# REPORT TO THE CONGRESS



## Need For Long-Range Planning For Avionics Development Programs

B-174248

Department of the Army

*BY THE COMPTROLLER GENERAL OF THE UNITED STATES*

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-174248

To the President of the Senate and the
Speaker of the House of Representatives

This is our report on the need for long-range planning for avionics development programs of the Department of the Army.

Our review was made pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

Copies of this report are being sent to the Director, Office of Management and Budget; the Secretary of Defense; and the Secretary of the Army.

Comptroller General
of the United States

*COMPTROLLER GENERAL'S REPORT TO THE CONGRESS*

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## D I G E S T

### *WHY THE REVIEW WAS MADE*

In prior reviews of Army aircraft system developments, the General Accounting Office (GAO) found that significant aircraft modifications were necessary due to the need to redesign armament and avionics subsystems to correct development deficiencies. Because the standard lightweight avionics equipment (SLAE) package, which was committed for use in several new Army aircraft systems, was experiencing development problems impacting on airframe programs, GAO reviewed the SLAE program to determine the underlying causes for such program shortcomings.

### *FINDINGS AND CONCLUSIONS*

Although the military characteristics established in May 1960 for the light observation helicopter limited the weight of the avionics equipment to 100 pounds, in October 1960 Army officials decided to use existing equipment which was about 55 percent heavier. The Army did not contract for the development of lightweight avionics until 1966, about 4 years after contracting for the helicopter development. This delay forced a compression of the development cycle of SLAE and, in GAO's opinion, was the primary cause of development and production problems. GAO believes that this inadequate planning occurred because the Army did not have a system for long-range avionics planning to provide timely identification of the avionics subsystems needed for its aircraft. (See p. 12.)

As a result of the delay in starting the development of SLAE, the Army found it necessary to push the avionics package into production 9 months before preliminary design testing was completed to meet aircraft delivery schedules. Because SLAE was not available, older, larger, and heavier avionics equipment ultimately was installed in all 1,071 helicopters initially contracted for. An older type UHF-AM transceiver was installed also in 942 helicopters bought on follow-on contracts. Use of the substitute equipment reduced the effectiveness of all 2,013 helicopters. (See p. 19.) The schedule slippages and design changes to overcome deficiencies in the avionics equipment produced additional costs of about $2.4 million. (See pp. 20 and 21.)

In December 1966 the Assistant Chief of Staff for Force Development directed the installation of SLAE in seven additional Army aircraft systems and in all Army aircraft produced after fiscal year 1969, even though SLAE had never been successfully tested in the light observation helicopter

for which it was designed. A component of the SLAE package also was specified for installation in five aircraft systems as a second FM transceiver. These actions were taken without determining whether the expected benefits would outweigh the expected cost and before completion of any testing of SLAE to determine its suitability for Army use. (SLAE also was selected for installation in an aircraft system procured for the Air Force, the Navy, the Marine Corps, and the Canadian Armed Forces.) (See p. 23.)

SLAE was not installed in two of the aircraft systems because the Army later determined that this use was not cost effective. Installation in three other aircraft systems was canceled because SLAE was not available, but modifications to one of these aircraft systems to prepare for SLAE installation had cost about $185,000. (See p. 23.)

The Army issued invitations for bids on a second FM transceiver for the SLAE at an estimated cost of over $20 million without determining whether the need justified the cost. The Army also did not consider the alternative of using FM transceivers already being used in other Army aircraft. GAO brought this to the attention of Army officials who promptly reevaluated the requirement and reduced the planned procurement about $7 million. (See pp. 26 and 27.)

A decision was made in August 1969 by the Commanding General, Army Materiel Command, to transfer program and fund control of the Avionics Laboratory from the Electronics Command to the Aviation Systems Command. This decision, however, has not been implemented. GAO believes that, if the Aviation Systems Command is given program and fund control, it should also be given command control over the Avionics Laboratory to avoid the problem of dual control of the laboratory. (See p. 33.)

*AGENCY ACTIONS AND UNRESOLVED ISSUES*

In commenting on a draft of this report, the Army agreed that improved long-range planning was needed. The Army did not agree, however, with our findings and conclusions as to the causes of the SLAE developmental problems. The Army contended that these problems had been caused by changing requirements and unforeseen technical difficulties. GAO believes that these problems would have been minimized or avoided if the Army had initiated plans for the development of lightweight avionics in 1960 to meet the military requirements then specified.

The Army also commented that the GAO recommendations were sound management practices. The only action cited by the Army, however, was that a long-range avionics plan was being prepared. (See p. 40.) No work has actually begun in preparing the long-range avionics plan.

The Army stated that suitable regulations were in effect to control the commitment of untested subsystems to additional systems. The regulation referred to in the Army reply controls type classification of materiel; however, it does not preclude the commitment of incompletely tested subsystems to additional systems.

In the reply the Army stated that cost-effectiveness determinations and economic analyses were required and that the appropriate degree of cost analyses had been conducted. GAO found that these determinations and analyses had not been prepared and that additional controls were needed to ensure their preparation. (See p. 30.)

The Army stated also that the regulation requiring economic analyses was sufficiently clear regarding which activity prepared these analyses, in this case the Army Materiel Command. The Army Materiel Command's implementing regulation, however, does not clearly indicate which of its subordinate commands should prepare the analyses when more than one subordinate command is involved. (See pp. 30 and 31.)

The Office of the Secretary of Defense (OSD) disagreed with a GAO proposal that engineering development not be approved unless all critical subsystems were under development with sufficient lead time to ensure proper interface. OSD contended that SLAE was not committed to additional systems prior to testing and that therefore the proposal was not appropriate. GAO disagrees. The plan to install SLAE in additional aircraft was included in the Five Year Avionics Requirements Plan used as the basis for procuring avionics and for modifying aircraft to accept new avionics. Based on this plan, one project manager initiated modification actions to enable installation of SLAE. These were subsequently terminated because of nonavailability of the SLAE.

OSD similarly disagreed with a GAO proposal that congressional committees be advised when engineering development of a weapon system is authorized, although a critical subsystem is still under development for another system.

*RECOMMENDATIONS OR SUGGESTIONS*

The Secretary of the Army should:

- --Place additional emphasis on the timely preparation of a long-range avionics requirements plan. (See p. 18.)
- --Prepare a regulation which prohibits commitment of incompletely tested subsystems to additional systems except under extraordinary conditions. (See p. 31.)
- --Establish additional controls to ensure that cost-effectiveness determinations and an analysis of economic alternatives are prepared prior to program approval, as required by Army regulations. (See p. 31.)
- --Initiate actions that will clarify responsibility within the Army Materiel Command for preparing an economic analysis when more than one of its subordinate commands are directly involved. (See p. 31.)

In addition, the Secretary of Defense, before approving engineering development of an aircraft, should require that all subsystems needed to

fulfill critical requirements of an aircraft be under development and have sufficient lead time to ensure proper interface. (See p. 18.)

The Secretary of Defense also should establish procedures whereby his authorization is required prior to commitment of a critical developmental subsystem to additional systems before it is proven acceptable by suitable tests. (See p. 31.)

*MATTERS FOR CONSIDERATION BY THE CONGRESS*

GAO believes that the Congress may wish to be informed by the Secretary of Defense when critical subsystems still in development are committed to additional systems, since such commitments can have adverse effects on the performance of all involved systems and on the combat effectiveness of the U.S. Armed Forces.

# Contents

ABBREVIATIONS

| | |
|---|---|
| GAO | General Accounting Office |
| OSD | Office of the Secretary of Defense |
| SLAE | standard lightweight avionics equipment |
| RFP | request for proposal |

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# CHAPTER 1

## INTRODUCTION

A review of the development, production, and installation of the standard lightweight avionics equipment package in Army aircraft has been made by the General Accounting Office to enable an evaluation of the Army's management of avionics programs, including planning, development, and production. Avionics equipment is vital to the accomplishment of aircraft missions. Avionics provides the primary means of communication, identification, and navigation to aircraft systems and also represents a substantial and increasing percentage of total aircraft system costs.

The objective of the SLAE program, when originated in 1964, was to provide a compact, lightweight, inexpensive avionics package for the light observation helicopter. Later the package was committed for use in several other aircraft systems. The SLAE contract cost, initially valued at $16.1 million, had increased to about $39 million by December 1970. In September 1970 the contractor submitted a claim for $44.6 million more to cover extra costs incurred in the development and production of SLAE. We did not determine the validity of the contractor's claim.

