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WASHINGTON, D.C. 20548



PROCUREMENT, LOGISTICS,
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The Honorable Caspar W. Weinberger
The Secretary of Defense

Attention: Director, GAO Affairs

Dear Mr. Secretary:

Subject: Air-Launched Cruise Missile: Logistics Planning
Problems and Implications For Other Weapon Systems
(PLRD-82-68)

We have reviewed the integrated logistics support (ILS) planning for the Air Force's air-launched cruise missile (ALCM) and the related B-52 carrier aircraft modifications and identified problems which will inhibit the economy and effectiveness of logistics support for the systems.

These problems were primarily caused by the programs' concurrent development and production acquisition strategy, which was adopted to meet the required operational availability date for the ALCM. More specifically, we found that:

- Program constraints created special problems for logistics planners, which made it difficult to ensure timely and accurate logistics support.
- Action on suggested design changes to improve logistics supportability was given a low priority.
- Testing programs which would provide needed information on logistics supportability requirements were delayed, and a program to develop depot maintenance capabilities was deferred.
- Management tools, such as logistics support analysis, life-cycle costing, and budgeting for logistics resources, could be used more effectively.

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We also found that logistics support costs for the ALCM and other cruise missile variants might be reduced by consolidating depot maintenance for those components which are common to the missile systems.

The Department of Defense (DOD) initiated a number of actions during 1981 to improve the acquisition process. One of the areas specifically addressed was the development of procedures to overcome the inherent logistics support planning problems which occur when weapon systems are fielded using concurrent development and production acquisition strategies. Although DOD can do little at this point to correct some of the logistics problems we noted for the ALCM and related B-52 modification programs, we believe that our observations illustrate the kinds of logistics problems which may occur in future concurrent acquisition programs. These problems must be addressed as DOD develops and implements its new procedures to improve the acquisition process.

The objective of our review was to assess the adequacy and effectiveness of ILS planning for the ALCM and B-52 modification 1/ programs. We assessed the ILS planning efforts based on the criteria set forth in DOD and Air Force regulations, policies, and procedures. We held discussions with DOD and contractor officials who were responsible for program management. We also reviewed pertinent records and data at the various activities we visited.

ACQUISITION CONSTRAINTS

In 1972 DOD began developing the Air Force's ALCM and the Navy's sea-launched cruise missile. To fulfill an objective of component commonality, DOD used the same basic propulsion, guidance, and warheads in both systems. In January 1977 full-scale engineering and development was approved for the ALCM, the sea-launched cruise missile, and a ground-launched cruise missile. All were placed under the management of a Joint Cruise Missile Project Office with the Navy designated as the lead service. In August 1980 the ALCM program was placed under Air Force management, but the acquisition of missile engines, guidance sets, and radar altimeters remained under joint project management.

1/The ALCM is integrated with the B-52 aircraft by means of a set of carrier aircraft equipment. The cruise missile integration equipment consists of the pylon, pylon adapter, and the mechanical, electrical, and electronic interfaces. In addition, the B-52 is being equipped with a new offensive avionics system which provides improved automatic navigation and guidance.

The cancellation of the B-1 bomber in 1977 made early deployment of the ALCM a higher priority than it had been previously. A concurrent and compressed development and production schedule was established for the ALCM and related B-52 modification programs to meet requirements for a first alert capability 1/ in September 1981 and an initial operational capability 2/ in December 1982.

As a result of the concurrent and compressed schedule, ALCM and related B-52 modification managers often had to choose between meeting schedule and performance requirements and accomplishing the necessary tasks to assure adequate logistics support. These were management decisions which had to be made as the acquisition progressed.

IMPACT OF CONCURRENCY
ON ILS PLANNING

ILS planning for the ALCM and related B-52 modification programs was made more difficult by a concurrent production and development schedule. Consequently, certain logistics support elements will not be fully available at initial operational capability and questions remain regarding the accuracy of support requirements.

