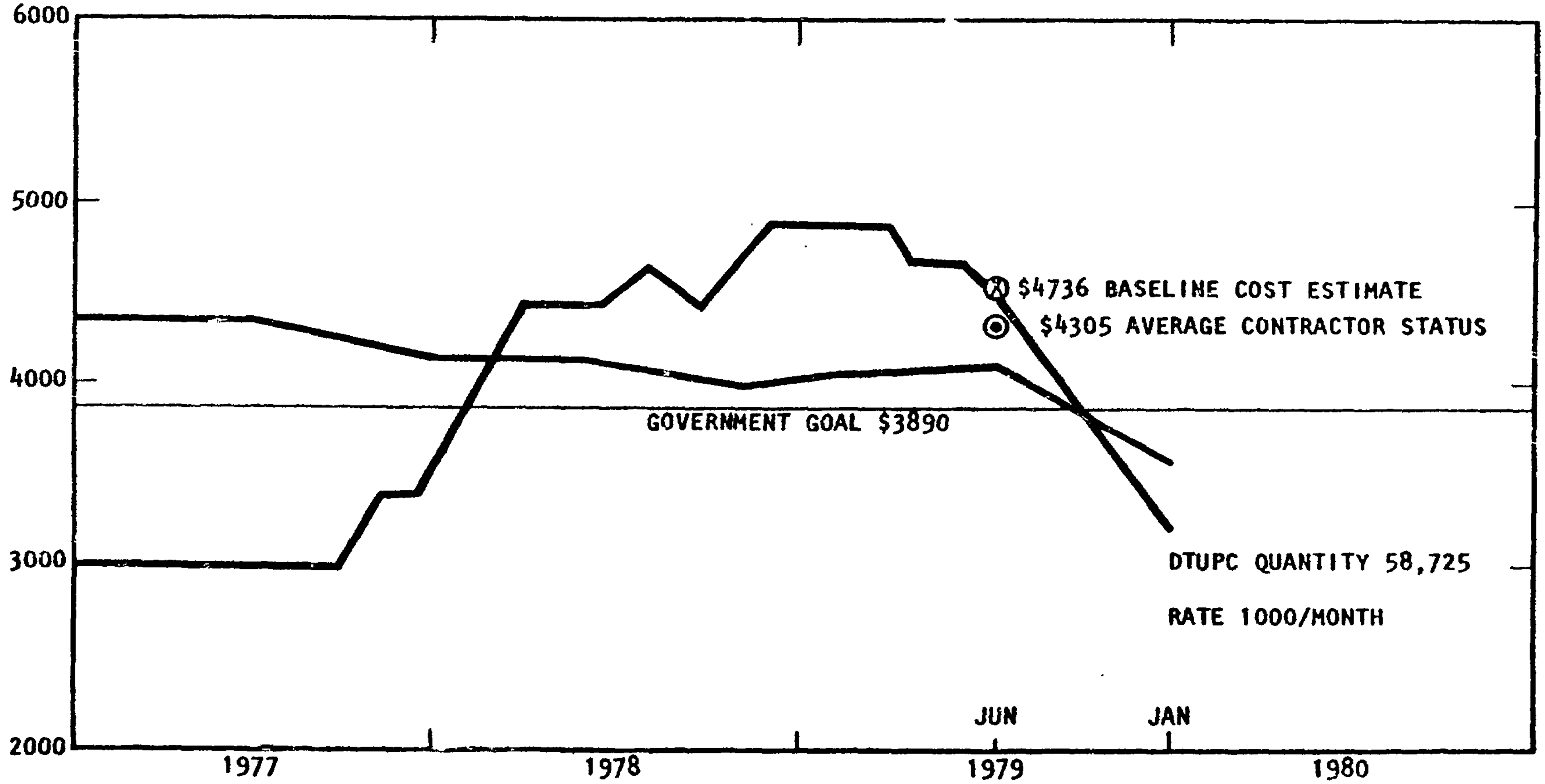

FIGURE F-2 LAUNCH POD/CONTAINER COSTS (1980 CONSTANT $)

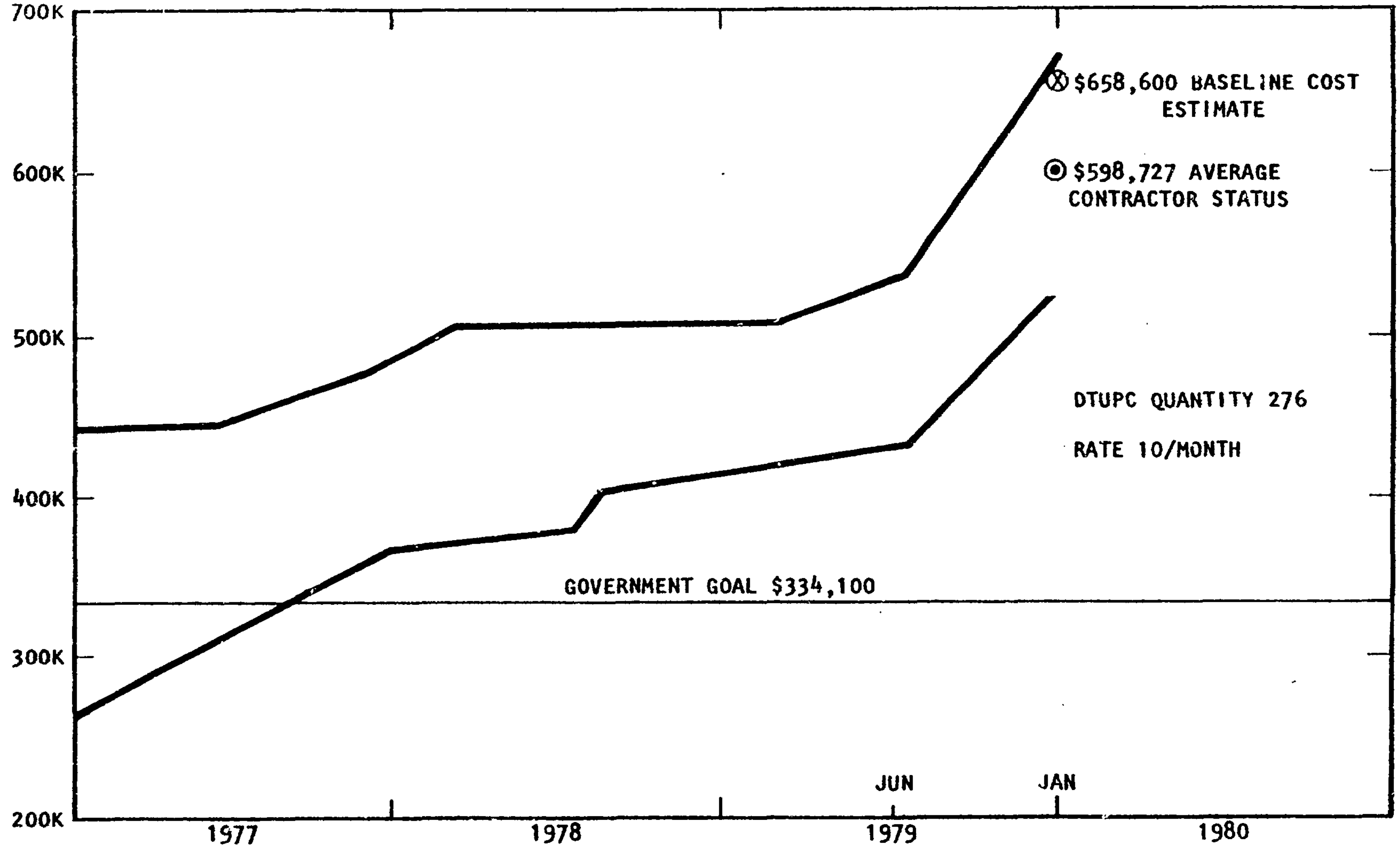

FIGURE F-3 LAUNCHER LOADER MODULE COSTS (1980 CONSTANT $)

b. Study Team Observations.

(1) The Validation Phase contracts established source selection criteria that covered all major program objectives. Rank ordering of the evaluation criteria served as a guide for each contractor and encouraged use of management by objectives. These criteria must be developed by the project manager (as opposed to contract personnel) to insure that they provide a thorough system approach.

(2) The evaluation criteria should be included in the Request for Proposal and not altered during the competitive Validation Phase.

(3) The Validation Phase contracts provided each contractor with identical information, requirements, and guidance. Concepts, rather than specifications, encouraged innovation. Mr. B. M. Smith, General Manager of Vought's MLRS Division, stated, "This was really a smart way to go at it. Instead of trying to specify in detail the nuts and bolts design of the advanced weapon, they gave us the problem and a great deal of freedom in figuring out how to solve it."3/

(4) Each contractor was provided with the data that the Army planned to use to measure ammunition cost-effectiveness. These data included a target array (over 500 targets), and the algorithms required to determine performance, e.g., the number of rounds required to attack the target. This technique provided each contractor with the ability to optimize rocket unit cost and the number of rockets required to attack the target in order to achieve the lowest ammunition cost-effectiveness.

(5) The MLRS project team technical personnel observed the contractor's developmental tests and firings, reviewed contractor trade-off studies, and participated in preliminary and final design reviews and quarterly program reviews. However, the MLRS project team members avoided answering

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3/ Aviation Week and Space Technology, May 5, 1980 questions, giving advice, or giving any form of help to either contractor. When comments were made, project team personnel ensured that both contractors received identical information.[4]

(6) It appears that competition, although requiring more R&D funds than a sole source contract would have required, contributed to potential government system acquisition cost savings. Not only did the contractors better the government cost goals for MLRS, but they also expended considerable corporate funds. If MLRS had been a sole source contract, any cost overruns would probably have been paid by the government. Another contribution to cost savings was the fact that competition kept the project on schedule.

(7) The competition planned for the second source rocket and launch pod/container production and for the buy-out, may foster further cost reductions. However, if the planned production quantity of 362,000 rockets is reduced, a break-even point may be reached at which any second source competition is not economically feasible. Vought was willing to invest its own funds during the Validation Phase because it believed that these funds could be recouped during the Production Phase. If Vought fails to receive a significant production contract for the rockets and pods, it will lose money on the MLRS project. If the government reduces the rocket production rates and quantities, the willingness of Vought and other contractors to engage in future competitive projects will be jeopardized.

2. Contracting and Source Selection

a. Background. The competitive environment discussed earlier in this appendix reflects the extensive use of contracting to separate the MLRS project efforts. Numerous observations were made of the contracting and source selection aproaches used for the Validation and Maturation/Initial Production Phases.

4/ See Appendix L for a sample project office policy for contacts with and direction of competitive contractors.

b. Study Team Observations.

(1) Careful deliberation is needed in deciding if components or assemblies under the design or contracting mission of other government agencies are to be GFE, or Contractor Furnished Equipment (CFE). When an item is GFE, the government is responsible for its suitability and timely delivery. This government liability is absent if the item is CFE. When an item is CFE, the government has contractual rights to enforce timely delivery to specifications, or to obtain an equitable adjustment. When another government agency is involved, this contractual leverage is not available. In reality the only leverage available is moral persuasion. (See Appendix G, Paragraph 2k, for further discussion of the GFE/CFE issue).