## DESCRIPTION OF SLAE PACKAGE

The SLAE package consists of the following items.

| Equipment | Model designation | Major function |
|---|---|---|
| VHF-FM transceiver | AN/ARC-114 | Very-high-frequency FM radio used to send and receive messages from ground and airborne units. |
| VHF-AM transceiver | AN/ARC-115 | Very-high-frequency AM radio used to send and receive messages from the control tower. |
| UHF-AM transceiver | AN/ARC-116 | Ultra-high-frequency AM radio used to send and receive messages from the control tower. |
| Automatic direction finder | AN/ARN-89 | Navigational aid giving automatic or manual compass bearing on any radio signals within a given frequency range. |
| Intercommunication control set | C-6533/ARC | Provides a means for crew selection of any of the transceivers for voice transmission and for communications among crew members. |

The SLAE package is about one third of the size and weight of the former avionics equipment and uses 800 watts less power. See page 11 for photography provided by the Army comparing SLAE components with current equipment.

## MANAGEMENT STRUCTURE FOR AIRCRAFT AND AVIONICS PROGRAMS

Responsibility for management of Army avionics for aircraft systems is divided among several organizations described briefly below.

### Office of the Assistant Chief of Staff for Force Development

This Office is responsible for approving requirements, coordinating development programs, determining priorities, and designating equipment to be included in Army budget submissions.

### Office of the Assistant Chief of Staff for Communications-Electronics

Some of the functions of this Office are to review, monitor, and coordinate tactical communications requirements, research and development, logistics, personnel and training, and associated programs and budgets, to provide integrated tactical communications systems.

### U.S. Army Combat Developments Command

This command develops, tests, and recommends improved operational and doctrinal concepts for the Army and monitors research and development programs to ensure that new equipment meets Army requirements. It provides the Army Materiel Command with guidance and requirements from equipment users.

### U.S. Army Materiel Command

The Army Materiel Command provides centralized direction of its subordinate commands which are responsible for management of equipment. Those involved in avionics include the Aviation Systems Command, the Electronics Command, and the Test and Evaluation Command.

U.S. Army Aviation Systems Command

This command is responsible for the development, production, initial fielding, and supply and maintenance support of Army aircraft systems. At the time of our review, this command also prepared (jointly with the Electronics Command) the Five Year Avionics Requirements Plan for Army aircraft. Prior to fiscal year 1968, this command only coordinated and approved plan requirements after the fact.

Overall management of aircraft systems is assigned to project managers who are responsible to the Commanding General of the Aviation Systems Command.[1] During aircraft systems development, the aircraft project manager is responsible for ensuring timely development and testing and successful integration of subsystems, such as avionics, being developed by other commodity commands. He also budgets engineering development funds for avionics peculiar to his aircraft systems and funds to procure installed-avionics equipment. But these funds are released directly to the Electronics Command by the Army Materiel Command.

The SLAE package initially was developed for use in the light observation helicopter, and the above-mentioned aircraft project manager assumed overall responsibility for this avionics program. In December 1968 this responsibility was transferred to the project manager for Selected Avionics Equipment for Army Aircraft at the Electronics Command.

U.S. Army Electronics Command

The Electronics Command is responsible for the life-cycle management of avionics equipment, including research, development, procurement, and supply management. This command prepares the Five Year Avionics Requirements Plan for Army aircraft jointly with the Aviation Systems Command.

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[1]Prior to August 1969 project managers were responsible to the Commanding General, U.S. Army Materiel Command.

The Avionics Laboratory of the Electronics Command carries out research and development for avionics equipment and provides systems engineering support for the integration of avionics equipment in Army aircraft.

Centralized management for the SLAE package is assigned to the project manager for Selected Avionics Equipment for Army Aircraft. He is responsible for the coordination and control of the development, procurement, distribution, and logistical support of SLAE. He reports to the Commanding General of the Electronics Command.

U.S. Army Test and Evaluation Command

This command is responsible for planning, coordinating, conducting, and evaluating engineering and service tests of avionics equipment and the equipment's integration with aircraft systems.

## ARMY STUDIES OF AVIONICS MANAGEMENT

The Army has conducted studies of its avionics program management, including the development of SLAE. One of these studies was made by the Research Analysis Corporation, McLean, Virginia, for the Office of the Chief of Research and Development. This comprehensive study was authorized because of concern over the organization, procedures, and rationale used by the Army for development of avionics and because of concern that Army avionics lagged behind the state of the art. A report on this study was issued in October 1967. (See p. 15.)

In April 1969 the Army asked a consultant to form a committee to examine the technical and administrative evolution of the SLAE program and to recommend improved procedures for the acquisition of avionics systems for future aircraft. A report on the findings and recommendations of this committee, known as the Avionics Systems Committee, was issued in October 1969. (See p. 16.)

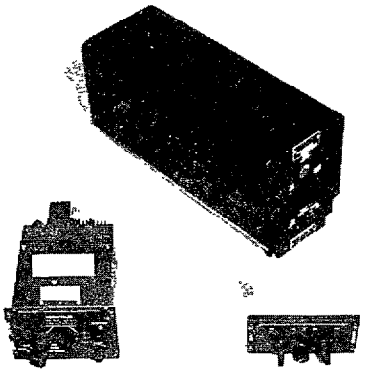
On July 15, 1971, the Army Audit Agency issued a special report of audit number NE 72-5, entitled "Standard Lightweight Avionic Equipment." The report contained several recommendations which would, if implemented, terminate all procurements of additional quantities of SLAE components unless reviews being conducted by the Assistant Chief of Staff for Force Development and the Army Materiel Command indicated that SLAE components met Army requirements. In such event the Army Audit Agency recommends that sufficient testing be performed to ensure that reported deficiencies are corrected and that Army requirements are met before the components are deployed.

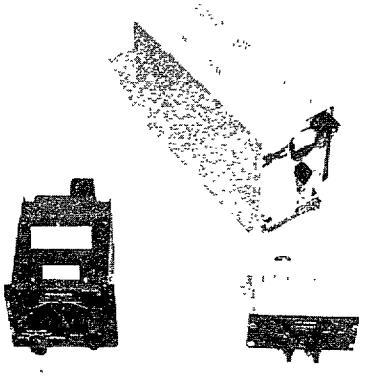
The recommendations in the Army Audit Agency report were based on unsatisfactory equipment reports from Vietnam and on deficiencies reported by the Army Test and Evaluation Command.

A preliminary draft of this report was furnished to OSD for comment. The Acting Assistant Secretary of the Army (Research and Development) replied on June 11, 1971, on behalf of the Secretary of Defense. The comments are discussed in pertinent sections of this report and are

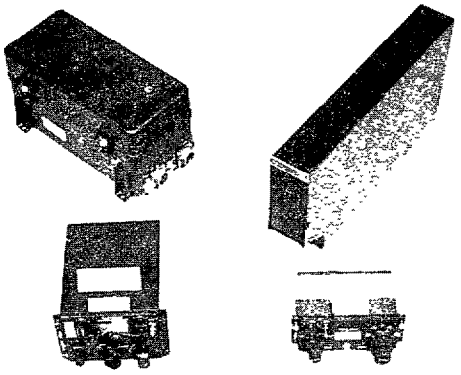
included as appendix II. A chronology of events is included as appendix I to this report.

