1040

ECONOMICS OF DEFENSE PROCUREMENT: THE C-5A AND STRATEGIC MOBILITY

HEARINGS

BEFORE THE

SUBCOMMITTEE ON PRIORITIES AND ECONOMY IN GOVERNMENT

OF THE

JOINT ECONOMIC COMMITTEE CONGRESS OF THE UNITED STATES

NINETY-FOURTH CONGRESS

SECOND SESSION

NINETY-FIFTH CONGRESS

FIRST SESSION

AND

NINETY-SIXTH CONGRESS

SECOND SESSION

PART 1

JUNE 8, 1976, DECEMBER 21 AND 22, 1977, AND AUGUST 25 AND SEPTEMBER 16, 1980

Printed for the use of the Joint Economic Committee

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[1] Committee and subcommittee membership, 96th Congress, 2d session.

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Thursday, December 22, 1977

Monday, August 25, 1980

TUESDAY, SEPTEMBER 16, 1980

ECONOMICS OF DEFENSE PROCUREMENT: THE C-5A AND STRATEGIC MOBILITY

TUESDAY, JUNE 8, 1976

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON PRIORITIES AND
ECONOMY IN GOVERNMENT OF THE
JOINT ECONOMIC COMMITTEE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10:30 a.m., in room 5302, Dirksen Senate Office Building, Hon. William Proxmire (chairman of the subcommittee) presiding.

Present: Senators Proxmire and Taft.

Also present: Richard F. Kaufman, general counsel; and George D. Krumbhaar, Jr., minority professional staff member.

OPENING STATEMENT OF SENATOR PROXMIRE, CHAIRMAN

Senator PROXMIRE. The subcommittee will come to order.

Mr. Comptroller, I apologize. We had a live quorum and then a rollcall, and I had no option except to go to the floor. I do apologize for keeping you waiting for a half hour.

Today's hearings concern the relationship between military mission requirements and the procurement of major weapons systems.

A number of persons have observed that too often individual weapons systems are discussed or criticized in a piecemeal fashion without seeking to understand the purpose or mission of the weapon.

There are occasions when individual weapons need to be examined, regardless of their mission, because of problems that arise during their procurement. For example, if a weapon fails to perform satisfactorily, as was the case with the Cheyenne helicopter and many other weapons, it is proper to inquire into that problem alone.

However, it may also be the case that a weapons system, no matter how well it performs, may not contribute enough to the military mission for which it was designed to justify its cost.

In addition, questions need to be asked about the military missions themselves. It may seem proper to procure a number of different new weapons systems in view of the military mission they have been assigned to. What about the definition of the mission?

How are mission requirements defined and is there a body of quantified data which can be examined or analyzed and which would justify the mission requirement?

Is that body of data available to Congress and the General Accounting Office so that it can be analyzed and evaluated?

Are mission requirements derived after careful analysis in light of our overall defense policy goals and the resources available to accomplish those goals, or are they simply "wish lists" compiled by military leaders without regard to the realities of the situation?

These are some of the questions we want to explore this morning. We want to understand how the Defense Department orders its priorities and whether it is utilizing the resources made available by Congress in the most efficient and economical manner.

We are particularly interested in the mission requirement for strategic airlift. This subcommittee has done extensive work in the area of military cargo aircraft programs such as the C–5A, a program which we severely criticized several years ago and which has turned out to be one of the most disastrous procurements in recent decades.

More importantly, strategic airlift is one of the foundations underlying our commitment to our allies in Europe. Experts estimate that as much as two-thirds of the conventional portion of the defense budget is earmarked for the European contingency, to be used in case of a war in Europe.

The European contingency is thus one of the most powerful driving forces behind the defense budget.

Obviously, we need to have an effective airlift program in order to defend our interests and commitments in Europe.

Strategic airlift has been an expensive program up to now, but recently the Defense Department revised the definition of this mission by doubling the amount of cargo it believes necessary to transport to Europe during the first 30 days following the beginning of a war. To accomplish the new mission the Defense Department has requested or plans to request new airlift programs that will cost an estimated $13 billion.