(2) The high degree of corporate integrity exhibited by the competing Validation Phase contractors had a direct bearing on the success of the project.

(3) Key project team members must be assured access to critical information during the solicitation and evaluation phases of a competitive contracting action. This is necessary to: (a) permit the project manager to comply with the mission in his charter, (b) allow the project office to discharge its overall management responsibilities, (c) assure a meeting of the minds between the parties on what is expected under the contemplated contract, and (d) minimize post-award misunderstanding and disputes. This action must be accomplished without a loss in the integrity of the contracting system.

(4) When more than one contractor is under contract during the Validation Phase, and the contractors are competing for a single full-scale engineering development or maturation contract, traditional source selection procedures cannot be used. First, the validation must be directed primarily toward selection of a system rather than a contractor. Second, if the

competing systems have been subjected to formal government development and operational tests, the test results may be of more importance in the selection process than the contents of the written proposal. In other words, where possible selection of a contractor for the next project phase should be based on demonstrated, not predicted performance.

(5) The Source Selection Evaluation Board chairman and deputy chairman plus key sub-group (management, logistical, and technical) personnel must be appointed early. This permits their participation in development of the Source Selection Plan and review of the solicitation document.

(6) Preparation of the Source Selection Plan must be a joint endeavor of the SSEB, the project office personnel, and the Principal Contracting Officer (PCO). Any unresolvable differences can be arbitrated or decided by the Source Selection Authority (SSA). This permits all concerned parties to provide input, and it protects the best interests of the government.

(7) During the SSEB evaluation of proposals, it is most helpful if members of the cost and management team visit each proposer's plant for the purpose of trying to completely understand the cost build-up, data validation process, and production capabilities and capacities.

(8) In preparing the RFP, a standard clause concerning the bidders' proprietary rights must be included.

(9) In those cases where multiple contracts will be awarded to only one of several competitors, the advantages and disadvantages of a single solicitation, or a solicitation for each project phase, must be judiciously weighed.

(10) The use of award-fee provisions for DTUPC goals in competitive validation and engineering development contracts is questionable. Competition for follow-on contracts (and the opportunity for more profit) is more of

an incentive to reduce projected unit production cost than the offering of a comparatively small award-fee. Therefore, the award-fee is an unnecessary cost to the government.

(11) If a single contractor is to be selected for the validation or engineering development effort, the contract should be negotiated using the conventional, rather than the four-step process. It is imperative that none of the rules of the four-step process be introduced into the conventional contracting process.

(12) The use of senior resident functional officials (or "over-seers") to monitor SSEB sub-group efforts on behalf of the chairman of the Source Selection Advisory Council (SSAC) may be desirable. The use of over-seers has several advantages: (1) they are on-site at all times, whereas SSAC members are often stationed at other locations; (2) they can act as the SSAC member's surrogates; (3) they are functional experts and able to act with objectivity; and (4) they can lend the weight of their senior positions to assure supporting functional areas are fully responsive to the needs of the SSEB.

3. Cost Management

a. Background.

(1) The MLRS project team made a commitment early in the project to demonstrate a cost-effective design. As a result, the project was characterized throughout conceptual development by trade-off decisions based, to a large degree, on cost and operational effectiveness analyses (COEA). These analyses were performed by various Army agencies early in the conceptual phase and, more recently, by the hardware contractors and the MLRS project management team. The early COEAs helped to establish broad system requirements, as well as design objectives. More recently, each contractor performed design

trade-off studies using life cycle cost as the cost measure of cost-effectiveness. Also level-of-repair analyses were jointly performed by the contractors and the Army as a basis for decisions. The project management team had to: (1) guide the performance of design trade-offs among system elements; and (2) implement LCC tracking and cost analyses which were responsive to the OSD Cost Analysis Improvement Group (CAIG) needs.

(2) The MLRS project team has established an intensive DTUPC program that is innovative in several aspects. The DTUPC goals have been managed by the contractors with little oversight by the project management team. Multiple cost goals were set in the original contract for each of the major hardware elements; e.g. rocket, LP/C, and launcher loader. Top level goals, with subsidiary goals were established for key project elements. To increase leverage, competition was exploited as a strategy to improve the chances of achieving cost and cost-effectiveness objectives. The DTUPC goal for the rocket was met by each contractor; but the DTUPC goal for the launcher loader was missed by a significant margin by both contractors. There appeared to be an overt decision to minimize total LCC of the program by placing management emphasis on the rocket. A second source strategy in the form of a producibility competition is being considered to improve cost competition during the Production Phase of the project; however, this strategy is sensitive to the total rocket procurement quantity and production rates.

(3) Reliability and maintainability (R&M) goals were set in accordance with the system design objectives. Unfortunately, the DTUPC goals do not appear to be consistent with the design needs to achieve the project R&M goals.

(4) The MLRS project team recommended use of the IFV derivative as the MLRS carrier because it provided an oportunity to employ a tracked-carrier

that did not require extensive development. Actually, however, adaptation of the IFV carrier -- a DSARC level project -- to the MLRS involved both cost and developmental risks. There is an inherent transfer of risk to the MLRS schedule and, obviously, a transfer of risk relative to the planned Army funding of the IFV in its basic configuration. The concurrency of development of the MLRS carrier and the IFV could increase the cost of the MLRS project because the IFV design is still immature.

(5) The MLRS project team selected the HEMTT and HEMAT as the re-supply vehicle and trailer, respectively. These new vehicle designs, although established as being cost and performance effective, will transfer risk to the project because the achievement of design characteristics, cost targets, and delivery schedules is still questionable.

(6) A LCC model (LOCAM V), utilized by Army organizations, was provided to each competitive contractor, however; it is not clear to what extent the model was used. The MLRS project team indicated that the contractors did tailor the LCC approach for their own use, and established independent data collection procedures. Each contractor established data interchange agreements with government agencies. Although the contractor costing methods were reviewed, the reviews did not evaluate the credibility of the cost estimates thus generated. The results of each analysis were documented, but only roughly. The MLRS project team had an internal LCC approach that served as a rapid LCC trade-off analysis tool. Within the project office, LCC efforts are centralized.

b. Study Team Observations.

(1) Early LCC analyses can provide management with significant insight for use in setting program goals and objectives. Clearly, adequate consideration of development and acquisition risks will help to reduce management problems and improve confidence that the goals can be achieved.

(2) Documentation of the results of early COEA must be made available to the project team as the information is useful in making early decisions.

(3) Effective DTUPC and LCC management is a definite "plus" on a program where competition has been established.

(4) The establishment of multiple DTUPC goals may not be a good management strategy when trade-offs between design elements are desired. There should be a serious attempt in any project to assure that all of the design goals and objectives are compatable with cost objectives and budgets. If they are not, the effort to assure achievement of goals and objectives could translate into significant cost overruns.

(5) Normally DTUPC goals are not set prior to Milestone II; however, the early goal setting strategy used on this project was beneficial because of the high degree of acquisition concurrency.

(6) To control cost, the project management team should assure that all significant development responsibilities are controllable in-house. When this is not feasible, the team should build in margins to allow for transference of risk between projects.

(7) It is important that major trade-offs by each competing contractor be exposed and documented for later review by members of the project team.

(8) Compressed time to IOC generates a logistics risk; thus, contractor support should be considered.

(9) When doubling (concurrency) is used, and development risks have not been resolved, competition should be maintained for as long as feasible. If the procurement is large, as in MLRS, multiple sources could provide the greatest assurance for continuing cost management, quality control, and maturation. In general, doubling is an expensive choice when the hardware is immature.

(10) A project team has a significant responsibility for LCC analyses to verify credibility of contractor choices, and to perform analyses not design-oriented. Project teams must establish an effective LCC analysis capability early in a project, using a tailored methodology, and working closely with the design contractor to assure consistency in the analytical approach.

(11) Acquisition of the cost data base can be a problem. Close cooperation with the contracts organization within the project office can provide confidence in the cost data that is acquired. The Army needs to improve its data reporting procedures to enhance costing of initial support and operating and support cost categories.

(12) Trade study analyses must be documented to justify decisions. The project team must be aware of the documentation and be able to access it within a reasonable time.

APPENDIX G

TECHNICAL MANAGEMENT

1. Background.

a. The design of the MLRS was influenced by the experience gained from earlier attempts to field an artillery rocket system; e.g., the Multiple Artillery Rocket System and the Rapid Fire Area Saturation System. These lessons included:

(1) A clear message that cost-effectiveness was a major issue. There had to be a significant advantage gained from the addition of a new system to the field artillery mix, as opposed to the activation of additional conventional cannon artillery firing units.

(2) The proposed system must have low operational and logistical manpower requirements.

b. Based on the Special Study Group's analysis of many rocket system concepts and designs, and on a cost and operational effectiveness analysis performed by the Field Artillery School, a "best technical approach" was recommended. The approach called for a system that could fire an 8-inch free rocket from a self-propelled launcher. A disposable launch pod/container would enable the system to meet operational and logistical manpower limitations, as well as provide a rapid reload capability.

c. Responsibility for the design and development of a prototype MLRS was given to the two competing contractors during the Validation Phase. Their approach to the system design was limited by: (1) the guidance discussed in paragraph b above, and (2) by the fact that the government furnished the carrier for the SPLL, the M42 submunitions carried and dispensed by the warhead, and the XM-445 fuze. Each contractor was provided with a ranked set of criteria that the system had to meet. This technique led each contractor to focus on ammunition cost-effectiveness (highest ranked criteria); and encouraged innovative use of trade-offs among the criteria.

d. Each contractor recieved an array of more than 500 targets selected especially for the MLRS mission from the SCORES target list.[1] The algorithims necessary to compute the number of rockets required to attack each target were also provided. Each contractor provided variables -- such as the numbers of submunitions in the warhead of each rocket, the radius of effect, and the rocket accuracy -- in order to determine how many rockets fired from the system would be required to attack each target. Based on the rocket costs, a system ammunition cost-effectiveness could be determined. Contractors were able to make use of trade-offs among the design variables because they knew the sensitivities of the model's output to the variables.

e. The contractors were restricted by a short prototype development schedule that forced them into a state-of-the-art design using proven technology. (Some technology, such as the warhead dispersal system, had to be demonstrated.) The decision to use the standard M42 submunition; the IFV carrier; and the XM-455 fuze designed by the Harry Diamond Laboratories further reduced each contractor's development requirements.

(1) The MLRS system was to be designed to deliver the M42 submunition. However, the M42, a dual purpose submunition standardized for use in the 155mm and 8-inch projectiles, had to be modified to function in the rocket system environment. Because of the lower acceleration and spin characteristics of the rocket versus those of the artillery projectile and the different dispensing methods (laterally exploded from the rocket warhead versus base ejection from the projectile), changes had to be made to the M42 Both Vought and Boeing introduced modifications to the M42 so that it became a non-standard item. Configuration control of these modifications was accomplished

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[1] TRADOC European Scenario, Sequence 2A, 1986.

by utilizing type designators M42E1 and M42E2 for the Boeing and Vought efforts, respectively. The Vought modifications included changes in the stabilizer ribbon and its attachment and the fuze, as well as proposed changes in body strength to withstand the radial ejection force at warhead event. These changes were sufficient to make the item no longer interchangeable with the M42. The US Army Armament Research and Development Command has assigned a new type designator to the M42E2, to make parts and assembly segregation easier to control at the Government Owned-Contractor Operated (GOCO) ammunition plants that will produce the submunitions.