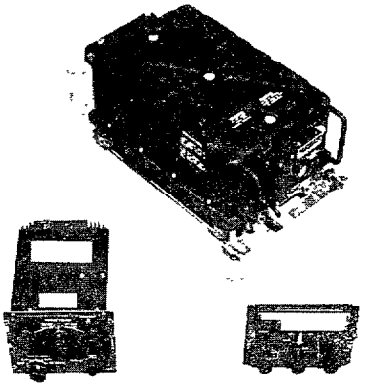
# COMPARISON OF SLAE COMPONENTS WITH CURRENT EQUIPMENT

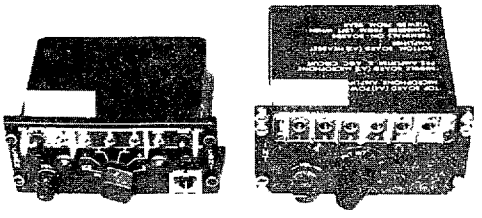


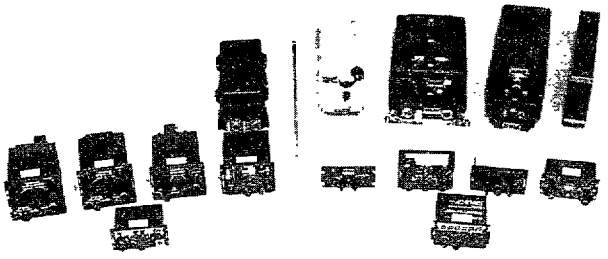


VHF AM RADIO SETS









| | BAND | MODE | |
|---|---|---|---|
| AN/ARC-[illegible] | [illegible] | [illegible] | |
| AN/ARC-[illegible] | UHF | AM | |
| AN/ARC-[illegible] | | | |
| AN/ARC-[illegible] | | | |
| AN/ARC-[illegible] | VHF | AM | |
| AN/ARC-[illegible] | | | |
| AN/ARC-[illegible] | UHF | AM | |
| AN/ARC-[illegible] | | | |
| AN/ARC-[illegible] | AUX | | |
| AN/ARC-[illegible] | | | |
| [illegible] | GUARD CONTROL | | |
| [illegible] | JAMMER CONTROL | | |

## CHAPTER 2

## PROPER INTERFACE OF SLAE AND HELICOPTERS HAMPERED BY LACK OF LONG-RANGE PLANNING

Although the military characteristics established in May 1960 for the light observation helicopters limited the weight of helicopter avionics equipment to 100 pounds, Army officials decided in October 1960 to use existing equipment that was about 55 percent heavier. The Army did not contract for development of lightweight equipment until 1966, about 4 years after contracting for development of the helicopter. The results of this delay are discussed in chapter 3. (See p. 19.)

We believe that this inadequate planning occurred because the Army had no system for long-range planning (10 to 15 years) to provide for timely identification of the avionics subsystems needed for aircraft. Since then the Army has developed a long-range plan of its contemplated aircraft requirements through 1985 but has not developed a plan for avionics equipment needed for the aircraft. We believe that a long-range avionics plan is necessary to ensure the timely development of equipment needed for the aircraft.

In its comments on the draft report, the Army disagreed with our position that avionics available in 1960 exceeded the 100-pound weight limitation in the military characteristics for the light observation helicopter.

The Army reply stated that the characteristics specified (1) complete provisions[1] for UHF-AM and VHF-AM transceivers with only one to be installed at a time, (2) a VHF-FM transceiver, an auxiliary FM receiver, and an FM homing, (3) two intercom stations, (4) one headset, (5) complete provisions for an automatic direction finder (installation dependent on mission), and (6) space, weight, and

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[1]All necessary wiring, brackets, etc., needed for installation and operation.

power[1] for battlefield identification of friend or foe. The reply stated also that, using standard avionics available in the early 1960's, the weight of the required equipment totaled 100 pounds. (See p. 41.)

In its 1967 report on the Army's management of its avionics programs, the Research Analysis Corporation listed the individual weights of the required avionics equipment specified in the military characteristics. These weights totaled 155 pounds, or 55 percent over the 100-pound weight limitation.

The Army computation of 100 pounds did not include either the automatic direction finder or the identification of friend or foe. The automatic direction finder was specified in the military characteristics as being required on some flights, although the identification of friend or foe was to be included on the aircraft as soon as it became available. Consequently the weight of these items (31 pounds) was an important factor in meeting the military characteristics specified in 1960.

The Army computation of 100 pounds also did not include any provision for the antennas and associated equipment necessary for the operation of the avionics equipment. When the weight of these items (24 pounds) is considered, the total weight of the avionics is 155 pounds. The importance of this additional weight to the effectiveness of the helicopter is explained on page 20.

The Army reply stated that the 100-pound weight limitation on the avionics equipment was not exceeded until 1964, when the mission selectable avionics concept was changed, when the identification of friend or foe system was approved, and when voice security equipment became necessary. As shown above the total weight of the required avionics equipment specified in the 1960 military characteristics was 155 pounds.

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[1]Make available space and power for the equipment as well as provide for the weight of it.

The reply stated also that a weight reduction through the use of solid-state communication radios appeared to be possible in 1964. The Research Analysis Corporation report stated that this equipment was well within the development state of the art in 1960. We believe that, if the Army had planned for the development and production of the solid-state avionics for use in the light observation helicopter on a more timely basis, the problems encountered with this equipment could have been recognized earlier and possibly could have been resolved before the aircraft became operational.

## NEED FOR LONG-RANGE PLANNING

In January 1964 the helicopter project manager informed the Electronics Command that existing avionics equipment was too large and too heavy for the helicopter. This was almost 4 years after approval of the helicopter, and 2 more years elapsed before the Electronics Command contracted for the development of SLAE in January 1966.

The contract provided for deliveries beginning in January 1968, which would have allowed the installation of SLAE in the 483d light observation helicopter. This allowed only 2 years for development and production of SLAE, although 5 to 8 years normally are required for projects of this kind.

The Army asked the Research Analysis Corporation to study Army avionics management. Its 1967 report[1] showed:

1. That transistorized circuitry was well within the development state of the art (1960) and that a lightweight avionics package could have been formally recommended coincident with the light observation airframe development.

2. That the avionics weight limitation specified in military characteristics documents could not be satisfied by hardware then existing.

3. That the request for proposal (RFP) for the avionics was issued almost 5 years after the initial RFP (1960) for the airframe.

4. That SLAE-equipped aircraft were scheduled for delivery only 27 months after the avionics contract was awarded. No other Army equipment of such major proportions or impact had been able to proceed through the testing and acceptance cycle with such speed.

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[1]Research Analysis Corporation report RAC-R-22, October 1967, "Avionics Development and Technology."

These findings were recognized by the Avionics Systems Committee in an October 1969 report on SLAE.

In our opinion, the lack of planning for avionics precipitated a sequence of events which adversely affected the light observation helicopter program. The issuance of the contract for development of SLAE about 4 years after the contract for development of the light observation helicopter compressed the SLAE development period to meet aircraft delivery schedules, which resulted in inadequate development and production before some of the technical difficulties were known or solved. These problems led to impaired aircraft effectiveness and to costly modifications.

The Research Analysis Corporation, in its 1967 report, recommended a long-range plan for Army aviation and a companion long-range avionics plan. In 1969 the Army prepared a plan which projected its aircraft systems requirements from 1970 to 1985. This plan did not identify the avionics equipment needed but did state that the aircraft systems would need communications and navigation equipment. We found that there was no companion long-range avionics plan in support of the aviation plan.

## PROPOSED ARMY AVIONICS PLAN

In July 1970 the Office of the Assistant Chief of Staff for Communications-Electronics prepared a plan for tasks to be accomplished during a 2-year study to develop an Avionics Master Plan. An Army official told us that the study was necessary because of the lack of adequate management information on avionics and because of failure in the past to ensure adequate avionics for Army aircraft.

Included in this study plan were tasks designed to determine avionics needed to support projected aircraft missions to meet the estimated threat. From such information the tasks were to identify avionics technology and subsystem developments needed to meet these requirements. The information would provide necessary guidance for the avionics part of the air mobility research and development program. But the study plan had not been approved at the time that we completed our fieldwork in December 1970.

## CONCLUSIONS, PROPOSALS, AND AGENCY COMMENTS

In our opinion, the lack of adequate planning for avionics to meet the needs of the light observation helicopter was the primary cause of development problems encountered later in the SLAE program. To ensure the timely development of avionics equipment, we believe that the Army should prepare a long-range avionics plan to support its long-range aviation plan.

In replying to our draft report, the Army disagreed with our conclusion as to the cause of the development problems in the SLAE program. The Army said that the problems had been caused by changing requirements and unforeseen technical difficulties. (See p. 40.)

It is our belief that, if planning had been adequate and if the development of SLAE had started on a timely basis, provision for unforeseen technical difficulties might have been included in the development time schedules. Also time might have been available to cope more effectively with changing requirements. These problems might have been solved before production, and thus the Army might have avoided additional problems and costs and the need to authorize

production. (Our position on this matter is given in greater detail in ch. 3, p. 19.)

We proposed that the Secretary of the Army have a long-range avionics plan prepared to support the long-range aircraft requirements plan. The Army replied that such a plan was needed and was being prepared. (See pp. 43 and 44.)

The plan being prepared is for the aforementioned Avionics Master Plan which is to include long-range avionics requirements. Planning for this plan was authorized in April 1969. A coordination draft of the tasks to be accomplished during a 2-year study leading to an Avionics Master Plan was distributed in July 1970. This study plan was revised and a second coordination draft was issued in September 1971. No work has actually begun on the study or on the preparation of the Avionics Master Plan itself. Considering the long delays that have occurred already, we believe that the Secretary of the Army should accelerate the preparation of a long-range avionics requirements plan.