A year ago I asked the General Accounting Office to undertake a comprehensive review of military airlift requirements over the next 5 years. The testimony today concerns the results of that inquiry.

We will also hear briefly about two other military missions, the field Army air defense mission, and the sea control mission.

Our witness is Elmer Staats, Comptroller General of the United States.

Elmer, it is very good to see you and I am pleased you are able to be here today. I have had a chance to read your testimony and the strategic airlift report. They are both impressive documents and I believe they contain important findings and recommendations.

There is a very, very interesting report that we have just received, apparently just released within the hour or so. It is brief. And when you finish your regular statement I would appreciate it if you could read that to us, because I think it is something we ought to have in the record, concerning the field Army air defense mission.

STATEMENT OF HON. ELMER B. STAATS, COMPTROLLER GENERAL OF THE UNITED STATES, ACCOMPANIED BY RICHARD W. GUTMANN, DIRECTOR, PROCUREMENT AND SYSTEMS ACQUISITION DIVISION; JEROME H. STOLAROW, PRINCIPAL DEPUTY DIRECTOR, PROCUREMENT AND SYSTEMS ACQUISITION DIVISION; AND FELIX E. ASBY, ASSISTANT DIRECTOR, LOGISTICS AND COMMUNICATIONS DIVISION

Mr. STAATS. Thank you very much, Mr. Chairman. We are pleased to be here this morning at your request to discuss our current and planned work in this area that you have so well summarized in your opening statement.

In particular, we will discuss certain recommendations of the Commission on Government Procurement, and the process within the Department of Defense relating to the generation of requirements for new weapon systems.

The General Accounting Office has been deeply involved in reviews of the acquisition of major weapon systems since 1970 growing out of the interest in the Congress in independently developed data on the cost, schedule and performance of systems for which funding was being requested. I have attached to this statement a letter which I sent to the chairmen of the House and Senate Armed Services Committees in 1969 on this subject. During the past 6 years we have issued several hundred studies on individual systems, primarily for the use of the Armed Services and Appropriations Committees.

In recent years it has become evident to many Members of the Congress, and others who are concerned with the acquisition of weapons systems, that the Congress and senior management officials in the Department of Defense cannot evaluate the need for new systems without considering their relationship to other weapons systems and the military missions to be accomplished.

In 1972, in hearings before the House Armed Services Committee we also pointed out that the Congress and the Department of Defense should better identify needs for weapon systems. We presented in 1973 a very comprehensive statement with a series of charts and graphs which we compiled for that purpose. It was entitled "Cost Growth in Major Weapon Systems," and how we felt they should be controlled. With your permission I would like to have that also a part of the record of this hearing.

Senator PROXMIRE. Yes, without objection.

Mr. STAATS. The points we made are numerous, and I think they are equally valid today as they were at the time they were on March 28, 1973.

[The statement referred to follows:]

STATEMENT OF HON. ELMER B. STAATS, COMPTROLLER GENERAL OF THE UNITED STATES, BEFORE THE COMMITTEE ON ARMED SERVICES, HOUSE OF REPRESENTATIVES, ON "COST GROWTH IN MAJOR WEAPON SYSTEMS," MARCH 28, 1973

Mr. Chairman and Members of the Committee: We appear this morning at your request to discuss our report, "Cost Growth in Major Weapon Systems", which was prepared in response to your request of June 21, 1972.

For 4 years we have been providing the Armed Services and the Appropriations Committees with (1) staff studies on specific weapon programs and (2) annual evaluations of the overall process of weapons acquisition so that they will have reliable information to carry out oversight and legislative duties. We share the deep concern of the Congress with the problem of the escalating cost of weapons.

In the summer of 1969 we advised you that we were establishing a special group in our Defense Division to deal with major weapons system acquisition problems. About a year ago, we established a separate division to better coordinate all our procurement and systems acquisition work. To date, most of our reviews have been on weapon systems, but we are beginning to cover civil systems as well.

We have also been broadening the base of our competence by selectively acquiring a wide range of disciplines in our technical staff.