(a) Early in the program, the Project Manager for Selected Ammunition (PM-SA) suggested to MICOM that he could manage the total warhead development for the MLRS project. The PM-SA pointed out that the warhead might be a high risk item.

(b) The offer was not accepted by MICOM because it was MICOM management's desire to have the contractor design, develop, and integrate the complete system; therefore, consistent with this policy, the PM-SA was tasked with responsibility for the submunition only. Each contractor, through the MLRS project office, worked with the Selected Ammunition Office to have the M42's modified to their particular requirements.

(2) The Harry Diamond Laboratories (HDL) was tasked to provide the fuze for MLRS. This course of action recognized HDL's capabilities and the recommendations made in four of the five rocket system concepts presented by the contractors in 1976 to the Special Study Group.

(a) The development schedule required that a fuze be available early in the project. Vought, for instance, needed fuzes within five to six months -- probably too short a time for development of a fuze outside of HDL. Since the fuze had to be designed against each contractor's rocket system characteristics, HDL, in effect, had to design for the worst case. The fuze was designed to meet the lower acceleration of the two systems. It had two warhead-mating methods combined on one fuze to meet the different contractor requirements, and incorporated other system-related requirements such as maximum altitude of the trajectory and rocket velocity.

(b) After early problems, the fuze performed very well (100% effectiveness) in DT-I/OT-I. Although the fuzes used during the Validation Phase were produced by HDL, a 31-month contract for their production has been awarded to KDI Corporation. The HDL technical data package was furnished to KDI and is being modified for production. A competitive second source contract is being considered for subsequent procurement. The decision will be based on the performance of the KDI fuzes. The MLRS project team is concerned that the KDI manufactured fuzes may exhibit new characteristics because of design changes deemed necessary to reduce production costs. High altitude testing of the fuze has not been completed.

(3) The Fighting Vehicle Systems (FVS) program manager was tasked to provide the carrier for the MLRS (a derivative of the IFV). Because MLRS plans to procure only 276 carriers, it was logical to consider adapting the IFV to the MLRS requirements rather than to design a new vehicle solely for MLRS. Coordination between the MLRS project team, the FVS project team, and FMC management is accomplished through an assistant FVS program manager and the West Coast Field Office personnel located at FMC.

(a) Although the carriers have been provided to the MLRS project on schedule, the IFV cost growth is jeopardizing the total buy. This, in turn, could increase the MLRS project costs.

(b) The Validation Phase prototype SPLLs were equipped with a North-seeking gyro for alignment capability. Horizontal and vertical control was to be provided by artillery survey teams and the positioning and azimuth determining system. However, based on the user's desires, future models will contain their own position determining system. Although the SPLL cost increased, the cost benefits from elimination of most of the survey personnel and equipment far exceeds the added costs.

f. Supporting Systems. Concurrent with the development of the MLRS, several other Army R&D projects are scheduled to field equipment that will enable the MLRS to achieve its maximum effectiveness. Some of these equipments are the responsibility of the MLRS project team, some are the responsibility of other project managers and material developers with whom the MLRS project team must coordinate and provide funds for the MLRS buy.

(1) Training Rockets. The MLRS project manager recommended, and the ASARC/DSARC members agreed, that the training rocket not be developed during the Validation Phase. It would not be needed early because of the requirement to fire only tactical rockets to obtain additional firing data and for training. Currently, the user is studying the problem and considering alternatives. The MLRS project manager has suggested that the user state his requirement and allow the MLRS project team to offer solutions.

(2) FIREFINDER. These are new counterbattery and countermortar radars and they are significant target acquisition systems for the MLRS. They will be fielded in the early 1980's.

(3) Remotely Piloted Vehicles. These are designed to fly into hostile territory and locate targets, adjust artillery fire, and laser designate small targets. They are in development and scheduled for fielding in the mid-1980's.

(4) Standoff Target Acquisition System. This target acquisition system operates from a helicopter flying behind friendly lines. The system is in full-scale engineering development and advanced development systems have been successively demonstrated in field maneuvers in Europe.

(5) Resupply Vehicles and Trailers. Based on their cost effectiveness, a decision was made in 1977 to use 10-ton trucks and trailers. When the MLRS need was presented, the Army identified other requirements for this size truck; and a program has been funded at TARADCOM to provide both the HEMTT and HEMAT for the MLRS project. Substitute resupply vehicles were used during OT-I. The schedule currently calls for the new vehicles to be available for OT-III.

(6) Battery Computer System (BCS). This system, being developed on the TACFIRE/BCS project at Fort Monmouth, New Jersey, will provide tactical target data to the MLRS fire units and pass on other data such as meteorological messages. The BCS will be used by cannon artillery units; it has been type classified standard. Initial production of the BCS will begin in 1980. The MLRS utilizes the battery computer unit developed as part of the BCS, however, the schedule for MLRS software has not been determined.

(7) Field Artillery Meteorological Acquisition System (FAMAS). This new meteorological set will automate the entire data collection, computation, and distribution process. It will employ a faster-rising balloon and a more efficient radiosonde. The system is desired for support of the MLRS spatial and time requirements for meteorological data. FAMAS may be in the field by the time MLRS is deployed.

(8) Platoon Leaders Digital Message Device (PLDMD). This device will enable the platoon leader to communicate by digital link with his three dispersed SPLLs and the battery. It is an important command and control device. The MLRS project manager is currently considering alternatives to this requirement. A decision is expected by 1 September 1980. The device should be available for OT-III.

(9) TACFIRE. This system communicates with the BCS, FIREFINDER, other artillery units, and FAMAS by digital data link. It is in service, but production has been halted at approximately the half-way point. MLRS batteries may be assigned to cannon artillery units equipped with TACFIRE. Separate MLRS battalions may or may not be equipped with TACFIRE. The Army is committed to getting the program funded.

(10) Test Equipment. The original MLRS automatic test equipment program plan was to use the Automatic Test Equipment, Missile Systems (ATEMS) system. However, early in 1980, a higher level decision directed that MLRS achieve compatibility with the Electronic Quality Assurance Test Equipment (EQUATE) system. This decision had a severe impact on the MLRS program. Essentially, the MLRS project team had to re-start its automatic test equipment development program. The likely result is that the MLRS EQUATE software will not be ready for IOC; and the contractor may have to provide interim general or depot support.

(11) Software. Several of the above systems require MLRS peculiar software. While there is no technical risk, a definite schedule risk exists in meeting all software requirements.

(12) Communications. No significant problem with the US systems, but integration with those of other nations may be a significant problem.

2. Study Team Observations.

a. There are lessons to be learned from previous attempts to field similar weapon systems. A review of the history of these earlier attempts, combined with the recognition of the effects of changes such as technology advances, new threats, and the improved environment for defense spending, may yield useful insights in developing new program acquisition strategy, management techniques, and the "selling" of a project to the DoD and Congress.

b. Competition should be conducted in a "hands-off" environment in order not to jeopardize the positions of the contractors, or the contract itself.

c. Allowing the contractors considerable freedom to design to a concept/requirement, rather than to strict specifications, encourages innovative solutions and trade-offs, as necessary to meet specific criteria.

d. Changes to the initial system performance requirements should be avoided unless absolutely necessary during a competitive Validation Phase. Changes cause delays and cost growth, and threaten program competition. It is important that the material developer and the user are in total agreement, and that the user gives unwaivering support to the developer. Such a rapport tends to discourage user-sponsored changes. It must be established early in the project.

e. Postponing tasks that are not time or competition critical, such as the MLRS training rocket development, could be a sensible way to focus efforts on more critical issues.

f. Moderate or lower risk is a key to avoiding cost growth and schedule slips. Risk may be reduced by selecting components/subsystems which have undergone at least one generation of development. The more immature components should receive the greatest share of early development emphasis.

g. After the competitive Validation Phase, the government needs to look at options that will allow it to recoup it's investment in the loser's effort. Use of the losing contractor as a second source during production may be one solution. However, it may be necessary to keep his technology "warm" with some transition investment. At a minimum, there should be an exchange of ideas -- an effort to bring together the people who have worked on the problems -- and early planning for technology transfer where feasible. In the case of MLRS, the competitive development, restrained by time, discouraged technology transfer even when proprietary rights could be resolved. If the Boeing TDP is to be considered in addition to the Vought TDP, there are several important issues that must be resolved by the decision-makers. These issues include:

(1) MLRS project costs will increase because of the additional test firings required, the increased fire control computer capacity needed to handle the additional algorithms, the increased development costs to improve the accuracy of the Boeing system, and increased costs to develop the terminally guided warhead.

(2) Two rocket designs would decrease the user's operational effectiveness.

(3) A question of the FRG willingness to design an AT-II warhead for the second rocket.

h. For the competitive Validation Phase, the project manager designated assistant project managers for interfacing with Vought and Boeing. The primary task of each assistant project manager was coordination with his assigned contractor. (See Appendix E, Paragraph 5i and Appendix L.).

i. All projects have problems because of variations between the prototypes and the production configurations. These problems must be anticipated, and the transition must be carefully monitored to measure, evaluate and take corrective action to minimize the effects of using different materials or manufacturing processes in the Production Phase. The impact of changes made to reduce production costs must also be measured.

j. There were project risks (schedule and cost) involved in the decision to use the IFV carrier. If that program production schedule slips, MLRS will incur delays and additional costs. These kinds of risks have to be considered by the decision makers in an accelerated project.

k. The MLRS project presents several issues that can affect a single acquisition project or, possibly, the Army acquisition philosophy as a whole.

(1) If the project manager gives the entire (or the maximum possible) hardware responsibility to the competing contractors, in-house technical expertise developed over years of participation in the system acquisition process cannot fully contribute to the design/development efforts of the competing contractors.

(2) On the other hand, if the government provides much of the system hardware, some degree of competition in the Validation Phase is sacrificed and costs and schedules may suffer because GFE puts bounds on the contractor's solutions and requires time-consuming coordination. In addition, the project team responsibilities and requirements are broadened because of the coordination and control necessary to assure system integration among the contractors and government agencies. From the project manager's view, it may be desirable to allow the contractors to be responsible for all of the hardware. This shifts the burden from the government to the contractor. (See Appendix E, Paragraph 5j for one contractor's discussion of this issue.)

(3) What is good for the project may not be best for the in-house laboratories and material developers; and vice-versa. A possible solution in the case where the contractors have had total, or near total hardware responsibility, may be to involve the in-house system after a competitive Validation Phase. The laboratories/developers could evaluate each contractor's solutions; incorporate the best of these; and include their own solutions to improve the performance and costs of the production configuration. Of course the cost and schedule impacts versus the IOC objective would have to be examined.

APPENDIX H

CONFIGURATION MANAGEMENT AND TECHNOLOGY TRANSFER

1. Configuration Management

a. Background.