We proposed also that the Secretary of Defense, before approving engineering development of an aircraft, require that all subsystems needed to fulfill the critical requirements of the aircraft be under development and have sufficient lead time to ensure proper interface. The reply stated that one of the prime objectives of a development program was to ensure that all subsystems were developed in sufficient time for proper interface. However, no specific actions related to our proposal were cited. (See pp. 44 and 45.)

## RECOMMENDATIONS

We recommend that the Secretary of the Army take actions which will place additional emphasis on the timely preparation of a long-range avionics requirements plan.

We recommend also that the Secretary of Defense direct that procedures be established to ensure that, before engineering development of an aircraft is approved, all subsystems needed to fulfill critical requirements of the aircraft are under development and have sufficient lead time to ensure proper interface.

## CHAPTER 3

## ADVERSE EFFECTS OF INADEQUATE AVIONICS PLANNING

As a result of the delay in starting the development of SLAE, the Army found it necessary to push the avionics package into production before testing was completed. The Assistant Chief of Staff for Force Development authorized production of the SLAE package in March 1967 (9 months before preliminary design testing was completed) to enable its scheduled installation in aircraft being produced.

Because SLAE was not available, older, larger, and heavier avionics equipment ultimately was installed in all 1,071 helicopters initially contracted for. An older type UHF-AM transceiver was installed also in 942 helicopters bought under follow-on contracts. The substitute equipment reduced the effectiveness of all 2,013 helicopters.

The schedule slippages and design changes to overcome deficiencies in the avionics equipment also resulted in additional costs of about $2.4 million. This amount includes $890,000 for schedule slippages and about $1.5 million for changes to overcome deficiencies in the SLAE package.

### PRODUCTION AUTHORIZED BEFORE TESTING

When the Army authorized production of SLAE, Electronics Command officials knew that additional design effort would be required to correct deficiencies. They believed that the design problems would be resolved when production started and risked the need for redesign during production. They assumed this risk in an attempt to have the equipment installed as soon as possible in aircraft being produced.

Although preliminary design testing was not completed until 9 months later, early tests had shown design deficiencies in the UHF-AM transceiver and radio-frequency interference in all transceivers. The contractor had proposed redesign of the equipment to meet reliability requirements imposed by the Army.

## CAPABILITY OF HELICOPTER DEGRADED

The payload-to-empty weight ratio[1] is a critical design factor in the light observation helicopter. Adding about 55 pounds to the empty weight of the helicopter by substituting older type avionics reduced aircraft speed and maneuverability, or mission endurance. Also, because of greater space and weight required for the older type avionics, the Army did not install battlefield identification and voice security avionics systems in the initial 1,071 helicopters.

The older, heavier type UHF-AM transceiver also was installed along with certain SLAE components in 942 additional helicopters bought under follow-on contracts. Thus the effectiveness of these helicopters also was compromised.

Another serious problem that had not been corrected as of November 1971 was interference among the automatic direction finder, the identification transponder,[2] and the FM transceiver. As a result these items cannot be used simultaneously. A modification to the automatic direction finder is expected to eliminate interference with the FM transceiver in SLAE packages purchased in the future. But the other interference problems had not been resolved when we completed our review.

## SCHEDULE SLIPPAGES

The contractor tried to use the automated-production method to meet the 24-month delivery schedule but found that preliminary designs were not susceptible to such production. Use of slower production methods resulted in extensive slippage in the delivery schedule. This caused the Army to defer the planned SLAE installation in helicopters being

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[1] Payload-to-empty weight ratio is the relationship of the flying weight of the aircraft, including pilot and fuel, to the empty weight of the aircraft. Each additional pound added to the empty weight reduces the payload.

[2] Notifies air and ground receivers of the identity and location of the aircraft.

produced to the 712th aircraft. If there had been sufficient time to refine preliminary designs, the contractor might have been able to use the more efficient automated-production method.

The installation schedule later was revised to begin with the 1,072d helicopter produced because of the need for redesign of SLAE to correct deficiencies and to meet reliability requirements. Design tests, completed after production began, disclosed serious deficiencies. These deficiencies required redesign of the UHF-AM transceiver after 136 transceivers were manufactured and modification of the VHF-AM and FM transceivers after 400 of each were manufactured.

The aircraft manufacturer was directed to prepare design changes for the SLAE installation, but the changes were abandoned later because the SLAE packages were not available. The contractor received $320,000 for these efforts. SLAE was designated for installation in the follow-on procurements of 2,542 helicopters, but, because the UHF-AM transceiver was being redesigned, the older, heavier transceiver was substituted in 942 aircraft. The cost of engineering changes to make this substitution was $570,000.

AIRCRAFT MODIFICATIONS
TO OVERCOME SLAE DEFICIENCIES

In December 1968 the light observation helicopter manufacturer informed the contracting officer that serious difficulties were being experienced in incorporating SLAE in the aircraft. The major problems were radio-frequency interference in each of the transceivers and interference among SLAE components which, at times, rendered them inoperable. The contracting officer directed the manufacturer to submit engineering-change proposals to correct these deficiencies. The contractor submitted proposals to correct some of the problems and, as of December 1970, was preparing another engineering-change proposal. A second aircraft contractor had similar problems.

The following costs were incurred under the aircraft contracts for changes.

| | |
|---|---|
| Elimination of radio-frequency interference among the transceivers | $1,244,000 |
| Elimination of interference among the automatic direction finder, the identification transponder, and the FM transceiver (not successful, see p. 20) | 108,000 |
| Correction of other problems | 186,000 |
| Total | $1,538,000 |

We believe that many, if not all, of the reported deficiencies might have been avoided, along with the necessary modification costs to correct the deficiencies, if development of SLAE had not been delayed because of inadequate planning.

## CHAPTER 4

## COMMITTAL OF UNTESTED SLAE COMPONENTS TO OTHER AIRCRAFT SYSTEMS

In December 1966 the Assistant Chief of Staff for Force Development directed the installation of SLAE in seven additional Army aircraft systems[1] and in all Army aircraft produced after fiscal year 1969, even though SLAE had not been successfully tested in the light observation helicopter. This decision was made without giving adequate consideration to the cost effectiveness of the proposed installations and prior to any testing of SLAE to determine its suitability for Army use in any of these aircraft systems.

SLAE was not installed in two of the aircraft systems because the Army later determined that this use was not cost effective. Its installation in three other aircraft systems was canceled because SLAE was not available. Modifications to one of these aircraft systems to prepare for SLAE installation had cost about $185,000.

In March 1967 the Assistant Chief of Staff for Force Development directed also the installation of the AN/ARC-114, VHF-FM transceiver, a component of SLAE, in five aircraft systems as a second FM transceiver. This decision was made also without determining its cost effectiveness. In November 1970 the Army issued invitations for bids expected to cost $21.5 million to fill this requirement. We called this lack of cost-effectiveness determination to the attention of Army officials who promptly reevaluated the requirement and reduced the planned procurement about $7 million.

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[1] The Air Force selected SLAE for installation in two aircraft systems, but, due to the unavailability of SLAE packages, it was not installed in one of the aircraft systems. The abandoned engineering effort for that system cost $120,000. SLAE also was installed in an aircraft system purchased for the Navy, the Marine Corps, and the Canadian Armed Forces.

The Army's Five Year Avionics Requirements Plan, dated December 1966, scheduled the installation of SLAE to begin with the fiscal year 1969 production of seven Army aircraft systems other than the light observation helicopter. This plan was approved by the Assistant Chief of Staff for Force Development to be used as the basis for procuring avionics equipment for new production aircraft and for aircraft retrofit programs. Project managers cite this plan as authority for processing engineering changes and for modifying aircraft specifications to incorporate the avionics equipment indicated in the plan.

In accordance with the plan, the project manager for a utility aircraft directed the aircraft manufacturer in May 1968 to prepare an engineering-change proposal for installation of SLAE. As late as January 1969, the Electronics Command assured the project manager that SLAE would be available, but in February 1969 the command advised him that it would not. In March 1969, the contractor's efforts to install SLAE were terminated but the contractor was paid $184,620 for preparatory costs which had been incurred.

In the reply to our draft report, the Army disagreed with our position that SLAE had been committed to other aircraft systems before testing. The Army stated that only planning guidance had been given by the Army for the installation of SLAE in additional aircraft and that two additional steps were required before implementation of these plans. These steps were: (1) the item must be type classified "standard A" or Department of the Army approval must be given for limited procurement and (2) funds must be released to the procurement agency. (See p. 42.) The Army said that neither was done before completion of testing.