We are, of course, proud of our staff capabilities, but we are finding it useful to engage outside experts for advice on overall approaches and, to occasionally assist our staff in evaluating the technical aspects of particularly complex systems. This has substantially increased our competence in dealing with both acquisition policies and specific weapon systems.

Today, we will summarize our views on weapons cost growth and closely related problems. The points we will discuss and recommendations we will make are not novel nor are they cure-alls.

Many other groups and experts have studied weapons procurement. In our study we have analyzed the observations, perspectives, and recommendations of others who, like ourselves, are concerned about the disturbing trends in weapon system cost, including those participating in and managing the weapon acquisition process. Our findings and recommendations, therefore, are based on a broad consensus and make good sense to us.

PRINCIPAL ELEMENTS OF THE GAO REPORT

Probably no segment of the Defense budget has received more attention during the past several years than the growth in cost of new weapons or weapons systems, caused principally by:

Increased performance demanded of new systems which, in turn, require greater complexity, and

Increases resulting from the way a weapon program is managed during development, design, and production.

The military services continually demand performance and capabilities of new systems significantly more advanced than those to be replaced—to meet new or potential threats and to exploit new technology.

Efforts to monitor these weapon acquisition programs in detail; to achieve often elusive and distant cost, schedule, and performance objectives; and to control various kinds of changes have resulted in much debate and many studies within and outside the Defense Department.

Our report includes what we believe to be key observations and conclusions of recent studies made by such groups as the:

Blue Ribbon Defene Panel
National Security Industrial Association
RAND Corporation
Department of Defense
Commission on Government Procurement
General Accounting Office

A summary of their key ideas is attached as an appendix to this statement.

Although no data is available to measure the causes of cost growth precisely, it is generally agreed that the greatest single factor in cost growth stems from continuously expanding performance requirements.

Cost Growth Resulting From Greater Capability Being Demanded of Replacement Systems

Most resources are invested in systems to supersede existing ones. Successive generations of systems following this pattern crowd state-of-the-art frontiers and, of course, costs increase with each increment of improvement. This technological escalation can be expected to drive costs up, no matter how well the programs are managed.

The Navy S–3A antisubmarine aircraft, the Air Force F–15 fighter and B–1 bomber, as examples, will cost many times more than the systems they are to replace. These increases might be described as performance cost growth—the tendency to continually seek higher performance systems—one of the most serious aspects of cost growth because, under fixed budgets, tradeoffs for more complex and more costly systems means fewer systems.

Later, you will see a graph comparing cost and performance changes in 13 new weapon systems with systems they replace. Performance is estimated to be two to three times greater for the new systems. For those increases, R&D costs went up five times and production unit costs four times. These performance gains, i.e., higher speed, greater range, and improved payload, must be looked at as interim gauges—the ultimate measure of weapon effectiveness is success in combat.

The process of justifying a new weapon system must not only compare the performance improvements of the new weapon over the old but also must consider such factors as reliability and effect on readiness, crew training and motivation, support from associated systems, tactics, and doctrine.

Cost Growth Due to Acquisition Management (Overruns)

Histories of 45 systems under development at June 30, 1972, show that current cost estimates to acquire the systems increased by some $31.5 billion, or 39 percent, over planning estimates and $19.1 billion, or 20 percent, over development estimates. These widely publicized overruns have shaken public confidence in the ability and credibility of both Government and industry managements. In the case of the highly publicized C–5A, the estimated cost per plane doubled in a 5-year period.

An analysis of the cost changes reported by DOD in these 45 systems shows at least three different reasons for the cost growth.

1. Inaccuracy in estimating—DOD records show that cost-estimating changes accounted for about 25 percent, not 100 percent as many people are prone to assume.

2. Inflation—accounts for about 30 percent. DOD has furnished you with a report on the effects of inflation, and we won't duplicate this report.

3. Revisions to specifications, i.e., time schedules, quantities, or engineering changes—account for some 45 percent. Again, much of this type of cost growth results from unrealistic performance targets at the outset; including:

Trying to do too much—challenging the outer reaches of the state-of-the-art, and

Trying to develop and produce the system too rapidly.