Supply support

Spare missile requirements for the ALCM are estimated to be 7 percent of the cost of acquiring the system. This estimate is based on historical experience from the short-range attack missile program. That missile, unlike the ALCM, is a relatively mature and reliable weapon system with well-defined requirements. Therefore, spare missile requirements for the ALCM may be understated. Additionally, program funding reductions caused the Air Force to reduce ALCM production from 480 to 440 per year. This reduction will also adversely affect the number of spare ALCMs available, because deployment schedules will continue as originally planned.

1/The first aircraft capable of alert status is equipped with new avionics and armed externally with 12 ALCMs and internally with short-range attack missiles and gravity bombs. This was accomplished on September 30, 1981.

2/Each aircraft in the first alert squadron (16 B-52 aircraft) is equipped with new avionics and armed externally with 12 ALCMs and internally with short-range attack missiles and gravity bombs.

The Air Force is basing ALCM spare parts requirements on the contractor's reliability estimates, however, testing has failed to verify this level of reliability in either an operational or dormant environment. Spare parts requirements will not be accurate unless reliability estimates are met.

Also, precise spares requirements have not been established for the B-52 offensive avionics system. Consequently, interim contractor support will be used in lieu of the standard Air Force supply system. Air Force officials stated that this procedure was necessary because of design instability and program concurrency.

Support and test equipment

Certain support and test equipment may not be available at initial operational capability and other equipment will not be fully capable because of development problems. The electronic system test set, the primary piece of automatic test equipment, is to play a key role in minimizing ALCM life-cycle costs by shortening the time required to maintain the missiles. Instead of performing certain maintenance tasks on the aircraft, such as checking empty pylons or missile/launcher integration, the test set will perform these tasks in an integrated maintenance facility.

The ALCM system maintenance concept depends upon the test set to detect and isolate faults requiring maintenance action. However, fault isolation capability was not demonstrated in testing before the production decision. Air Force officials stated that, to minimize development costs, demonstration of fault isolation capability was not required during the competitive phase. The test set software to perform detailed fault isolation is behind schedule. Spares requirements and maintenance burden could increase until the test equipment can identify the specific failed components.

Also, a new missile radar altimeter was incorporated late in the development program. Therefore, capability to test the new missile radar altimeter must be added to the test set. Until this capability can be added, the Air Force and the contractor are using an interim tester. Current schedules call for the new tester to be available by June 1982. Air Force officials stated that the development of interim capabilities is necessary in concurrent programs.

Training and training devices

The primary device required to train crews to operate the B-52 offensive avionics system and cruise missile integration equipment and to fire the ALCM is the weapon system trainer simulator, which

is being developed as a less expensive way to train flightcrews. The simulator is not scheduled to be available until December 1982, when the first squadron is to be deployed. Thus, initial crew training will have to be provided through other means. According to Air Force officials, making the trainer available sooner would be impossible due to weapon system design instability. However, as a result of not having the simulator earlier than projected, training costs will increase.

Technical data

Preparation of technical data for the ALCM and B-52 modification programs has been complicated by the unstable system design and may not be available when needed. In its report on the initial operational testing, the Air Force Test and Evaluation Center concluded that the contractor's technical data may be deficient and that availability of adequate technical data in time to meet the ALCM's initial operational capability date was a major concern. Since that time, the Air Force has established and implemented procedures to ensure that the minimum technical orders essential for initial operational capability would be verified in time. Additionally, since development is not complete, all ALCM technical orders will be provisional. The Air Force, therefore, will publish technical orders in limited quantities, recognizing the orders will have to be revised to reflect future design changes once testing is complete.

Preparation and verification of B-52 modification technical orders are similarly constrained by design instability. The Air Force and the contractor have agreed to a system of provisional technical orders, recognizing that they will have to be revised to reflect design changes.

LOGISTICS DESIGN CONSIDERATIONS RECEIVE A LOW PRIORITY

Design considerations to improve logistics support have received a low priority in the ALCM and B-52 modification programs. Two mechanisms for identifying logistics problem areas and for suggesting design changes are engineering change proposals and service reports. These mechanisms could have been used more effectively by program managers to improve ALCM and B-52 modification logistics support.