The Adjutant General of the Army, in a letter of January 23, 1967, made the following statement about the plan.

> "The *** plan lists approved Department of the Army installation requirements for avionics ***.
>
> "Standard configurations listed in this plan will be used as the basis for materiel management computations, programming and procurement of

avionics and surveillance equipments to support both new production aircraft and aircraft retrofit programs. ***

"*** This document [the plan] is to be used as a basis for processing ECP's [Engineering Change Proposals] and modifying aircraft detailed and model specifications to incorporate the configuration changes indicated. ***"

Also, as pointed out above, the project manager for a utility aircraft directed the aircraft manufacturer in May 1968 to prepare an engineering-change proposal for installation of SLAE. In addition, SLAE was being procured under a limited-production authorization, and the Electronics Command assured the project manager that SLAE would be available for his aircraft in 1969.

In our opinion, the Adjutant General's letter and the project manager's action demonstrate that the Five Year Avionics Requirements Plan is more than a plan and is, in effect, a commitment of equipment to aircraft systems. We recognize that a plan to utilize developmental equipment, when available, is important and necessary. We believe, however, that such planning should not be set forth in documents used as the basis for procurement and modification, such as the Five Year Avionics Requirement Plan.

## COST EFFECTIVENESS NOT DETERMINED

Army officials did not prepare cost-effectiveness studies when changes in avionics equipment were specified in the 5-year avionics plan. Although Army regulations provided for cost-effectiveness determinations before changes in aircraft were approved, Army officials informed us that, at the time these changes were specified, the installation of SLAE in these aircraft was obviously cost effective. As shown below, however, later decisions to delete the SLAE requirement from two aircraft systems were based on the fact that installation costs would be excessive.

In February 1968 the project manager for a heavy lift helicopter requested Army approval for deleting the requirement for SLAE in that aircraft because of excessive costs. The prototype installation and retrofit costs for 54 aircraft were estimated at $6.7 million. Army officials agreed that the costs were excessive and withdrew the requirement. Later another project manager (for an attack helicopter) decided not to install SLAE because of the excessive cost of modifying the few aircraft being produced. These costs were estimated at $381,000 for 38 aircraft.

### Second FM transceiver needs questioned

In January 1967 the Army Combat Developments Command recommended that a second FM transceiver be installed in all aircraft that were used in direct support of combat operations. This recommendation was based on the rationale that (1) there was often a need to use two FM transceivers simultaneously and (2) there was a need for a backup FM transceiver. In March 1967 the Assistant Chief of Staff for Force Development directed that the AN/ARC-114 transceiver be installed in 50 percent of five aircraft systems and that all wiring, brackets, etc., needed for installation be installed in the other 50 percent.

Army officials said that, at the time this decision was made, the change was obviously cost effective. The project manager for the heavy lift helicopter, however, informed the Assistant Chief of Staff in September 1969 of the cost (estimated at $915,000) to modify the aircraft and to install a second FM transceiver. The project manager

was advised in January 1970 that the increased capability did not justify these costs.

Project managers for two of the other aircraft systems questioned the need for a second FM transceiver. During a review of the aircraft modification program for fiscal years 1972 through 1976, Army officials found that costs were more than could be expected to be approved at higher levels. As a result each project manager was requested to rank each modification and to recommend only essential programs.

The utility aircraft project manager did not recommend the installation of a second FM transceiver in a utility aircraft because he felt that the program was not essential.

The project manager for the light observation helicopter ranked the procurement and installation of a second FM transceiver 10th in a list of 11 proposed modifications. Nevertheless the Army funded this program although it did not fund programs that the project manager had ranked higher in priority, such as an improved landing gear. The aircraft project managers told us that, since the second FM transceiver program had been directed by the Department of the Army, they had had no other choice than to proceed with the procurement and installation of the transceivers.

To meet the second FM transceiver requirement, on November 16, 1970, the Electronics Command issued invitations for bids for a multiyear buy of 6,310 transceivers expected to cost about $21.5 million.

In view of the questionable cost effectiveness of this requirement, we presented our findings to officials of the Aviation Systems Command on November 24, 1970, and suggested that cost-effectiveness determinations be made before proceeding with the procurement. On November 28, 1970, the Duputy Commanding General, Aviation Systems Command, requested that higher headquarters reevaluate the requirement for a second FM transceiver on a cost-effectiveness basis. At a meeting held on December 9, 1970, Army officials reconsidered the need for a second FM transceiver in each aircraft on this basis and decided to reduce the quantity to be purchased by 2,060. This reduced the estimated cost of the planned procurement by about $7 million.

Use of other FM transceivers not studied

Prior to our review the Army had not considered the alternative use of other FM transceivers installed in its aircraft. Army regulations provide for an analysis to determine the most economical way to accomplish an approved objective, but they do not clearly identify the organization responsible for preparing the analysis. Because of this lack of clarity, no such analysis was made. We discussed this matter with Army officials, and an analysis was prepared. It showed that the use of the SLAE component would be more economical than the use of other FM transceivers.

PROPOSALS AND AGENCY COMMENTS

We proposed that the Secretary of the Army establish regulations providing that, in general, development of a new subsystem be completed and the subsystem be proven acceptable by suitable tests for operational use in its initial application before it is committed to additional aircraft or weapons systems.

The Army position is that suitable regulations are in effect and that untested subsystems have not been committed to additional aircraft or weapons systems. (See p. 44.) An Army official told us that the reply was referring to Army Regulation 71-6 entitled "Type Classification/Reclassification of Army Materiel," effective January 1, 1970.

One of the steps necessary before a subsystem can be installed in a system and can be issued for use is type classification. The subsystem must be classified either "limited production-urgent," which means that the subsystem is approved by the general staff of the Department of the Army for procurement and distribution in limited quantities to meet an urgent operational requirement that no adopted item will satisfy, or "standard A," which means that the subsystem has successfully completed all required tests and is fully acceptable for Army use.

Army Regulation 71-6 controls this type classification of subsystems; however, it does not preclude the commitment of incompletely tested subsystems to additional systems. It merely exerts a degree of control over one of the steps in the process of installation. In view of the potential adverse effects evidenced by this report, we believe that regulations should be revised or established that would preclude the commitment of incompletely tested subsystems to additional systems.

We proposed also that, when such committal was considered necessary even though a crucial subsystem was still under development, the Secretary of Defense furnish a certification to the appropriate congressional committees, stating the reasons for such authorization and the status of development. The OSD position is that this proposal is not

appropriate for this report because SLAE was not committed to additional aircraft systems prior to testing. (See p. 45.)

For the reasons stated on pages 24 and 25, it is our opinion that SLAE was committed to additional aircraft and that the proposal was therefore appropriate. We believe also that any commitment of an incompletely tested subsystem to additional systems should require approval by the Secretary of Defense because of the adverse effects which can occur. A requirement for Secretary of Defense approval would serve as a management tool and would help to ensure that a thorough evaluation had been made before a request for commitment reached him.

We proposed further that the Secretary of the Army establish controls to ensure that required cost-effectiveness determinations and an analysis of economic alternatives are made prior to program approval. In reply the Army stated that the cost-effectiveness determinations and analysis were required by Army Regulation 37-13 entitled "Economic Analysis of Proposed Army Investments," dated June 4, 1969, and that the appropriate degree of cost analysis had been conducted. (See p. 44.)

As shown on page 26, adequate analyses were not made when the plan to install SLAE in additional aircraft was approved. Also analyses of the quantities and alternative types of second FM transceivers were not made until we brought this to the attention of Army officials. Therefore we believe that additional controls are needed.

Finally we proposed that the Secretary of the Army clarify the regulation requiring the economic analysis to clearly show the organization responsible for its preparation. The Army stated that regulation 37-13 clearly defined responsibility for cost-effectiveness preparation. (See p. 44.)

The cited regulation does clearly show that the Army Materiel Command is responsible for the preparation of analyses. The difficulty, however, arises within this command. Its regulations do not indicate which of its subordinate

commands should prepare the analyses when more than one of the subordinate commands are directly involved, as in the case of SLAE--the Aviation Systems Command and the Electronics Command.

## RECOMMENDATIONS

We recommend that the Secretary of Defense establish procedures whereby his authorization is required prior to commitment of a critical developmental subsystem to additional systems before it is proven acceptable by suitable tests.