Overly ambitious performance requirements; combined with low initial cost predictions, optimistic-risk estimates, and quick development; lead almost inevitably to engineering changes, schedule slippages, and cost increases. To keep total program cost from rising, planned quantities are reduced which, in turn, increases unit cost.

Yet another point to consider is the general consensus that production capacity, particularly in the aerospace and shipbuilding industries, exceeds current and reasonably foreseeable military needs. In those industries, a contractor obtaining one of the scarce development contracts can mean the difference between its staying in the business or not.

This pressures competing contractors to propose optimistically low prices, promise new and attractive system capabilities, and emphasize sophistication.

The cost overrun story is not peculiar to weapon systems. Civilian systems, such as nuclear power plants, Government buildings, and masstransit systems, also have these problems and for many of the same reasons.

REFORMS TO EMPHASIZE

The past 4 years have seen vigorous activity to moderate weapon acquisition problems and to initiate new policies and management techniques.

The various actions proposed and being implemented are aimed at three key objectives.

Making the right decision at the outset of what to develop and for what purpose.

Avoiding the pitfalls in development and production that cause slippages and cost overruns.

Strengthening the overall management of the systems acquisition process.

In 1969 DOD, under the guidance of Deputy Secretary Packard, began a series of comprehensive changes to weapon acquisition policies, seeking such things as

(1) greater reliance on hardware demonstration and less reliance on paper studies, (2) wider use of cost-reimbursement contracts for development, (3) separation of development from production, and (4) improved cost estimating. These changes, taken together, were incorporated in DOD Directive 5000.1.

Another policy change, embodied in proposed Directive 5000.2, would involve the Secretary of Defense earlier in the decision cycle by requiring OSD-Service agreement on operational need and affordable cost and require more thorough analyses and evaluations of alternative systems.

These changes have found widespread support from the study groups mentioned earlier. The DOD Blue Ribbon Panel of 1970 and the Commission on Government Procurement have both urged that the Secretary of Defense participate in earlier decisionmaking on new weapons, as would be proposed by Directive 5000.2.

Through looking back over 4 years of our own efforts, and evaluating the views of prominent study groups and experts, we have compiled a list of 13 interrelated reforms which we believe deserve particular emphasis. These are discussed in our report and summarized below.

1. Obtain OSD, Service, and Congressional agreement on the basic operational need, the fundamental weapon system characteristics, and the expected level of resources to be allocated to that need.
2. Strengthen the staff support to provide the Secretary of Defense with comprehensive and objective analyses of missions and weapons requirements.
3. Extend the span of congressional authorizations—at least for 1 year in advance of the upcoming budget year.
4. Strengthen congressional reviews of weapon budgets by first considering and approving budget totals for major missions. This review will consider the overall needs of the various military missions.
5. Avoid concurrent development and production, and adhere to orderly and sequential design, test, and evaluation.
6. Stress austerity, small design teams, freedom to innovate, and maximum competition in the design phase, with clear separation of development and production. Encourage continuous development of subsystems.
7. Adopt contracting practices and Government/contractor relationships which will encourage the most effective team performance.
8. Continue to improve the Government's capability to develop cost estimates covering the development phase and the production phase of new systems.
9. Emphasize life-cycle costing to gain better perspective on proposed new systems and to strengthen cost-effectiveness analyses.
10. Continue the current strong emphasis on upgrading the competence, stature, and tenure of program managers and procurement specialists.
11. Continue to emphasize operational test and evaluation by establishing in each military department an organization independent of the developer and the user. The senior OSD official in this activity should report to the Secretary of Defense or to his deputy.
12. One of the two Deputy Secretaries of Defense should assume the responsibility for mission analysis and systems acquisition.
13. Improve the planning for maintaining the development and production base.

In this brief statement we have highlighted some of the more salient causes of cost growth in weapon systems and proposed suggestions, developed in our work and by various authorities.

We would now like to present a visual review of our report. A set of the charts which we will use is attached to this statement.