(1) During the early staffing of the MLRS Project Office, the Project Manager and Deputy Project Manager recognized the need for disciplined, yet innovative, Configuration Management (CM) procedures. Therefore, in December 1976 (during the Concept Definition Phase), a person with prior CM and engineering experience was assigned as Chief, CM Offi . to plan and execute a formal CM program. The CM office was given the responsibility to identify and document the functional and physical characteristics of each configuration item, control changes to those characteristics, and to record and report change processing and implementation status. In addition, following the signing of the MOU, the CM ofice was given responsibility for codevelopment and transfer of the technical data package to the international partners.

(2) The Chief of the CM Office reports directly to the MLRS Project Manager and serves as: (a) Chairman of the Configuration Control Board (CCB) (see Figure H-1 for the CCB composition), (b) manager of CM reviews and audits, (c) manager of serialization and lot control, (d) Chairman of the Interface Control Working Group, (e) Chairman of the Metric Design Steering Committee, (f) Data Management Officer, and (g) Chairman of the Technology Transfer Metric Panel of the four-nation Production Planning Working Group.

(3) The CM Office:

(a) Assures preparation of technical documentation required to identify hardware and software baselines. The baselines are approved points of departure for control of future changes to the design and performance

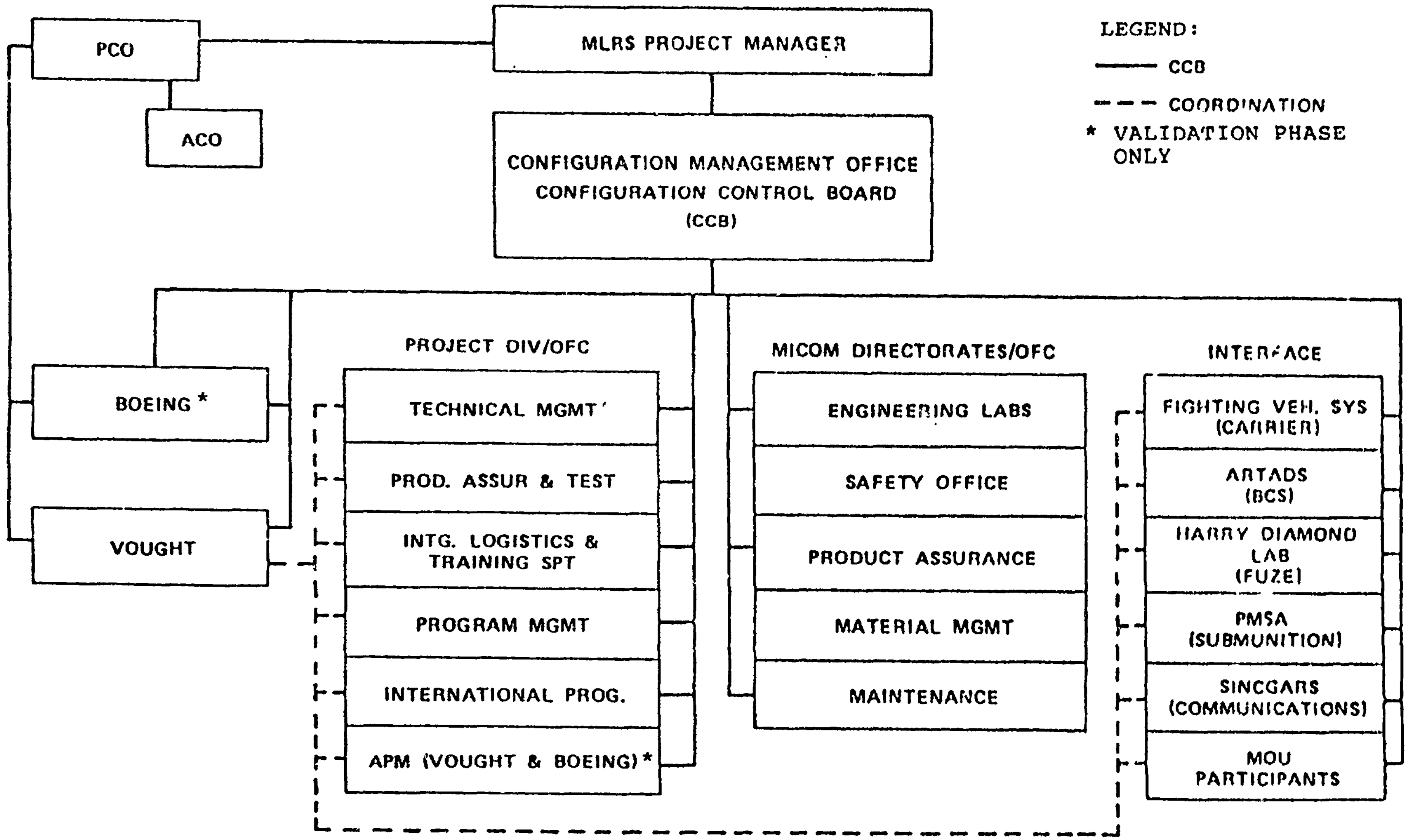

FIGURE H-1 MLRS CONFIGURATION CONTROL BOARD requirements of the system or hardware and software items. (See Figures H-2 for the nature of the MLRS CM baselines).

(b) Controls changes to approved baselines through the CCB (see Figure H-3 for specific controls required for MLRS baselines).

(c) Performs status accounting by using a computer system to record and report all changes. The recording and reporting effort includes listing approved hardware and software baselines, status of proposed changes, and implementation status of approved changes. (See Figure H-4 for status accounting to the MLRS baselines).

(d) Conducts CM reviews and audits. These include the following:

- Functional Configuration Audit (FCA) - Verification that the functional performance of the hardware fulfills the system and development specification requirements. Two such audits were planned. FCA-I was conducted during the competitive validation phase contracts to compare hardware performance with the system specifications. FCA-II will be conducted during the Maturation/Initial Production Phase contract to compare hardware performance with the development specifications.

- Physical Configuration Audit - Comparison (100%) of the as-built initial production hardware with the product baseline documentation to assure their compatibility.

- Configuration Item Verification Review - Verification that the full scale production hardware of the initial and second source contractor is being produced on hard tooling and to the product baseline documentation.

(e) Defines and manages interfaces between contractor provided hardware and that provided by other government agencies and the international partners. The following are examples of how these interfaces are managed:

- Carrier. Fighting Vehicle Systems Program Office, by approved support agreement, scope of work, and interface control documentation.

- Fuze. Harry Diamond Laboratories, by approved support agreement, scope of work, and interface control documentation.

<u>FUNCTIONAL BASELINE</u> (CONCEPT DEFINITION PHASE)

- APPROVED SYSTEM SPECIFICATION
- USED FOR AWARD OF COMPETITIVE VALIDATION CONTRACTS

<u>ALLOCATED BASELINE</u> (VALIDATION PHASE)

- DRAWINGS/SPECIFICATIONS PREPARED DURING VALIDATION CONTRACT
- USED FOR AWARD OF MATURATION/INITIAL PRODUCTION CONTRACTS

<u>PRODUCT BASELINE</u> (MATURATION PHASE)

- ALLOCATED BASELINE UPGRADED DURING MATURATION/INITIAL PRODUCTION CONTRACT
- USED FOR AWARD OF US FULL-SCALE PRODUCTION CONTRACT AND CO-PRODUCTION BY ALLIES

FIGURE H-2 MLRS CONFIGURATION MANAGEMENT BASELINES

FUNCTIONAL BASELINE

- FULL GOVERNMENT CONTROL FROM AWARD OF VALIDATION PHASE CONTRACT (SEP 1977)

ALLOCATED BASELINE

- GOVERNMENT CONTROL OF DEVELOPMENT SPECIFICATIONS AND ASSEMBLY DRAWINGS AFTER APPROVAL DURING VALIDATION PHASE CONTRACT (MAY 1980)

PRODUCT BASELINE

- FULL GOVERNMENT CONTROL AFTER APPROVAL DURING MATURATION/INITIAL PRODUCTION PHASE CONTRACT (DEC 1982)

INTERFACE CONTROL DOCUMENTATION

- FULL GOVERNMENT CONTROL FROM DATE OF APPROVAL
- INCLUDED AS PART OF ALLOCATED AND PRODUCTION BASELINES

FIGURE H-3 MLRS CONFIGURATION CONTROL

<u>FUNCTIONAL BASELINE</u>

- o MANUAL

<u>ALLOCATED BASELINE</u>

- o CONTRACTOR'S COMPUTER

<u>PRODUCT BASELINE</u>

- o CONTRACTOR'S COMPUTER
- o GOVERNMENT'S COMPUTER FOR THE TECHNICAL DATA/CONFIGURATION MANAGEMENT SYSTEM

FIGURE H-4 MLRS CONFIGURATION STATUS ACCOUNTING

- o Submunition. Development Project Office for Selected Ammunition, ARRADCOM, by approved support agreement, and production drawings.
- o Communication. Communications Research and Development Command, by general support agreement with MILCOM and interface control documentation.
- o AT-II Scatterable Mine Warhead Section. International partners by MOU and interface control documentation.

(4) The MLRS project is one of the first major US defense systems to be designed using the metric system of units. The metric criteria was selected as achievable in the late 1970's and early 1980's. The metric system of units is being refined as multinational cooperation expands and it will facilitate production of MLRS hardware by the international partners. The MLRS contract statement of work specifically requires:

(a) All new components/systems are to be designed in metric units.

(b) Off-shelf components, previously qualified, are to be retained in the units in which they were designed.

(c) Electronic parts are to meet US military specifications.

(d) Fasteners are to conform to the international metric standards.

(e) Materials are to be procured/processed in metric units.

(f) Engineering data are to be presented in metric units.

(g) Technical reports, if prepared using US analytical techniques, are to be presented in metric units.

(h) Commercial test equipment may be built in US units, but must be altered to display metric values.

(i) Delivered drawings are to be in metric units, unless otherwise indicated.

(j) Mil Specs are to be modified by notes or reference documents to interface with the metric standards.

(k) Hardware is to be designed for user operation, maintenance, and assembly using common metric hand tools.

b. Study Team Observations.

(1) The need for dedicated CM procedures and the assignment of at least one person in the CM area during the Concept Definition Phase are vital to the success of a project.

(2) The head of the CM office should report directly to the project manager. This will ensure that: (a) sufficient attention is given to this important discipline, and (b) the head of the CM office will be able to participate in project planning on an equal basis with all of the other project office disciplines.

(3) The early establishment of support agreements and interface control documentation is essential to ensure that: (a) the responsibilities of each agency are documented, and (b) a competitive environment is maintained when providing identical government furnished equipment to each competing contractor.

(4) A unique change processing procedure should be used when the Allocated Baseline is upgraded to the Product Baseline. Specifically, only the development specifications and top assembly drawings should be released to government control as a part of the Allocated Baseline. This requirement binds the contractor to performance, yet allows him to exercise control below the government approved level of the TDP. Before approval of the Product Baseline in the Maturation/Initial Production Phase, considerable costs can be saved by not processing Engineering Change Proposals (ECP) against all of the Allocated Baseline elements.

(5) A Functional Configuration Audit should be conducted during the Validation Phase to verify that the hardware satisfies the system specifications (Functional Baseline). An audit should also be required in the Maturation (or Engineering Development) Phase to verify that the hardware satisfies the requirements in the development (or performance) specifications.