We recommend also that the Secretary of the Army:

--Prepare a regulation which prohibits commitment of incompletely tested subsystems to additional systems except under extraordinary conditions.

--Establish additional controls to ensure that cost-effectiveness determinations and an analysis of economic alternatives are prepared prior to program approval, as required by Army regulations.

--Initiate actions that will clarify responsibility within the Army Materiel Command for preparing an economic analysis when more than one of its subordinate commands are directly involved.

# CHAPTER 5

## PROGRAM AND FUND CONTROL OF AVIONICS RESEARCH AND DEVELOPMENT

In its 1967 report on avionics management, which included a case study on the SLAE development for the light observation helicopter, the Research Analysis Corporation concluded that (1) the Army's avionics problems could be attributed directly to an unwieldy organizational structure within the Army Materiel Command and (2) a reorganization and consolidation of avionics activities under a single command structure was essential to the solution of the Army's avionics problems. The report recommended a two-phased approach: first, the establishment of a project manager for avionics at the Army Materiel Command and the consolidation of avionics materiel management into one activity at the Electronics Command and second, the ultimate transfer of command responsibility for this consolidated avionics organization to the Aviation Systems Command.

The Aviation Systems Command has submitted proposals designed to implement these recommendations, to improve the planning for avionics and aircraft needs, and to provide better management of the entire air mobility research and development program.

The Avionics Systems Committee, in its report dated October 1, 1969, stated that SLAE had been started too late to meet the light observation helicopter system requirement. Because of this, the committee recommended that the Electronics Command be permitted to support advanced development and to engage in research in avionics systems not scheduled for installation on production aircraft prior to the selection of specific avionics equipment for a particular aircraft system. Both the Aviation Systems Command and the Electronics Command endorsed this recommendation and forwarded it in September 1970 to the Army Materiel Command for further consideration.

## ARMY EFFORTS TO REALIGN AVIONICS MANAGEMENT STRUCTURE

In 1970 the Army established a project manager organization[1] within the Electronics Command. The responsibility of the new organization includes coordination of the SLAE program among the Electronics Command, the Aviation Systems Command, and aircraft project managers.

In August 1969 the Army Materiel Command established an Air Mobility Research and Development Laboratory complex under the Aviation Systems Command. This complex is to provide centralized management of research and development programs for air mobility, including avionics and weapons. The complex consists of working agreements for aeronautical research and development with three National Aeronautics and Space Administration laboratories and with the Army Aeronautical Research Laboratory at Fort Eustis, Virginia. The Army considered consolidating four other laboratories, including the Avionics Laboratory, into the complex. It decided, however, that such a move would be undesirable at that time. The Commanding General, Army Materiel Command, concluded in August 1969 that the efforts of these laboratories could be managed by the complex by means of program and fund control of the air mobility research and development budget.

At our request the Deputy Commanding General, Aviation Systems Command, in September 1970 provided us with a status report on the efforts by the Aviation Systems Command to exercise program and fund control over research and development funds for avionics. A part of his reply is quoted below.

> "*** The requirement for program and fund control of the Avionics Laboratory by AVSCOM [Aviation Systems Command] was recognized and approved by the Commanding General, Army Materiel Command. Current status of this decision is as follows:

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[1] This was an upgrading of an Army Materiel Command product manager organization established in 1968.

"The FY 71 RDT&E [research, development, test, and evaluation] funds designated for the Avionics Laboratory were released directly from AMC [Army Materiel Command] to ECOM [Electronics Command]. This was done because the Air Mobility R&D Laboratory (AMRDL) Complex, which was approved by DA, 1 Jul 70, was not operational at the time funding guidance was issued by AMC. The CG [Commanding General], AMC concluded it would be appropriate to temporarily delay program and fund control by AVSCOM until the AMRDL became operational. Funding guidance for the Avionics Laboratory is expected to be issued through AVSCOM commencing with FY 72.

"AVSCOM conducted an RDT&E review of the FY 71 planned implementations, based on new FY 72 guidance, on 11 and 12 Aug 70. The Avionics Laboratory was represented at this meeting and participated in the program review and planning. Program control will be exercised by meetings of this type and also by the conduct of specific in-process reviews required by existing regulations.

"RDT&E 6.2 funds [funds for exploratory development] will be controlled by the AMRDL and consistent with the policy of AVSCOM, 6.3 [funds for advanced development] RDT&E funds [funds for engineering development] will be controlled by Deputy for Research, Engineering and Data, AVSCOM. The Avionics Laboratory does not show any 6.1 RDT&E funds [funds for basic and applied research] on its Command schedule, therefore, all 6.1 funds relating to electronic developments will go directly from AMC to ECOM."

Electronics Command officials told us that they had not been informed by the Army Materiel Command of any changes in program and fund control over avionics research and development. They told us also that the meeting at the Aviation Systems Command was merely a briefing to coordinate efforts. The Deputy Commanding General, Aviation Systems Command, however, informed us again in December 1970 that his command had program and fund control and had furnished

the Electronics Command with detailed budget guidance for fiscal year 1972.

We contacted Army Materiel Command officials to inform them of this apparent confusion concerning the status of program and fund control over avionics research and development. We were told that, although the decision was made (August 1969) to give the Aviation Systems Command such control, no action had been taken to implement this decision. These officials stated that eventually a policy statement would have to be issued covering this matter, but they did not feel that the matter should be clarified at that time.

## CONCLUSIONS

We believe that it is necessary for the Army to decide whether program and fund control of the Avionics Laboratory will be under the Aviation Systems Command or the Electronics Command so that the confusion that now exists between the two commands may be ended.

We believe also that, if this responsibility is assigned to the Aviation Systems Command, command control of the Avionics Laboratory should also be assigned to this command to avoid the problem of dual control of the laboratory. This change in command authority would not necessarily require a relocation of the laboratory.

## AGENCY COMMENTS

The Army reply made no mention of the findings or conclusions contained in this chapter. We subsequently contacted the Department of the Army and the Army Materiel Command during July 1971 and were informed of several actions which had been taken.

The Army Materiel Command has contacted the Aviation Systems Command and the Electronics Command to clear up the confusion which existed between the subordinate commands over the program and fund control of the Avionics Laboratory. Both subordinate commands were informed that the Electronics Command would retain control over the Avionics Laboratory until a final decision on Avionics Laboratory control was made. If and when a decision is made to implement the Army

Materiel Command plan to shift control from the Electronics Command to the Aviation Systems Command, these commands will be notified by the Army Materiel Command.

We were informed also that there had been a reorganization within the Army Materiel Command Headquarters. Avionics development management was shifted from the Communications-Electronics Division to the Air Mobility Division.

We believe that this reorganization will help to improve avionics development management at the command headquarters level, since avionics now is included with all the other subsystems which make up an aircraft. Avionics no longer will have to compete for funds with other electronics equipment, such as tactical radios and satellite communications. Avionics now will compete with the other aircraft subsystems for funds, and the personnel involved in the decisionmaking process should better understand the importance of avionics to aircraft.

We believe also that communications within the Army Materiel Command concerning avionics in relation to aircraft should be improved, since avionics personnel are now reporting to aircraft personnel instead of to electronics personnel. In our opinion, similar benefits also could be realized by transferring the program and fund control, as well as the command control, of the Avionics Laboratory to the Aviation Systems Command.

## CHAPTER 6

## SCOPE OF REVIEW

Our review of the SLAE program covered the period from inception of the program to December 1970. We reviewed contract records, correspondence files, and pertinent Army regulations. We also discussed these matters with appropriate Army officials.

We visited the following organizations to obtain information.

Office of the Assistant Chief of Staff for Force Development, Washington, D.C.

Office of the Assistant Chief of Staff for Communications-Electronics, Washington, D.C.

U.S. Army Combat Developments Command, Fort Belvoir, Virginia

U.S. Army Materiel Command, Washington, D.C.

U.S. Army Aviation Systems Command, St. Louis, Missouri

U.S. Army Electronics Command, Fort Monmouth, New Jersey

# CHRONOLOGY OF EVENTS

| Event | Date |
|---|---|
| Military characteristics of light observation helicopter approved | May 1960 |
| Engineering-development contract for helicopter awarded | Nov. 1961 |
| SLAE need recognized by project manager of the helicopter | Jan. 1964 |
| Production contract for helicopter awarded | May 1965 |
| Development-production contract for SLAE awarded | Jan. 1966 |
| Preliminary engineering-design tests of SLAE: | |
| Begun | Dec. 1966 |
| Completed | Dec. 1967 |
| Production of SLAE authorized by Department of the Army | Mar. 1967 |
| Engineering-design tests of SLAE: | |
| Begun | Aug. 1967 |
| Completed | Feb. 1969 |
| Engineering tests of SLAE: | |
| Begun | July 1968 |
| Completed | Oct. 1970 |
| Service tests of SLAE: | |
| Begun | Jan. 1969 |
| Completed | Aug. 1970 |

APPENDIX II

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, D.C. 20310

11 JUN 1971

Dear Mr. Bailey:

This is in response to your letter of 29 March 1971 to the Secretary of Defense requesting comments on your draft report titled "Need for Long-Range Planning for Avionics Development Programs" (OSD Case #3258).