We are also attaching excerpts from some of the more prominent studies and informed comments on weapon system acquisition problems.

Appendix I

Briefing Charts

1. Cost growth in major weapon systems.
2. Timeliness of this subject.
3. Recent major studies.
4. The development process for a major weapon system.
5. The pattern of deeper involvement and decreasing options.

6. Two major causes of cost growth.
7. The rising system cost.
8. The tank story.
9. Because of increasing costs force levels have been reduced.
10. Average increase in cost and performance.
11. Cost growth implications.
12. The second cause of cost growth is management and timing factors.
13. Cost overrun histories of 45 weapon systems.
14. Planning estimates have been low historically.
15. What causes overruns?
16. Estimating errors (25 percent).
17. Inflation (30 percent).
18. Specification changes (45 percent).
19. Reforms proposed by most authorities stress three key objectives.
20. Make the right decision at the outset.
21. Illustration of revised congressional review process.
22. Avoid pitfalls which history shows have led to slippages and overruns.
23. Avoid pitfalls . . . Continued.
24. Parametric estimates can be helpful in predicting total costs.
25. Strengthen the management of the acquisition process.
26. (Illustrative chart—GAO's concept) Deputy Secretary of Defense for Mission Analysis and Systems Acquisition.
27. Suggested next steps for the responsible committee.