(6) The system specifications (Functional Baseline) should be placed under government control prior to award of the Validation Phase contract. This will assure that the requirements are firm. On the MLRS project, only four ECPs were processed against the system specifications during the 32-month Validation Phase.

(7) During the Validation Phase, Level 1 drawings should be required rather than higher level (Level 3) drawings. This is a good procedure to follow because Level 1 drawings:

(a) are less costly than higher level drawings,

(b) are more economical when there are competing contractors,

(c) satisfy minimum requirements for entry into initial low-rate production, and

(d) can be upgraded to Level 3 (full-scale production quality) during the single contractor Maturation/Initial Production Phase.

(8) The MLRS configuration management provisions in the Memorandum of Understanding were as follows:

> "The US Project Manager, who will act as overall program coordinator, will establish a configuration management system and maintain control of the MLRS baselines by approving all changes throughout the project life cycle. He will be guided by a system configuration control board which will have a representative of each participating nation."

To date, this approach appears to be satisfactory.

(9) The establishment of a CM plan, as well as the project instructions associated therewith, is necessary for effective functioning of the CM procedures and it substantially supports the attainment of project objectives.

(10) The maintenance of adequate and accurate technical documentation, defining both hardware and software baselines, helps to: (a) assure the minimization of project costs, and (b) protect project schedules.

(11) Problems encountered in manufacturing and test can be resolved more readily if the exact configuration is known.

(12) Problems associated with the integration and checkout of subsystem elements can be minimized if the CM procedures are effective.

(13) Configuration changes can be evaluated promptly, and those deemed necessary can be incorporated expenditiously, if the configuration has been closely controlled and properly identified.

(14) The use of the Metric System of units can enhance RSI and coproduction by international partners.

(15) Initial efforts to use metrication on the MLRS project resulted in the following:

(a) Fear of the unknown (greatest obstacle).

(b) Discovery of non-availability of US metric standards.

(c) Discovery of non-availability of metric stock material.

(d) Delay in delivery of metric fasteners.

2. Technology Transfer

a. Background.

(1) The MLRS project team emphasized rationalization, standardization, and interoperability principles in discussions with the NATO nations. This culminated in a Memorandum of Understanding (MOU) establishing a Cooperative Development Program. It also established provisions for future production by the international partners. During the preparation of the MOU, CM and technology transfer provisions were established. The European partners were briefed on the US configuration management procedures, the TDP preparation

requirements, and the terms and conditions for the transfer of the TDP to the European partners for production purposes. A CM/Technology Transfer Milestone Schedule was prepared for the Cooperative Development Program.

(2) The MLRS hardware TDP was prepared in the metric system of units and, where available, European standards were used. Any variance to the US TDP is to be funded by the partners in accordance with the MOU.

(3) The MOU gave the MLRS Project Office the sole approval authority for all changes to the TDP. To accomplish this, the European nations were made members of the CCB. In order to facilitate the actions to be taken, the local representative of each partner acts for his nation and takes a position on each change. The MOU discourages variant designs in the MLRS TDP.

(4) TDP Transfer

(a) Authority for transfer of the TDP to the European partners was established by the MOU. To ensure a basic understanding of the content of the TDP and the transfer process, a Technology Transfer Plan was prepared by the MLRS CM office and approved for use. According to this plan, there will be two basic TDP transfers, provided that the terms and conditions are met:

- Allocated Baseline TDP in Oct 80
- Product Baseline TDP in Dec 82

(b) The Allocated Baseline TDP will be used for early production planning by the European participants. The Product Baseline TDP will be used in obtaining final bids for the production contract. Technical assistance requirements will be funded by the requesting participants. Details of the TDP transfer and production by the participants will be handled by the four-power Production Planning Working Group.

(c) The methods to be used for transfering technology are as follows:

- Government-to-Government: The MOU provides authority for transfer of all TDP elements, excluding limited and proprietary rights data.

- Contractor-to Contractor: Under the provisions of the Munitions Control Act and the International Traffic in Arms Act, an export license will have to be obtained from the Department of State by the US contractor to transfer limited and proprietary rights data.

The TDP will be transferred in the form of 35 mm microfilm aperture cards for all MLRS peculiar design elements.

b. Study Team Observations.

(1) Analyses of documentation related to technology transfer and in-depth discussions with dual production personnel from other programs have resulted in a better understanding of the procedures to be used, and of the physical transfer of technology (through a technical data package) to the international partners.

(2) The method of transfer can be either from: (a) contractor-to-contractor, or (b) government-to-government.

(a) In the contractor-to-contractor method of transfer, the US project manager should require that the US contractor(s) involved apply for and receive an export license(s) prior to transferring technical data. The contractor(s) should become legally responsible for the content of the TDP, the deliveries, the warranties (if any), and the schedules. The US project office should be responsible for monitoring, reviewing, and placing final approval on the application for a license. The export license should become the vehicle by which all subsequent data and materials are transferred.

(b) In the government-to-government method of transfer, the US project manager should submit a letter to the US Army Materiel Development and Readiness Command (DARCOM) requesting authority to transfer technical data to the international partners. After DARCOM approval of the technology transfer request, it must be forwarded to the Deputy Chief of Staff for Research, Development, and Acquisition (DCSRDA), Headquarters, Department of Army, for final approval. Upon granting this approval, the partners and the US project manager should be notified. Subsequently, coordination should take place between the US project office and the NATO participants. The MLRS MOU, as approved by DoD, contains authority for government-to-government technology transfer.

(3) The acquisition of limited and proprietary data rights, along with associated costs, incurred by the current owners and developers, should be borne by the NATO participants as set forth in the MLRS MOU.

(4) The TDP, in the form of 35mm microfilmed aperature cards, should be assembled by the US project office and sent directly to the participating country through embassy channels for transmittal to the foreign contractors who will be producing the weapon system.

(5) Criteria for transfer of technical data to a European partner includes the following:

(a) An evaluation of the TDP should be performed by the US project office prior to its transfer to a European partner.

(b) The configuration control management team should exercise control of the product configuration throughout the program.

(c) The European partners should build-to-print only.

(d) A change to the design should be paid for by the partner requiring the change.

(e) State Department, Commerce Department, and embassy contacts; customs and duties requirements; and audit capabilities of the partners should be established early in the project.

(f) Ground rules and requirements imposed on US prime contractors and their US suppliers should be established early in the project.

(g) American English should be established as the governing language, if possible. (On the MLRS: English, French and German are equally authoritative.)

(h) The European partners should be furnished all of the drawings, specifications, and associated performance documentation, and should be charged only for the cost of reproduction, packaging, and transportation.

(i) Longer lead times should be planned for the items produced by the European partners.

(6) A specific group of personnel should be appointed within the US project office to handle technology transfer requirements. This will ensure that the tasks, and problems associated with the tasks, are handled more expeditiously and cost-effectively than would otherwise be possible. Further, such a group should be able to minimize program schedule delays.

(7) The MOU should specify that: (a) the US government TDP shall be used, (b) changes can only be approved by the US Project Manager, (c) any approved change must be funded by the requesting partner, and (d) any technical assistance requirement must also be funded by the requesting partner.

(8) US project office manpower planning and requests for personnel should include the number of personnel required to manage the technology transfer activity and other RSI efforts. The need should be made known well in advance of MOU approval; otherwise, it would be more difficult to obtain the personnel space allocations.

APPENDIX I

TEST AND EVALUATION MANAGEMENT

1. Background

a. Validation Phase.

(1) The test program for the MLRS was tailored to support the accelerated acquisition strategy. DT-II/OT-II tests, which normally provide the data to support decisions for transition into low-rate production, were conducted in a combined DT-I/OT-I. Therefore, DT-I/OT-I tests were more comprehensive than those normally conducted during a Validation Phase. Figure I-1 shows the MLRS Validation Phase Test Schedule. Instead of testing on "breassboard" or surrogate hardware which simulates technical and operational characteristics, engineering prototype hardware was designed, fabricated and tested for the MLRS project. The system designs which were tested during government-scored testing (ADVT-G, portions of EDT-G, and OT-I) represented the production configurations and successfully demonstrated the potential of the MLRS to meet the specified performance requirements with no major hardware design changes resulting. Minor hardware design changes, identified at the end of the Validation Phase, were planned for implementation early in the Maturation/Initial Production Phase. Testing and qualification of all hardware changes were planned for accomplishment during the Maturation/ Initial Production Phase. Software changes, such as updating the ballistic algorithm, were planned to be accomplished as additional flight test data were collected and analyzed during the Maturation/Initial Production Phase.[1/] The plan calls for validation of the product configuration during PQT and OT-III, but prior to system IOC.