The inclosed statement, providing Department of the Army position on each finding and recommendation,agrees with the general thrust of the paper that improved long-range planning is needed. The Army is constantly striving to improve its planning. For example, in June 1970, the Chief of Staff directed the Assistant Chief of Staff for Communications and Electronics to prepare an Avionics Master Plan to assist the avionics management. However, the Army does not agree with your finding and conclusions as to the causes of the SLAE developmental problems. These problems were caused by changing requirements and unforeseen technical difficulties. The plan to install SLAE in additional aircraft systems was not a commitment since both type classification action and funding release by DA are required to implement the plan. These additional actions were not taken until after the completion of testing.

The Army believes the recommendations of the report are sound management practices and have been in effect in the Army for a period of years. It is suggested the data in this letter and the inclosure be considered for use in preparing the final GAO report on this subject.

This reply is made on behalf of the Secretary of Defense.

1 Incl
Army Cmts on
Draft GAO Rpt

Sincerely,

Charles L. Poor
Actg. Assistant Secretary of the Army (R&D)

Mr. C. M. Bailey
Director, Defense Division
U.S. General Accounting Office
Washington, D. C. 20548

DEPARTMENT OF ARMY COMMENTS
ON
GAO DRAFT REPORT, GAO CODE 67033, DTD 30 MAR 71
OSD CASE #3258

1. The Military Characteristics (MC) for the Light Observation Airplane, later renamed Light Observation Helicopter (LOH) specified the following avionics that were not to exceed 100 lbs.

a. Complete Provisions (CP) for UHF-AM and VHF-AM with only one to be installed at a time.

b. VHF-FM and auxiliary FM receiver and FM Homing.

c. 2 intercom stations.

d. 1 headset.

e. CP for automatic direction finder (ADF) (installation dependent on mission).

f. Space Weight and Power (SWP) for Battlefield Identification Friend or Foe (BIFF). (SWP is an acknowledgement that a new development is underway but not yet sufficiently identified to do detailed engineering in the aircraft.)

Using standard avionics available in the early 1960's the weight of the required installed equipment totaled 100 lbs. It was not envisioned the total quantity of avionics listed above would be installed at any one time but would be mission selectable. Therefore, a development program was not required to meet the 100 lb. criteria.

2. By 1964 the mission selectable avionics concept had been determined unacceptable, the MARK XII IFF system had been approved and voice security equipment became necessary for an increase in weight of 80 lbs. This increase equates to 20% of the LOH payload. It appeared possible at that time to achieve a 70 lb. weight reduction thru the use of solid state communications radios, as well as a quantum increase in reliability and a possible cost reduction. Several reputable electronic manufacturers were willing to guarantee production deliveries within 2 1/2 years at an attractive price through the use of a Total Package Procurement Contract (TPP).

3. The TPP contract was awarded in January 66 with production deliveries scheduled to begin in August 68. An 80 lb. weight reduction was achieved along with an increase in reliability and at a reduction in cost. But due to technical difficulities suitable production deliveries were delayed until January 70.

4. Under the provisions of the TPP contract it was necessary to authorize production prior to military testing of the equipment. It was therefore

necessary for DA to authorize a limited production (LP) type classification in 1967 or force the Government to default on the contract. In March 67 the status of the avionics development was reported. "As of this date, the LOHAP (Light Observation Helicopter Avionics Package) has met nearly all contractual specifications. The components have undergone manufacturer-testing under the supervision of the US Army Electronics representatives. Weight, distortion, power output and reliability data significantly exceed specifications. The only serious shortcoming is in the output stages of the AN/ARC-116 transceiver. Prototype transistors, which will bring the 116 up to specifications, have been located and are expected to be produced shortly." The LP was approved.

5. At this time the LOHAP was under contract to be produced for $6000 per aircraft set which provided almost equal capability of the older family of avionics that cost $16,000. In addition the contract provided for a reliability improvement by a factor of 10 and a 60% reduction in weight. From the above it was obvious that LOHAP would offer significant advantages to other aircraft systems. In view of the magnitude of improvement offered, additional cost effectivity analyses were not needed. Since Standard A type classification was scheduled for 1st quarter FY69, planning guidance was given by DA to plan for the change to LOHAP for all new production aircraft beginning in FY69 procurement. This planning guidance included the second or auxiliary FM. The LOHAP was renamed Standard Lightweight Avionics Equipment (SLAE) at this time.

6. Two additional steps were required by DA prior to implementation of the above planning guidance. These were:

a. The item must be type classified Standard A or DA approval be given for each Limited Procurement.

b. Funds must be released to the procurement agency.

Part of the requirement for Standard A type classification is successful completion of testing by the Army. By the time the detailed 1969 aircraft model specifications were required, it was apparent technical difficulties would preclude the use of SLAE. The planning guidance was held in abeyance until further notice. It can be determined from the above that DA did not commit an untested avionics system to additional aircraft. Adequate controls were in effect to prevent this. DA did however make a specific exception for two of the SLAE radios for 37 OV-1D's based on the merits of that particular case. No unusual problems were encountered in the OV-1D SLAE-interface.

7. The slippage of Standard A type classification caused the plan to install SLAE in other new production aircraft to be held in abeyance. By the time Standard A was achieved, only a very few new production aircraft were still planned to be procured. Under these changed conditions a re-evaluation was necessary. Based on the low volume of new production aircraft, a change to the SLAE radios for these aircraft did not appear economically attractive. However, if a large new production buy was planned, the SLAE components would probably have been selected for the communications radios.

8. The second DA decision necessary as a result of the SLAE type classification slippage was one of retrofit for the second FM. USACDC recommended the installation of the second FM for all aircraft habitually operating in the combat area. This requirement totaled slightly over 6000 radios based on FY 72 baseline force structure. The advanced procurement plan for that quantity was approved.

9. As a result of the GAO audit of SLAE, USAAVSCOM requested revalidation of the second FM requirement. The requirement was revalidated but the quantity was reduced to 4500 radios for the initial procurement. Experience gained from the initial employment of the second FM will be used to validate the total requirement.

10. Although the total program costs for the second FM were reviewed by DA in making the above decision, a formal cost effectivity analysis was not prepared since the dollar value of increased capability is subjective. No alternate FM radio was considered suitable by DA for the second FM requirement based on considerations of weight, volume and reliability. An economic analysis comparing the AN/ARC-131 vs. the AN/ARC-114 for the second FM for the OH-58 was prepared by USAECOM at the suggestion of the GAO. Assuming a $3000 price for the ARC-114, it still proved the most economically effective. Later a contract was signed for ARC-114's at a cost of less than $1200 each.

11. Some of the objectives of both the LOH and its avionics package were maximum capability with minimum size, weight and cost. These objectives are in opposition to an electromagnetically clean aircraft and avionics system. A reasonable compromise has been reached in the LOH between these opposing objectives. Part of the price of achieving this compromise was the more than normal system integration work required. When considering the LOH electromagnetic interference problem it should be remembered the LOH probably has more electronics within a smaller space than any other operational aircraft.

12. Army Position on GAO Recommendations or Suggestion:

GAO Recommendation.

(1) Require the preparation of a long range avionics plan in support of the Army's long-range aircraft requirements plan.

Army Position.

(1) A long range avionics plan is needed and is being prepared (reference cover letter).

GAO Recommendation.

(2) Establish regulations providing that development of a new subsystem generally must be completed and the subsystem proven acceptable by suitable tests for troop use in its initial application before it is committed to additional aircraft or weapon systems.

Army Position.

(2) Suitable regulations are in effect and untested subsystems have not been committed to additional aircraft systems (reference para 6).

GAO Recommendation.

(3) Establish controls to assure that the required cost effectiveness determinations and analysis of economic alternatives are made prior to program approval.

Army Position.

(3) Cost effectiveness determinations and analysis are required by Army Regulation 37-13. The appropriate degree of cost analysis was conducted (reference para 5).