COST GROWTH IN MAJOR WEAPON SYSTEMS

REPORT OF THE COMPTROLLER GENERAL

MARCH 1973

28-003 0 - 81 - 2

TIMELINESS OF THIS SUBJECT

1 — 116 MAJOR SYSTEMS BEING DEVELOPED

2 — TOTAL COST WILL BE $153 BILLION

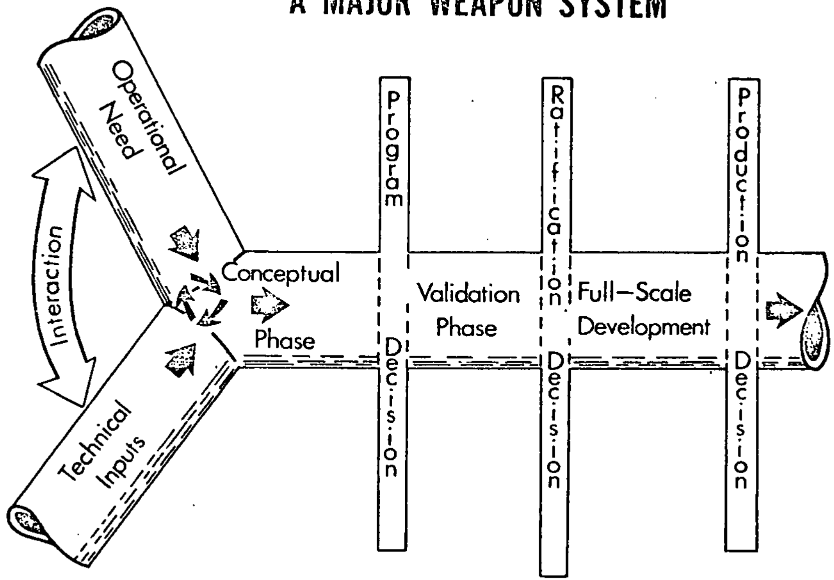
3 — OVER HALF YET TO BE APPROPRIATED

RECENT MAJOR STUDIES

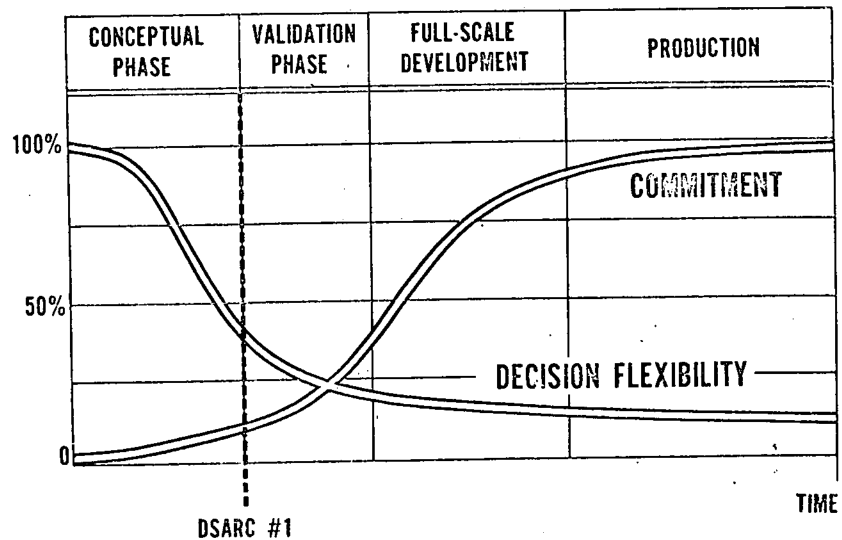
- BLUE RIBBON DEFENSE PANEL
- NATIONAL SECURITY INDUSTRIAL ASSOCIATION
- CONGRESSIONAL HEARINGS AND REPORTS
- RAND CORPORATION
- DOD, ESPECIALLY SECRETARY PACKARD
- COMMISSION ON GOVERNMENT PROCUREMENT
- GENERAL ACCOUNTING OFFICE