[1/] "MLRS Test and Evaluation Master Plan," May 1980

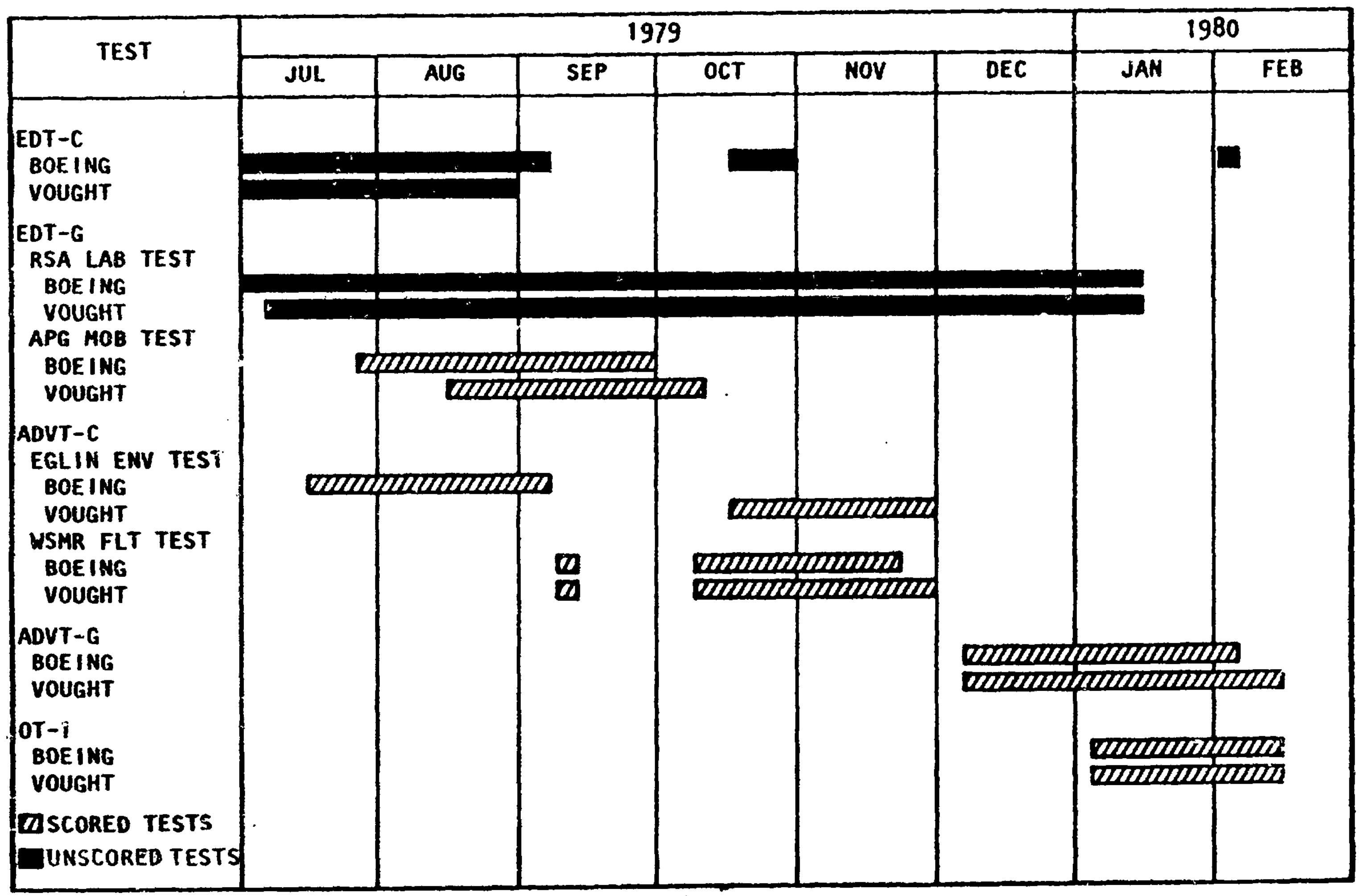

FIGURE I-1 VALIDATION PHASE TEST SCHEDULE

(2) The MLRS project team established two Test Integration Working Groups (TIWG) to integrate the test requirements, data requirements, and other peculiar requirements from all participating organizations into a combined program. The TIWGs were formally chartered on 26 October 1976 and met at least every six months to review the test progress and coordinate changes for future test activities. Boeing was a member of one TIWG, Vought was a member of the other. The other TIWG members were from the following organizations:

- MLRS Project Office (material developer)
- AMSAA (independent DT evaluator)
- OTEA (operational tester and independent OT evaluator)
- TECOM (development tester)
- MICOM (maintenance planner)
- LEA (logistician)
- TRADOC (combat development/user)
- PM Selected Ammunition (M-42 submunition developer)
- PM FVS (MLRS carrier developer)
- Harry Diamond Laboratories (fuze developer)

These TIWG members were informed that there was a short and firm schedule, due to the Validation Phase contractual requirements, and to be deviations from standard testing procedures because of the omission of Milestone II.

(3) International program management is accomplished through the MLRS International TIWG which consists of representatives from each of the participating nations. In addition, both the UK and Germany have personnel working in the Test Branch of the MLRS Project Office.

(4) ADVT-G was also conducted at WSMR by the US Army Test and Evaluation Command (TECOM) to verify that the two contractor's designs satisfied system requirements. ADVT-G tests accumulated 3976 Km and 720 firing cycles

and 48 scored rocket firings for accuracy, reliability, and effectiveness. Tests conducted during this phase provided a major portion of the data utilized (scored) by the government for the independent evaluation testing and included:

(a) SPLL performance and endurance testing

(b) System flight tests with rockets and LP/Cs at ambient and high/low temperature conditions (LP/Cs and rockets were subjected to stockpile-to target environmental sequence prior to flight testing).

(5) The US Army Materiel Systems Analysis Agency (AMSAA) conducted an independent evaluation of the developmental tests. An AMSAA MLRS Team was formed as soon as the TIWG became operational in 1977. Team members came from the following AMSAA divisions and offices.

- Ground Warfare Division - Team Chief
- Reliability, Availability, and Maintainability Division
- Tactical Operations Analysis Office
- Survivability Office
- Combat Support Division
- Communications and Electronics
- Mobility
- Industrial Logistics and Support Analysis
- Human Engineering Laboratory Detachment

Personnel from AMSAA, an independent evaluation agency within DARCOM, worked for the MLRS project team and evaluated the system against the Required Operational Capability (ROC) and the issues in the Decision Coordinating Paper (DCP). The ROC is considered by AMSAA as the project office contract with the Department of the Army. The evaluations were coordinated and reconciled with the MLRS project manager. Although it was not necessary in the case of MLRS, AMSAA can bring unreconcilable issues to the attention of DARCOM for resolution. As an independent development evaluator, AMSAA has its own funding. When AMSAA does developmental testing, it is funded by the project office involved.

(6) OT-I was conducted by the US Army Test and Evaluation Agency (OTEA) using one SPLL, four training LP/Cs, two tactical LP/Cs, and twelve rockets from each of the Boeing and Vought system designs. The SPLLs were driven a total of 1582 Km and 195 dry firing cycles were accomplished during the Fort Sill Phase of OT-I. At White Sands Missile Range (WSMR), 24 rockets were fired. OTEA, an independent operational test and evaluation agency, has its own funding. Its tests were designed against predicated operational issues and criteria.

(7) Figure I-2 shows the Validation Phase test results.

b. Maturation/Initial Production Phase.

(1) Because the Maturation/Initial Production Phase is a concurrent effort, the test schedule is critical. Design maturation, and the completion of all components/subsystems and software must be accomplished prior to Force Development Testing and Experimentation (FDTE) and operational testing. Some components/subsystems were not fully tested or qualified during the Validation Phase, and other components/subsystems development must be completed during the Maturation/Initial Production Phase. The availability of these equipments, and their software for OT-III and IOC, are critical to the MLRS achieving its full effectiveness.

(2) A recent report by the General Accounting Office (GAO) addressed the problem cited in the above paragraph.[2/] The GAO suggested that, because the MLRS's full potential would not be realized in the early years of its

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2/ GAO Report BAD-80-43, "Current Difficulties in Effectively Deploying MLRS Renders Program's Concurrency Questionable," 12 June 1980.

<u>WEAPON SYSTEM</u>

- TECHNICAL PERFORMANCE REQUIREMENTS ARE ACHIEVABLE WITH CURRENT DESIGNS
- WEAPON SYSTEM IS SAFE FOR OPERATIONAL TESTING

<u>SPLL</u>

- PROVIDES AN ACCURATE AND DURABLE LAUNCH PLATFORM
- DEMONSTRATED MOBILITY AND ENDURANCE AS SELF-PROPELLED LAUNCHER LOADER
- DEMONSTRATED PERFORMANCE IN ARCTIC, DESERT AND TROPIC ENVIRONMENTS WITH ONLY MINOR PROBLEMS WHICH ARE CORRECTABLE
- DEMONSTRATED C-141 AIR-TRANSPORTABILITY

<u>LP/C</u>

- APPEARS CAPABLE OF PERFORMING IN ALL INTENDED ROLES (TRANSPORTATION, STORAGE AND LAUNCHER CONTAINER)

<u>ROCKET</u>

- PERFORMANCE DEMONSTRATED OVER TOTAL RANGE REQUIREMENTS
- FUZE PERFORMED 100% OF TIME IN SCORED FIRINGS

FIGURE I-2 VALIDATION PHASE TEST PROGRAM ACCOMPLISHMENTS deployment, it should follow the more conservative acquisition approach of further proving the system before production, e.g., sequentially rather than concurrently. The GAO position is not unique, although, surprisingly, it is contrary to Congressional interest in accelerating the MLRS project. Although authority exists for accelerated acquisition, not all of the "players" in the defense system acquisition process agree that it is an appropriate strategy. The proponents of concurrency recognize the risks in, and the urgency of, the project. They believe that the risks are acceptable in view of the requirement for the MLRS.

(3) The project manager has recognized the following test and evaluation problems associated with accelerated development:3/

(a) The accelerated program did not allow for testing of the integration of MLRS into the Field Artillery system before low-rate production.

(b) Training devices and logistic support will not be completed and tested before full-scale production.

(4) The OT-I test report by OTEA pointed out that:4/

(a) Reliability and Maintainability had only limited evaluation.

(b) The resupply evaluation was limited.

(c) Interface equipment (such as BCS, PLDMD) were not available.

(d) Command and control issues had a limited evaluation

(e) Evaluation of supply and maintenance activity was limited.

The general observation by OTEA was that OT-I was more a validation of MLRS, than the operational test usually accomplished prior to a production decision.

(5) The AMSAA evaluation test results were inclined to be more critical than the OTEA test results. AMSAA comments included reference to several problem areas:5/

3/ "MLRS Integrated Program Summary," 5 May 1980.
4/ OTEA, "Executive Summary OT-I, MLRS," May 1980.
5/ AMSAA, "Executive Summary, MLRS," May 1980.

(a) Warhead performance

(b) SPLL aiming accuracy

(c) Effects of environmental extremes

(d) Reliability and Maintainability evaluation limitations

(e) Identification of issues that could not be evaluated

With some reservations, AMSAA agreed that the risks were acceptable and it supported the production decision.

2. Study Team Observations.

a. When a weapon system acquisition project is subjected to an accelerated schedule, it cannot meet all of the normal Milestone III requirements. The entire acquisition community should be cognizant of this fact and planning should be adjusted accordingly. The "players" must realize that the system may go into low-rate production before test and evaluation results can provide answers to all of the questions customary asked at ASARC/DSARC meetings. The decision-makers must be prepared to weigh the urgency of the need against the potential remaining risks in the system development process. If, as in the case of the MLRS, the urgency is considered high and the risks moderate to low (a moderate risk may be defined as one that will not delay the program in excess of six months), the decision to go into initial low-rate production is valid.

b. An early task for the project manager is the education of the acquisition community to the nature of the test and evaluation program. This goal can be achieved if the project manager has total weapon system responsibility. The test and evaluation management responsibility can be delegated to a product assurance and test division, whose representative acts as chairman of a Test Integration Working Group.

c. Success, as measured by the fact that a project has been given the go-ahead to proceed with the Maturation/Initial Production Phase, can be attributed to close, early coordination among all involved in the test and evaluation activity. Each activity has a schedule that has to be met if a project is to stay on schedule. The Validation Phase schedule applies to all staffs, agencies, and commands involved in test and evaluation activities.

d. One concern of the test and evaluation agencies is that the performance of the prototype and production systems can be significantly different. This concern stems from the LANCE project experience where many minor fixes resulted in significant performance changes.

e. There should be a continual effort to educate and reeducate (because of personnel changes) the acquisition community, concerning the unique nature of an accelerated program.

APPENDIX J

INTEGRATED LOGISTICS SUPPORT MANAGEMENT

1. Background

a. The MLRS Integrated Logistics Support Plan (ILSP) provides key logistics milestones including: provisioning, training, testing, ammunition, manpower requirements, publications, and technical data for the Maturation/Initial Production Phase and follow-on phases.

b. MLRS will be supported within the existing maintenance and supply concepts and organizations. It will have a total organic support capability.

c. The maintenance concept for the MLRS will be based upon maximum utilization of the established four levels of maintenance, without the addition of specialized maintenance organizations or detachments. The MLRS rocket will be a wooden round. No maintenance, other than normal routine surveillance, will be accomplished in the field. Recertification will be accomplished through lot sampling, functional testing, evaluation of annual service practice firings, and visible surveillance. Recertification intervals will be not less than twelve months.

d. Operator maintenance functions will include the performance of checks, adjustments, preventative maintenance, and minor repair functions such as replacement of bulbs. The operator will be able to monitor system performance by the self-check and system monitoring capability of the Built-In-Test Equipment (BITE). Malfunctions detected by BITE will be reported to the battery maintenance section for isolation to the "black box" level.

e. Organizational maintenance and supply will be performed by Field Artillery battery or battalion personnel, and will include the removal and replacement of electronic assemblies using BITE system servicing, and other minor repair beyond the capability of the operator. Organizational maintenance will perform adjustments and alignments not performed by the operator. Defective assemblies will be evacuated to the direct support unit for exchange. Direct support functions will include both maintenance and supply.