Although the contractors incorporated some maintainability features into their missile designs during the prototype competition, the Air Force has approved few engineering changes for maintainability since that time. We reviewed engineering change proposals submitted between April 1980 and May 1981 and found that

none were specifically directed at improving maintainability or at reducing life-cycle costs. Air Force officials stated that because of program concurrency and operational and performance problems, proposed design changes have been directed toward improving performance rather than improving support.

Service reports are written by Air Force officials to identify problem areas discovered during operational testing. The ALCM operational flight testing program was conducted between April 1979 and April 1981, and testing officials compiled numerous service reports on both the ALCM and B-52 modifications. About 75 percent of the service reports contained suggestions for improving logistics support, yet few had been incorporated into the design.

Program office and contractor officials state that they are working on resolving logistics support problems, but they are still more concerned with solving operational and performance problems. Also, program concurrency prevents resolution of many service reports before deployment. According to Air Force officials, as of March 1982, 526 out of 813 service reports for the ALCM and B-52 modification programs were resolved. However, resolution means only that solutions to proposed design changes have been identified and verified, and not that they have been incorporated into the design. Delays in resolving problems identified in service reports make incorporation of the design changes more time-consuming and costly since more units have been fielded which must subsequently be retrofitted.

TESTING AND LOGISTICS PROGRAMS
HAVE BEEN DELAYED OR DEFERRED

Certain testing and logistics programs which could have improved logistics support for the ALCM and B-52 modification programs were delayed or deferred. Consequently, the Air Force has missed opportunities to validate logistics resources estimates which are based primarily on engineering estimates and prior experience with similar systems.

ALCM reliability testing

Combined environmental reliability testing is a program which provides a comprehensive laboratory evaluation of missile reliability at much less cost than a flight test program. This program involves monitoring a missile while it is vibrated and subjected to various temperature and humidity changes intended to simulate actual mission profiles. The intent of the program is to compress operating experience and fault identification into a relatively short time early in production. Although the Air Force has approved the program, as of March 1982, it had not been funded.

Air Force officials stated that they would request funding for the program in their fiscal year 1984 budget.

Apparently, the combined environmental reliability testing program can verify estimated reliability and identify problems requiring design changes early. This can help logistics managers more accurately determine support requirements and can subsequently save support costs. Identifying problems early in the production cycle would reduce the cost of incorporating design changes.

Offensive avionics system
reliability testing

The B-52 offensive avionics system test, analyze, and fix program is similar to the ALCM reliability testing program except testing is done on key components rather than on the entire system. The Air Force originally delayed the test, analyze, and fix program because of a lack of funding and because the program was considered redundant with the normal operational testing program. The Air Force, however, reactivated the program in November 1980 because of the avionics system's decreasing reliability. Air Force officials estimate that the program, by improving reliability, will save about \$60 million in support costs over the life of the system. This does not include the retrofit costs saved by identifying problems early.

ALCM storage testing

The maintenance concept and estimated support requirements for the ALCM--number of spares, maintenance personnel, facilities and equipment--are based on the prediction that the missile can be stored for 30 months before overhaul or recertification. The prediction is based on engineering estimates and historical evidence from other missiles. Because of delays and interruptions, the concept has not been proven through testing. Should the 30-month storage cycle prediction prove inaccurate, it may cause a significant realignment of logistics resources and an expensive retrofit program.

In late 1977, while the ALCM was still in the prototype competitive stage and under the auspices of the joint project office, the Boeing Company suggested a dormancy storage testing program to determine whether the engine, fuel, lubricants, navigation system, and other components could be in storage for 30 months and still work properly. However, testing was delayed because of higher priority programs and the lack of test missiles.