A VERY BROAD CONSENSUS NOW EXISTS AS TO CAUSES AND SOLUTIONS TO PROBLEMS OF COST GROWTH

THE DEVELOPMENT PROCESS FOR A MAJOR WEAPON SYSTEM



THE PATTERN OF DEEPER INVOLVEMENT AND DECREASING OPTIONS



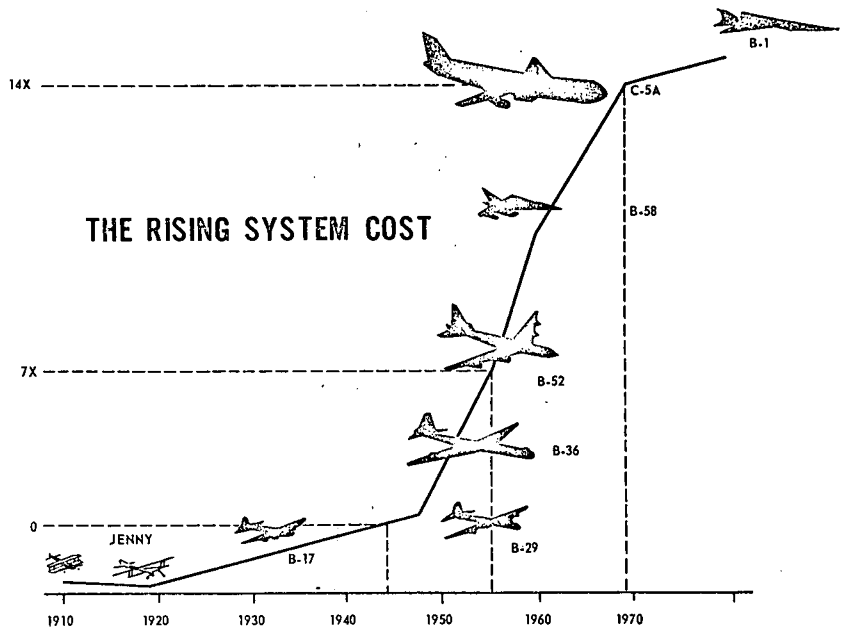
TWO MAJOR CAUSES OF COST GROWTH

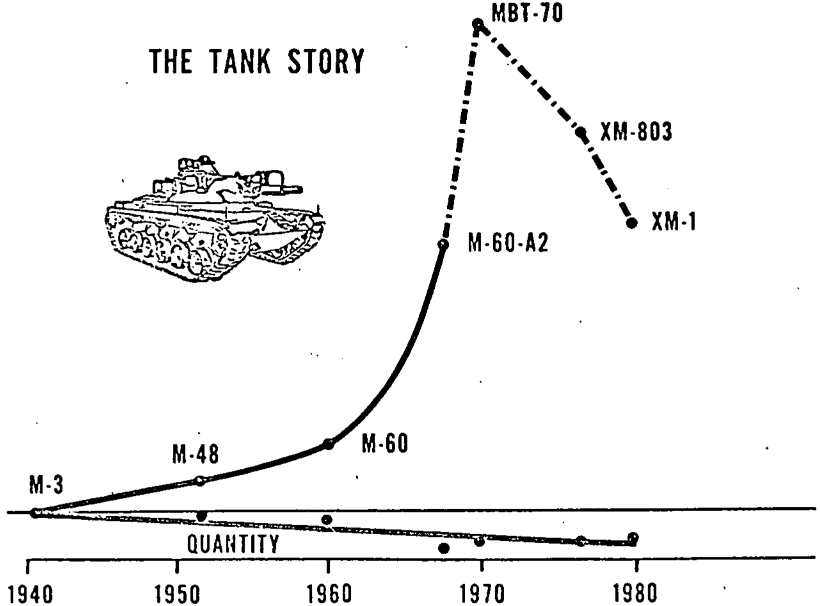
FIRST — INCREASED COMPLEXITY OF SYSTEMS

- GREATER CAPABILITY BEING DEMANDED
  RESULTS IN MARKED INCREASE IN UNIT
  COST FROM ONE GENERATION TO THE NEXT

SECOND — MANAGEMENT AND TIMING FACTORS

- INFLATION
- ESTIMATING ERRORS
- CHANGES IN REQUIREMENTS


THE RISING SYSTEM COST
14X
7X
0
JENNY
B-17
B-29
B-36
B-52
B-58
C-5A
B-1
1910
1920
1930
1940
1950
1960
1970


THE TANK STORY
MBT-70
XM-803
XM-1
M-60-A2
M-60
M-48
M-3
QUANTITY
1940
1950
1960
1970
1980

BECAUSE OF INCREASING COSTS FORCE LEVELS HAVE BEEN REDUCED

SYSTEM	QUANTITY ORIGINAL	QUANTITY NOW	UNIT COST ORIGINAL	UNIT COST NOW	TOTAL COST ORIGINAL	TOTAL COST NOW
			($MILLIONS)		($MILLIONS)	
LHA	9	5	$153.0	$194.0	$1,380.3	$970.0
C-5A	120	81	28.6	56.0	3,423.0	4,526.0
F-14	710	313(?)	8.7	16.8	6,166.0	5,272.0
F-111	1,388	466	3.4	15.0	4,686.0	6,994.0

OTHER PROGRAMS, FOR EXAMPLE THE MBT-70 TANK HAVE BEEN CANCELLED BECAUSE THEY WERE TOO EXPENSIVE.

AVERAGE INCREASE IN COST & PERFORMANCE

COST		PERFORMANCE					
R&D COST	UNIT COST	PAYLOAD	RANGE OR ENDURANCE	SPEED	AVIONICS FUNCTION	CREW COMFORT OR SAFETY	DELIVERY OR NAVIGATION ACCURACY
5.4X	[illegible].2X	2.3X	1.9X	1.8X	3.0X	3.0X	3.0X

THIS AVERAGE BASED ON 13 MAJOR SETS OF NEW AND OLD SYSTEMS (SOURCE: ODDR&E)