GAO Recommendation.

(4) Clarify the regulation to clearly indicate the organization responsible for preparation of the economic analysis.

Army Position.

(4) AR 37-13 para 1-6 clearly defines responsibility for cost effectivity preparation (Inclosure 1).

13. The OSD position on GAO Recommendations to the Secretary of Defense:

GAO Recommendations.

(1) Before approving engineering development of an aircraft, require that all subsystems needed to fulfill the critical requirements of the aircraft be under development with sufficient lead-time to ensure proper interface.

(2) Provide a certification to appropriate congressional committees in those cases where full-scale development of an additional weapon system is authorized even though a crucial subsystem is still under development for another system.

OSD Position.

One of the prime objectives of a development program is to ensure that all subsystems are developed in sufficient time for proper interface. However, these recommendations are not appropriate for this report since the SLAE was not committed to additional aircraft systems prior to testing (reference para 6 above).

Incl

creased decision effectiveness. For example, some major planning documents (such as the Armed Forces Development Plan and the Joint Strategic Objectives Plan) contain cost analysis, but an economic analysis of the total forces involved would not be meaningful for decision purposes.

(2) For proposed acquisitions of principal or secondary PEMA items, justified on the basis of an inventory objective in accordance with DA logistic guidance.

(3) When DA instructions and regulations provide for equipment age or condition replacement criteria, labor and equipment trade-off standards and requirements computations. (These may be used in lieu of the economic analysis called for herein, provided they can be demonstrated to be compatible with the basic principles of economic analysis contained in this regulation.)

*f.* Thresholds established by existing regulations and directives will remain in force.

**1–6. Responsibilities.** *a.* Comptroller of the Army will:

(1) Coordinate and provide policy and detailed guidance and assistance to the DA Staff concerning the preparation and use of economic analyses of proposed Army investments at Headquarters, Department of the Army level.

(2) Participate in the evaluation of economic analyses supporting proposed Army investment.

(3) Process through OASA(FM) or OASA(I&L), as appropriate, all investment proposals requiring economic analysis.

(4) Develop the coordinated staff position on each economic analysis which involves areas of responsibility of more than one Deputy/Assistant Chief of Staff.

*b.* Deputy/Assistant Chiefs of Staff, Headquarters, DA will:

(1) Establish implementing instructions, as necessary, for preparation and submission of economic analyses within their respective areas of responsibility, providing such additional guidance does not conflict with the provisions of this regulation.

(2) Evaluate the economic analyses within their areas of responsibility; issue implementing instructions as part of the normal program budget guidance, as appropriate.

*c.* Commanders of major Army commands and all agencies and activities reporting directly to Headquarters, Department of the Army will:

(1) Prepare and submit economic analyses of the projects, programs or changes for which analyses are required by this regulation.

(2) Establish necessary controls to insure effective application of the procedures and techniques of economic analysis to proposed project or programs competing for limited resources.

(3) Determine capability to conduct sophisticated economic analysis and establish a priority system for determining the projects to be analyzed within this capability.

**1–7. References.** *a.* AR 18–2, Army Information and Data Systems Responsibilities and Procedures.

*b.* AR 37–29, Accounting and reporting for the cost of military personnel services.

*c.* AR 37–40, Army Production Base Support Program Report.

*d.* AR 235–5, Commercial and Industrial-type activities.

*e.* DA Pamphlet 37–6, Accounting and Reporting Procedures Manual for Project Prime under Resource Management Systems.

## Section II. CONCEPTS

**1–8. General.** *a.* Investments are proposed on a "project" basis. Projects should be so defined that all resource requirements (including the use of assets on hand and currently not fully employed but planned for alternative use in some project) and all benefits related to the life cycle of the project are included in the investment proposal. Following are investment proposals to which this regulation applies but need not be limited to:

(1) Repair or replace decisions. Specific policy and procedures for the replacement of machine tools and other industrial production equipment are prescribed by AR 37–40.

# PRINCIPAL OFFICIALS OF THE DEPARTMENT OF DEFENSE AND THE DEPARTMENT OF THE ARMY RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES DISCUSSED IN THIS REPORT

| | Tenure of office | |
|---|---|---|
| | From | To |
| **DEPARTMENT OF DEFENSE** | | |
| SECRETARY OF DEFENSE: | | |
| Melvin R. Laird | Jan. 1969 | Present |
| Clark M. Clifford | Mar. 1968 | Jan. 1969 |
| Robert S. McNamara | Jan. 1961 | Feb. 1968 |
| Thomas S. Gates, Jr. | Dec. 1959 | Jan. 1961 |
| DEPUTY SECRETARY OF DEFENSE: | | |
| David Packard | Jan. 1969 | Present |
| Paul H. Nitze | July 1967 | Jan. 1969 |
| Cyrus R. Vance | Jan. 1964 | June 1967 |
| Roswell L. Gilpatric | Jan. 1961 | Jan. 1964 |
| James H. Douglas | Dec. 1959 | Jan. 1961 |
| DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING: | | |
| Dr. John S. Foster, Jr. | Oct. 1965 | Present |
| Dr. Harold Brown | May 1961 | Sept. 1965 |
| Herbert F. York | Dec. 1958 | Apr. 1961 |
| ASSISTANT SECRETARY OF DEFENSE (INSTALLATIONS AND LOGISTICS): | | |
| Barry J. Shillito | Jan. 1969 | Present |
| Thomas D. Morris | Sept. 1967 | Dec. 1968 |
| Paul R. Ignatius | Dec. 1964 | Aug. 1967 |
| Thomas D. Morris | Jan. 1961 | Dec. 1964 |
| Perkins McGuire | Jan. 1957 | Jan. 1961 |

APPENDIX III

## DEPARTMENT OF THE ARMY

| | Tenure of office | |
|---|---|---|
| | From | To |
| **SECRETARY OF THE ARMY:** | | |
| Robert F. Froehlke | July 1971 | Present |
| Stanley R. Resor | July 1965 | June 1971 |
| Stephen Ailes | Jan. 1964 | July 1965 |
| Cyrus R. Vance | July 1962 | Jan. 1964 |
| Elvis J. Stahr, Jr. | Jan. 1961 | June 1962 |
| Wilbur M. Brucker | July 1955 | Jan. 1961 |
| **UNDER SECRETARY OF THE ARMY:** | | |
| Thaddeus R. Beal | Mar. 1969 | Present |
| David E. McGeffert | July 1965 | Mar. 1969 |
| Stanley R. Resor | Mar. 1965 | July 1965 |
| Vacant | Dec. 1964 | Mar. 1965 |
| Paul R. Ignatius | Mar. 1964 | Dec. 1964 |
| Vacant | Jan. 1964 | Feb. 1964 |
| Stephen Ailes | Feb. 1961 | Jan. 1964 |
| Hugh M. Milton II | Aug. 1958 | Jan. 1961 |
| **ASSISTANT SECRETARY OF THE ARMY (RESEARCH AND DEVELOPMENT):** | | |
| Robert L. Johnson | Nov. 1969 | Present |
| Vacant | Jan. 1969 | Nov. 1969 |
| Russel D. O'Neal | Oct. 1966 | Jan. 1969 |
| Willis M. Hawkins | Oct. 1963 | Oct. 1966 |
| Vacant | Aug. 1963 | Sept. 1963 |
| Finn J. Larson | Aug. 1961 | July 1963 |
| Richard S. Morse | June 1959 | July 1961 |
| **ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS AND LOGISTICS):** | | |
| J. Ronald Fox | June 1969 | Present |
| Vincent P. Huggard (acting) | Mar. 1969 | June 1969 |
| Dr. Robert A. Brooks | Oct. 1965 | Feb. 1969 |
| Daniel M. Luevano | July 1964 | Oct. 1965 |
| A. Tyler Port (acting) | Mar. 1964 | June 1964 |
| Paul R. Ignatius | May 1961 | Feb. 1964 |
| Vacant | Jan. 1961 | May 1961 |
| Courtney Johnson | Apr. 1959 | Jan. 1961 |

| | Tenure of office | |
|---|---|---|
| | From | To |
| DEPARTMENT OF THE ARMY (continued) | | |
| COMMANDING GENERAL, UNITED STATES ARMY MATERIEL COMMAND: | | |
| Gen. Henry A. Miley, Jr. | Nov. 1970 | Present |
| Gen. Ferdinand J. Chesarek | Mar. 1969 | Nov. 1970 |
| Gen. Frank S. Besson, Jr. | July 1962 | Mar. 1969 |

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