(1) Direct support maintenance unit personnel will:

(a) Be capable of performing all of the maintenance functions authorized for the organizational maintenance level and repair and replacement of parts/units as authorized in the maintenance allocation charts.

(b) Be able to fault-isolate system assemblies and cables not identified by BITE.

(c) Handle removal and replacement actions through mobile contact teams.

(d) Evacuate unserviceable assemblies to the general support unit for repair.

(e) Maintain a direct exchange facility for MLRS assemblies.

(2) General support maintenance unit personnel will:

(a) Provide backup for direct support maintenance units.

(b) Have the capability to repair assemblies evacuated from the direct support maintenance unit.

(c) Using automatic test equipment, repair electronic assemblies by removal and replacement of printed circuit boards.

f. Depot maintenance unit personnel will:

(1) Overhaul repairable systems, end items, assemblies, and subassemblies, including those items beyond the capability of the general support unit.

(2) Repair printed circuit boards evacuated from general support.

(3) Support the MLRS concurrent with IOC.

g. The decision to utilize EQUATE may require interim contractor support for the MLRS electronics. This decision may also change the following depot assignments which were based on Automatic Test Equipment for Missile Systems (ATEMS):

(1) OCONUS

Pirmasens Repair Facility - MLRS electronics

Mainz Maintenance Plant - MLRS, less electronics

(2) CONUS

Anniston Army Depot - MLRS electronics

Red River Army Depot - MLRS, less electronics.

h. Maintenance float requirements were computed and submitted in the Army Acquisition Objective (AAO) in August 1979. These numbers were revised slightly in the January 1980 AAO. They include both the operational readiness float and repair cycle float for CONUS, USAREUR, and KOREA.

i. Transportability criteria require that the SPLL and LP/C be transportable by aircraft, railroad, truck and ship. The Military Airlift Command (MAC) Airlift Center has conducted load tests of the contractor's SPLL and LP/C and certified these units as air transportable on both C-141 and C-5A aircraft. The SPLL, when loaded on commonly available railroad flat-cars in CONUS, will meet the clearance requirements of the Association of American Railroads Diagrams. The SPLLs are transportable aboard most C3 and C4 break-bulk freighters, roll-on/roll-off ships, and most container ships. The LP/Cs are transportable by all modes of transportation and present no special problems. Initial rail impact tests of the LP/Cs started at Redstone Arsenal in October 1979, and are to be completed in May 1981. Results to date indicate that the shock isolation systems will have to be modified. Rail impact tests and road transportability tests of the LP/Cs will be conducted by the Defense

Ammunition Center, Savannah, Illinois, during the Maturation/ Initial Production Phase. These tests will evaluate the shock isolation and tie-down system. Rail impact tests of the SPLL will also be conducted during the Maturation/Initial Production Phase.

j. No unique requirements have been identified for preservation and packaging of the system. Development of preservation and packaging data, and testing of components and assemblies, will be accomplished during the Maturation/Initial Production Phase.

k. The US Army Tank-Automotive Research and Development Command (TARADCOM) is staffing a ROC document for the Heavy Extended Mobility Tactical Truck (HEMTT) for the Army. The PM for these vehicles expects to award a contract in December 1980 if funding is authorized. Sixty HEMTTs have been programmed as the initial buy for MLRS.

l. A Preliminary Required Operational Capability (PROC) for handling equipment to move LP/Cs into and within storage facilities has been written by the Army Missile and Munitions Center and School. A commercial front/side-loading electric forklift is being considered. The material handling equipment is planned to be available before the MLRS IOC.

m. MLRS Requirements for troop billets, maintenance facilities, and ammunition storage facilities were identified to USAREUR. That command presented the final MLRS budget requirements for Military Construction-Army funds to DA in May 1980.

n. The formal, individual, and unit training will be conducted at Fort Sill, OK; Aberdeen Proving Ground, MD; Redstone Arsenal, AL; and Fort Knox, KY. Skill performance aids, training materials, and technical manuals will be used in the training program. The complete training schedule is contained within the Integrated Logistics Support Plan.

o. The training base will be established as early as possible by utilizing five refurbished prototype SPLLs and five production SPLLs. The latter SPLLs are part of the nine SPLLs required for the PQT and OT-III test programs, and will be used by the Fort Sill training organizations. Three of the remaining four SPLLs will be placed at the training base in late 1982 (end of PQT and OT-III). This plan will establish a ten-SPLL training base as early as possible and it is in agreement with the scope of the MILPERCEN Initial Recruiting and Training meeting of April 1979. A total of eighteen SPLLs will eventually be available for the training base (five prototype and thirteen production).

2. Study Team Observations.

a. The establishment of working groups involving user, logistical, and technical personnel facilitates data flow and enhances interface communications.

b. The materiel readiness commands should establish points of contact at the start of any accelerated project. It is important to a project's success that the commands have knowledgeable people on board early.

c. The materiel development commands should be levied for resources and support by the project office early in a project. In responding to the levies, maximum use must be made of existing expertise.

d. The TRADOC System Manager should define the system concept in sufficient detail early in a project to preclude changes that could adversely affect the project schedule or increase project costs.

e. The MCA funding cycle has a five-year lead time associated with it. Therefore, it is important that MCA requirements be defined early in a project. This is particularly important in an accelerated project, such as the MLRS.

f. When a weapon system requires that real estate be made available in a foreign country, action to obtain such real estate should be taken as soon as the requirement is recognized. This is critical in an accelerated project.

g. Preparation of the training plan should be initiated during the Concept Definition Phase in an accelerated project.

h. TRADOC should be sensitive to specific project objectives and requirements to ensure that the overall training plan is supportive of the project.

APPENDIX K

INTERNATIONAL PROGRAM MANAGEMENT

1. Background.

a. In 1969, the basic principles for multinational cooperation in research, development, and production of military equipment were set forth in NATO Document C-M (66) 33 (2nd revise) (1). These principles are:

(1) Each country is responsible for equipping its own forces, whether NATO-assigned or not.

(2) Cooperation is indispensable for countries with relatively limited technical and economic resources; such cooperation should permit all members to participate in the research, development, and production effort, to the extent of their willingness to contribute effectively thereto.

(3) It is politically desirable that cooperation take place in NATO or under the NATO aegis.

(4) The characteristics of the system should be based on decisions made by member countries having responsibility for equipping forces.

(5) The system should be permissive, in that countries should bring their ideas for cooperative action to NATO for discussion.

(6) The new system should provide for an adequate sharing of the scientific, technical, and economic benefits resulting from each cooperative program, as a counterpart to the effective contributions of each country.

(7) Consultation on military operational concepts, as well as exchange of information on specific projects, should continue.

b. In April 1977, the United States submitted a proposal for cooperative development of the MLRS. A four power working group, composed of the Federal Republic of Germany; the United Kingdom of Great Britain and Northern Ireland, the Republic of France; and the United States, was established to draft an

MOU. On 14 July 1979, the MOU became effective and included technical and tactical concepts; logistical principles; and provisions for admission of other interested NATO countries. A joint MLRS Project Steering Committee was formed to monitor the implementation of the tasks enumerated in the MOU.

2. Study Team Observations.

a. Although the MLRS has been fully established as a multinational cooperative program, this was not accomplished without problems. These problems were partially due to the lack of guidance and direction from higher headquarters in the US government. Until the methods of dealing with NATO RSI are centrally controlled within the US Government, and RSI becomes "institutionalized" for all multinational programs, problems similar to those experienced on MLRS will occur on other programs in the future. Today, the basic principles for multinational cooperative programs serve only as a guide, and not as a working method.

b. A MOU should be prepared when multinational interest in a program becomes evident.

c. The draft MOU should be coordinated with the Department of State.

d. A MOU should be written so as not to jeopardize the national sovereignty of the United States.

e. The MOU should be very specific so as not to permit gross interpretation. Therefore, it is important that representatives of the prime contractor, as well as any GFE contractors, participate in the preparation of the MOU.

f. There is a long lead time involved in obtaining Department of State approval of translations of the MOU. It is important that the translations be prepared by higly qualified professional translators who are familiar with the jargon of defense agencies.

g. Adequate facilities for international meetings, requiring interpreters, are not available within the Pentagon. Therefore, such meetings should be held outside of the Pentagon. The Department of State will assist in providing facilities and interpreters.

h. It is important that the US delegation have one, and only one, spokesman, preferably the project manager.

i. In meetings of national representatives on a multinational program, it is imperative that good minutes of the proceedings be taken and signed by all parties prior to adjournment of the meeting.

j. In a multinational program it is important to have a close association among the engineers from the countries involved, not just for the purpose of liaison, but for actual participation in system development. The MLRS Project Office has eight engineers from the European countries actively working in Huntsville, Alabama.

k. Army project offices should make maximum use of the DARCOM offices in Bonn, Federal Republic of Germany and London, England and the DoD Office of Defense Cooperation in Paris, France. These offices can act as expediters for a multinational program.

l. Army project offices may utilize interpretor/translator services on an as available basis from the DARCOM Foreign Science and Technology Center, Charlottesville, Va.

m. In any competitive multinational program, the US competitors should not be permitted to link-up with foreign counterparts until a single contractor has been chosen and the Europeans have decided who will produce their system.

n. The transfer of technology to a foreign country requires licensing by the contractor. The export licenses must be obtained by the contractor and approved by the Department of State.

o. Currently, all US classified material being transferred to the co-producers of the MLRS must be staffed through the Assistant Chief of Staff, Intelligence. This procedure is too time-consuming. A procedure, that permits expeditious transfer of project data to European partners on a need-to-know basis, is needed.

p. A more efficient method for verification of security clearances of foreign nationals working in a project office should be implemented. Too much time is needed to process the paperwork using the current procedures.

APPENDIX L

SAMPLE PROJECT OFFICE POLICY FOR CONTACTS WITH AND DIRECTION OF COMPETITIVE CONTRACTORS

1. GENERAL

a. All reasonable requests for information from contractor personnel may be complied with directly by appropriate action personnel in the PM Office; however, any response requiring a written reply will be approved by a Division Chief and, in the case of the prime contractors, by an Assistant PM. Under no circumstance will competitive sensitive information relative to one contractor be made available to another contractor.

b. Any government direction to a contractor will be executed in writing, approved, when applicable, by an Assistant PM; concurred in by the Chief, Procurement and Production Branch, Resources Management Division, and the Legal Counsel; and signed by the PM/DPM. All direction affecting the scope of a contract will be processed through the Contracting Officer. Care must be taken in all working discussions with contractor personnel to avoid the appearance of giving "unofficial" direction to the contractor.

c. No hard or fast rule can be made as to what may constitute a requirement to give official direction to a contractor. Each situation will be judged on its own merit during the course of the contract, the interests of the government being paramount.