Two engines eventually were put into storage in November 1979 and storage testing of two complete missiles finally began in January 1981 at Griffis Air Force Base. However, the two

missiles were subsequently retrofitted with a new fuel control system, navigation system, and updated engine, and became part of the 13 missiles used to establish first alert capability in September 1981. Therefore, much of the storage experience was lost. In June 1981 four additional production missile aft sections and engines were placed in storage at Wright-Patterson Air Force Base, and these will be the baseline units for storage testing. Thus, testing results will not be available until November 1983--after over 700 missiles have been delivered.

Development of a depot maintenance capability delayed

The \$2 million originally budgeted to develop an Air Force depot maintenance capability for the missile was used instead to support the delayed flight testing program. When funding is limited, such decisions must be made. However, we believe that deferring development of a depot maintenance capability is only a temporary solution which will ultimately increase interim contractor support and delay the development of organic capability.

MANAGEMENT INFORMATION DEVICES
COULD BE USED MORE EFFECTIVELY

The ALCM and B-52 modification programs could more effectively use available management information in making logistics decisions. For example:

- While the ALCM program required the contractor to develop a logistics support analysis data bank, Air Force program managers told us they did not actively use it, once ALCM went into production, to estimate life-cycle costs, to make trade-off decisions between alternative equipment designs, or to estimate or verify logistics resource requirements.
- Each ALCM contractor was required to estimate life-cycle costs during the competitive phase. However, the estimates have not been actively monitored since that time. For example, each time an engineering design change is proposed, the program manager is supposed to consider the impact on life-cycle costs. We examined several engineering change proposals and found no associated life-cycle cost estimates. Additionally, no one within the program office had been assigned the life-cycle cost management responsibility.
- Program managers are also required by regulation to track the amount of funds spent on ILS planning. However, no procedures were established to track the amount of funds

budgeted or spent on ILS in either the ALCM or B-52 modification programs. We question how program managers can determine whether appropriate emphasis is being given to logistics without such information.

CONSOLIDATING DEPOT MAINTENANCE
COULD SAVE LOGISTICS SUPPORT COSTS

Although it is too late to influence ALCM front-end logistics planning, decisions regarding the establishment of a depot maintenance capability for the ALCM have yet to be made. The ALCM has components which are common to other DOD cruise missile programs. While we did not study the matter in detail, we believe depot maintenance consolidation for common cruise missile components represents an alternative support strategy which could reduce costs.

DOD policy encourages depot
maintenance consolidation

DOD maintenance policy and directives encourage consolidation and interservicing (maintenance done by one military service in support of another) as the preferred method for providing depot maintenance support whenever economic benefits will accrue without degrading operational capabilities or readiness.

DOD Directive 4151.1 states that a joint support plan will be developed in all cases where the same weapon, major end item, or component is being processed for use by two or more military services. Further, this joint support plan should indicate how existing DOD depot maintenance capabilities can be maximized and new investments for additional maintenance facilities can be minimized. DOD Directive 4151.16 states that maintenance activities and operations will be consolidated into the minimum number of facilities consistent with ensuring that readiness levels can be maintained and that operational commitments, including contingency deployment, can be satisfied.

Common cruise missile
components appear ideal
for consolidated maintenance

Components common to two or more of the cruise missile systems include the inertial navigation element, the missile radar altimeter, and the engine. One of the most important, time-consuming, and costly cruise missile depot maintenance actions will be the engine recertification program. We, therefore, selected this common component for analysis. The three versions of the cruise missile--the Air Force's air- and ground-launched missiles, and the Navy's sea-launched missile--will use the same engine and will need to be recertified every 30 months.

Each missile has a projected 15-year life, therefore, engine recertifications will create a considerable depot maintenance workload. DOD currently plans to buy 9,419 cruise missile engines. The engine recertification workload is estimated to increase from an average of 5 engines a month in fiscal year 1984 to an average of 276 engines a month in fiscal year 1995. If the storage testing results show that recertification is needed more frequently, this number will increase.