2. COMPETITIVE PRIME CONTRACTORS

a. Direct, working-level contact with the prime contractor is essential for fact gathering. The same individual (except for the Assistant PMs) may interface with each prime contractor for data gathering purposes.[1/] Whenever data indicates that a condition exists which is not in the best interest of

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1/ Note: Assumes than an assistant project manager was assigned to each of the competitive prime contractors.

the government, it will be brought to the attention of the responsible Division/Office Chief and the applicable Assistant PM. The Assistant PM will be responsible for directing any detailed analysis of the data which may be required; determining what course of action to take; obtaining the approval of the PM and, when appropriate, the concurrence of the Legal Counsel and the Contracting Officer; and forwarding any necessary guidance or comment to the applicable contractor.

b. Extreme caution must be exercised to assure that competition is maintained. Any information or direction given to a competitive contractor by the government must not work to improve his competitive position (defined as any action which improves the technical or operational characteristics of the system, makes the system cost less in production: i.e., DTUPC; or reduces development time or cost to the detriment of the other contractor.

c. Government personnel will not provide any recommended solution to what has been presented as, or is construed to be, a contractor's problem.

d. Revealing data of one competitive contractor to another is absolutely forbidden and extreme care must be exercised by all concerned to prevent this from inadvertently occurring. When representatives from a contractor visit the PM Office, or any segment thereof, all data pertaining to the other contractor must be secured in a file cabinet. Separate notebooks (one for each prime contractor) will be maintained by each individual in the PM Office keeping notebooks to prevent a possible compromise of information. All COMPETITIVE SENSITIVE material will be so marked and identified as to the contractor involved.

APPENDIX M

MLRS PROPOSAL EVALUATION CRITERIA

Criteria used for evaluation of proposals for the MLRS Maturation/ Initial Production Phase are identified below in their ranked order.

Criterion 1: Ammunition Cost Effectiveness

The score for Criterion 1 was based on an evaluation of the total ammunition cost required to defeat the government's target array, as specified in the RFP.

Criterion 2: Maturation and Full Scale Development Proposals

Evaluation of the proposals was performed in four areas - technical, cost, operational, and management. The following weights were utilized in scoring: technical, 30%; cost, 35%; operational, 20%; management, 15%.

Criterion 3: Low Rate Production Proposal

Evaluation of the low-rate production proposals was performed in three areas -- technical, cost, and management. The following weights were utilized in scoring: technical, 30%; cost, 50%; management, 20%.

Criterion 4: Mission Cycle Times

Scoring of this criterion was based upon the times demonstrated during operational testing.

Criterion 5: Operational Utility

This criterion was scored using the following factors: investment and support costs; human engineering; logistic support; survivability growth potential; operator skill/training requirements; safety.

Criterion 6: Initial Production Facilities Proposal

Evaluation of the initial production facilities proposals were performed in three areas -- technical, cost, and management. The following weights were utilized in scoring: technical, 30%; cost, 45%; management, 25%

Criterion 7: Validation Phase Contractual Performance

This criterion was scored based on information from the MLRS Project Office. The information was based on a continual assessment accomplished over the life of the Validation Phase contracts to determine the achievement of program and cost objectives; i.e., contractual performance. The assessment of each offeror's Validation Phase management performance was made through award fee evaluations. Assessment of attainment of Validation Phase cost objectives, i.e., cost performance, was made through analysis of cost performance reports. The following weights were utilized in scoring: management performance, 50%; cost performance, 50%.

Criterion 8: Reliability and Maintainability

The purpose of the reliability factor was to assess and evaluate the quantitative reliability achievements during the Validation Phase. Data utilized was obtained from the development and operational tests. The purpose of the maintainability factor was to estimate and evaluate the quantitative maintainability achievements of the Contractor Furnished Equipment designs for the SPLL. Two maintainability parameters -- mean time to repair and maximum corrective maintenance time -- were evaluated at each of two maintenance levels, organizational and direct support. The following weights were utilized in scoring: reliability, 70%; maintainability, 30%.

Criterion 9: Conformance to System Specifications

The offeror's Validation demonstration hardware was evaluated on a point-by-point basis against the requirements of the MLRS system specification. The evaluation considered only those specification elements not scored under other criteria. The results of government and offeror testing, together with the design description in the Maturation/Initial Production Phase proposal, served as the basis for this evaluation. Scoring was done using a listing contained in the Source Selection Plan. If, through no fault of the offeror, an item could not be scored, then that item was not scored for either offeror and remaining weights were adjusted to a 100 point basis.

APPENDIX N

GLOSSARY OF ACRONYMS

AAO	Army Acquisition Objective
ADVT-C(G)	Advanced Development Verification Test-Contractor (Government)
AMSAA	US Army Material Systems Analysis Agency
APG	Aberdeen Proving Ground, MD
ARRADCOM	US Army Armament Research and Development Command
ASARC	Army Systems Acquisition Review Council
ATE	Automatic Test Equipment
ATEMS	Automatic Test Equipment, Missile System
BCS	Battery Computer System
BITE	Built-In Test Equipment
CAIG	Cost Analysis Improvement Group
CCB	Configuration Control Board
CFE	Contractor Furnished Equipment
CM	Configuration Management
COEA	Cost and Operational Effectiveness Analysis
CONUS	Continental United States
DA	Department of the Army
DARCOM	US Army Material Development and Readiness Command
DCP	Decision Coordinating Paper
DCSRDA	Deputy Chief of Staff for Research, Development, and Acquisition
DESCOM	US Army Depot Systems Command
DoD	Department of Defense
DoDD	Department of Defense Directive
DPM	Deputy Project Manager
DSARC	Defense Systems Acquisition Review Council
DSMC	Defense Systems Management College
DT	Development Test
DTC (DTUPC)	Design-to-Cost (Design-to-Unit-Production-Cost)
ECP	Engineering Change Proposal
EDT-C(G)	Engineering Design Test-Contractor (Government)
EQUATE	Electronics Quality Assurance Test Equipment
ERADCOM	US Army Electronics Research and Development Command
FAMAS	Field Artillery Meteorological Acquisition System
FDTE	Force Development Testing and Experimentation
FRG	Federal Republic of Germany
FSP	Full-Scale Production
FVS	Fighting Vehicle Systems
GFE	Government Furnished Equipment
GSRS	General Support Rocket System
HDL	Harry Diamond Laboratories
HEMAT	Heavy Expanded Mobility Ammunition Trailer
HEMTT	Heavy Expanded Mobility Tactical Truck

ICD	Interface Control Document
IFV	Infantry Fighting Vehicle
ILSP	Integrated Logistics Support Plan
IOC	Initial Operational Capability
IPF	Initial Production Facilities
LCC	Life Cycle Cost
LEA	Logistics Evaluation Agency
LLM	Launcher Loader Module
LP/C	Launch Pod/Carrier
LRIP	Low-Rate Initial Production
LRP	Low-Rate Production
MCA	Military Construction, Army
MICOM	US Army Missile Command
MIPA	Missile Procurement, Army
MLRS	Multiple Launch Rocket System
MOB	Mobility
MOU	Memorandum of Understanding
NATO	North Atlantic Treaty Organization
OCONUS	Outside Continental United States
O&MA	Operation and Maintenance, Army
OMB	Office of Management and Budget
OSD	Office of the Secretary of Defense
OT	Operational Test
OTEA	US Army Operational Test and Evaluation Agency
PCO	Principal Contracting Officer
PLDMD	Platoon Leader's Digital Message Device
PM	Project/Program Manager
PMO	Project/Program Management Office
PQT	Production Qualification Test
PROC	Preliminary Required Operational Capability
PVT	Production Validation Test
RAM	Reliability, Availability, and Maintainability
RDTE	Research, Development, Test, and Evaluation
RFP	Request for Proposal
R&M	Reliability and Maintainability
ROC	Required Operational Capability
RSA	Redstone Arsenal, AL
RSI	Rationalization, Standardization and Interoperability
RST	Resupply Trailer
RSV	Resupply Vehicle
SA	Selected Ammunition
SPLL	Self-Propelled Launcher Loader
SSAC	Source Selection Advisory Council
SSEB	Source Selection Evaluation Board

ACRONYMS (Cont'd)

SSG	Special Study Group
SSP	Source Selection Plan
TARADCOM	US Army Tank-Automotive Research and Development Command
TD	Technical Data
TDP	Technical Data Package
TECOM	US Army Test and Evaluation Command
TIWG	Test Integration Working Group
TRADOC	US Army Training and Doctrine Command
TSM	TRADOC System Manager
UK	United Kingdom
USAREUR	US Army Europe
WSMR	White Sands Missile Range, NM

APPENDIX O

STUDY TEAM COMPOSITION

1. Team Leader

Lieutenant Colonel Garcia E. Morrow is the Chief, Research Division, Defense Systems Management College, Fort Belvoir, Va. He graduated from St. Lawrence University in 1963 with a Bachelor of Science degree. Following graduation, Ltc. Morrow entered the US Army as an Air Defense Artillery officer. He is a graduate of the US Army Guided Missile Staff Officer Course and has had R&D assignments with the Pershing, Sargeant, Lance and SAFEGUARD Systems.

2. Team Members

a. Mr. David D. Acker is Professor of Management and Senior Advisor, Defense Systems Management College, Fort Belvoir, Va. He earned two degrees at Rutgers University, a BSME in 1948 and an MS in 1950. Prior to joining DSMC seven years ago, Mr. Acker served for three years in the Plans and Policy Office, Directorate of Defense Research and Engineering, Office of the Secretary of Defense. He spent twenty-three years in industry in design and development, as well as in management and administration of Army, Navy, Air Force, and NASA projects and programs. During World War II, Mr. Acker served with the US Army in the European Theater of Operations.

b. Mr. Eugene Beeckler is a Procurement Analyst with the US Army Procurement Research Office, US Army Logistics Management Center, Fort Lee, Va. He received a BBA from the University of Wisconsin in 1961 and an MS in Procurement and Contract Management from the Florida Institute of Technology in 1976. Mr. Beeckler has worked on APRO projects in the areas of warranties, change order administration, evaluation and negotiation of IR&D and B&P costs, and Acquisition Strategies for Nondevelopmental Items. Mr. Beeckler was a

Contract Specialist with the AMC Chicago Procurement District, the NIKE-X Project Office and various Commands assigned to Ballistic Missile Defense Program. Mr. Beeckler was also a Supervisory Contract Specialist/Contracting Officer with the US Army Procurement Agency, Europe, Frankfurt/Main, FRG. After a short assignment as a Contract Negotiator with the Army Missile Command, Mr. Beeckler joined the APRO.

c. Mr. Elmer H. Birdseye is a retired US Army Officer who is currently employed as a management analyst with Information Spectrum, Incorporated, Arlington, Va. He is a 1951 graduate of the United States Military Academy. He received a Master of Engineering Administration degree from the George Washington University in 1968. Mr. Birdseye's military experience includes service with field artillery howitzer and rocket units; R&D staff officer in the Office of the Deputy Chief of Staff for Research and Development, Department of the Army; and as the US Army Field Artillery Standardization Representative to the United Kingdom.