A study by the Maintenance Interservice Management Office--the triservice organization responsible for making maintenance consolidation decisions for common weapon system components--found the Oklahoma City Air Logistics Center to be the most feasible DOD depot for Air Force cruise missile engine recertifications. The study showed that with a minimal capital investment of about \$131,000, the Air Force could establish this capability at Oklahoma City. Also, according to Air Force officials, Oklahoma City has old engine test cells which, with some renovations, would be suitable for cruise missile engines.

Current Air Force plans call for ALCM depot maintenance capability to be established in 1985 with half of the engine recertifications being done at an Air Force depot and the other half at the contractor's facility. Air Force officials stated that this will provide a broad industrial base and a backup capability. The Navy plans to have all engine recertifications for its cruise missiles done by the contractor. However, in January 1982 the Navy agreed to have the Maintenance Interservice Support Office study the cost effectiveness of having the engines recertified at a single DOD depot.

The Maintenance Interservice Management Office has begun studies on components common to all versions of the cruise missile to determine which DOD depot, if any, would be a feasible location for maintenance. These studies are in various stages of completion.

CONCLUSIONS

DOD missed several opportunities to improve logistics support for the ALCM and B-52 modification programs, primarily because of the constraints imposed on the programs by the concurrent development and production schedule made necessary by the urgent need to field the systems. We recognize that when circumstances such as these exist, program managers must decide how best to use their finite resources and that standard logistics planning policies and procedures will not always be appropriate. In our opinion, the ALCM and B-52 modification programs illustrate some of the difficulties of planning and acquiring logistics support in a timely and efficient manner when systems are concurrently developed and produced. Also, it appears to us that in some cases--such as

implementing certain testing and maintenance programs and resolving service reports--logistics considerations received a relatively low priority. In our opinion, these circumstances may ultimately result in less efficient and effective logistics support.

DOD's initiatives to improve the acquisition process recognize the difficulty of accomplishing effective logistics planning for concurrent programs and direct the services to develop procedures to overcome these problems. In developing these procedures, DOD should address problems such as those experienced in the ALCM and B-52 modifications--determining logistics requirements and providing support when design is not stable but schedule constraints require decisions to be made, lacking the time to do the necessary testing and to consider logistics design changes, and deferring logistics support plans. Once these new procedures are developed, it is imperative that their implementation be closely monitored.

ALCM and B-52 managers could improve the management of their logistics planning efforts if they made greater use of logistics support analysis data, life-cycle cost analysis, and budgeting for logistics planning. Appropriate use of this type of information would help assure that logistics costs considerations are addressed in the decisionmaking process.

The ALCM and other cruise missile variants appear to be ideally suited programs for the consolidation of depot maintenance for their common components. DOD policy and past experience show that cost savings can result from consolidating maintenance requirements for common components.

RECOMMENDATIONS

We recommend that the Secretary of Defense direct ALCM and B-52 modification program managers to more effectively use logistics support analysis, life-cycle cost estimating, and logistics budgeting planning data in making logistics decisions for their programs. We also recommend that the Secretary of Defense determine whether cost savings can be achieved by consolidating depot maintenance for common cruise missile components.

AGENCY COMMENTS

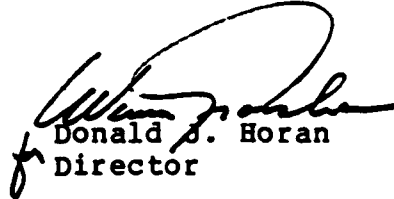
On March 12, 1982, we met with DOD officials and obtained their official oral comments. Changes have been made in the report where appropriate. The officials did not comment on our recommendation for making more effective use of management information devices. The officials agreed with our recommendation on consolidating depot maintenance for common cruise missile components and stated that studies of specific common components have been initiated or are planned.

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As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Director, Office of Management and Budget; the Chairmen, House Committee on Government Operations, Senate Committee on Governmental Affairs, and House and Senate Committees on Appropriations and on Armed Services; and the Secretaries of the Air Force and Navy.

Sincerely yours,



Donald J. Horan
Director

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