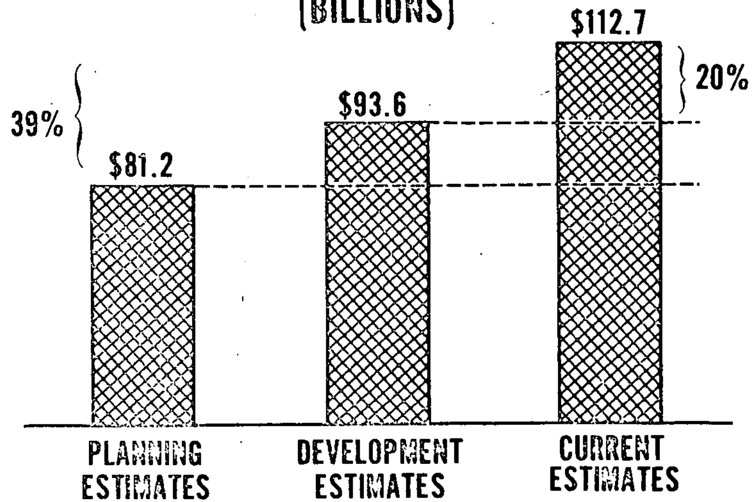
COST GROWTH IMPLICATIONS

- IF SIGNIFICANT UNANTICIPATED INCREASES CONTINUE
  THEN, DOD WILL BE FORCED
  - EITHER TO REDUCE FORCES BELOW PLANNED LEVELS
  - OR, TO SACRIFICE DESIRED PERFORMANCE
- FURTHER LOSS IN CONGRESSIONAL AND PUBLIC CONFIDENCE WILL OCCUR

THE SECOND CAUSE OF COST GROWTH IS MANAGEMENT AND TIMING FACTORS

THESE ARE THE PROBLEMS THE PUBLIC SEES AS "COST OVERRUNS"

COST OVERRUN HISTORIES OF 45 WEAPON SYSTEMS *
(BILLIONS)



* AS CURRENTLY REPORTED ON DOD SAR'S IN JUNE 1972

PLANNING ESTIMATES HAVE BEEN LOW HISTORICALLY

HARVARD STUDY 1962 – 12 WEAPONS

AVERAGE DEVELOPMENT COST

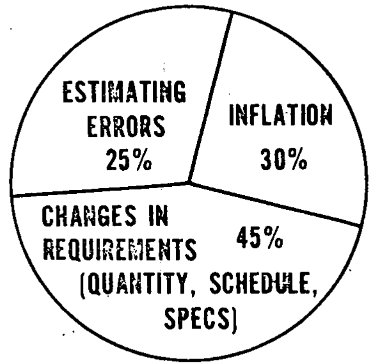
THREE TIMES

THE ORIGINAL ESTIMATES

RAND STUDY 1959 – 22 WEAPONS

COST INCREASES DURING DEVELOPMENT WERE
200% – 300%

WHAT CAUSES OVERRUNS?



DATA TAKEN FROM ANALYSIS OF COST CHANGES IN 45 WEAPON SYSTEMS REPORTED IN JUNE 30, 1972 SAR'S

ESTIMATING ERRORS (25%)

BOTH BUYER AND SELLER HAVE STRONG MOTIVATIONS TO ACCEPT LOW COST ESTIMATES IN A COMPETITIVE ENVIRONMENT

- THE BUYER OVERSTATES PERFORMANCE TO GAIN APPROVAL OVER COMPETING SYSTEMS
- THE SELLER UNDERSTATES THE COST DUE TO OPTIMISM
- BOTH UNDERESTIMATE THE SHEER DIFFICULTY OF PREDICTING THE UNKNOWN

INFLATION (30%)

- DOD HAS REPORTED ITS FINDINGS TO THE COMMITTEE
- THE GOVERNMENT IS LEARNING HOW TO COPE WITH THIS PROBLEM IN CONTRACT ESCALATION CLAUSES

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SPECIFICATION CHANGES (45%)

THIS MAY BE THE MOST IMPORTANT CAUSE OF OVERRUNS WHICH RESULT FROM—

- TRYING TO DO TOO MUCH — CHALLENGING THE STATE OF THE ART FRONTIER
- TRYING TO DEVELOP AND PRODUCE THE SYSTEM TOO FAST

THESE CHANGES AFFECT QUANTITY, SCHEDULE AND PERFORMANCE SPECIFICATIONS

REFORMS PROPOSED BY MOST AUTHORITIES STRESS THREE KEY OBJECTIVES

- MAKE THE RIGHT DECISION AT THE OUTSET
- AVOID PITFALLS WHICH LEAD TO SLIPPAGES AND OVERRUNS
- STRENGTHEN MANAGEMENT OF THE ACQUISITION PROCESS

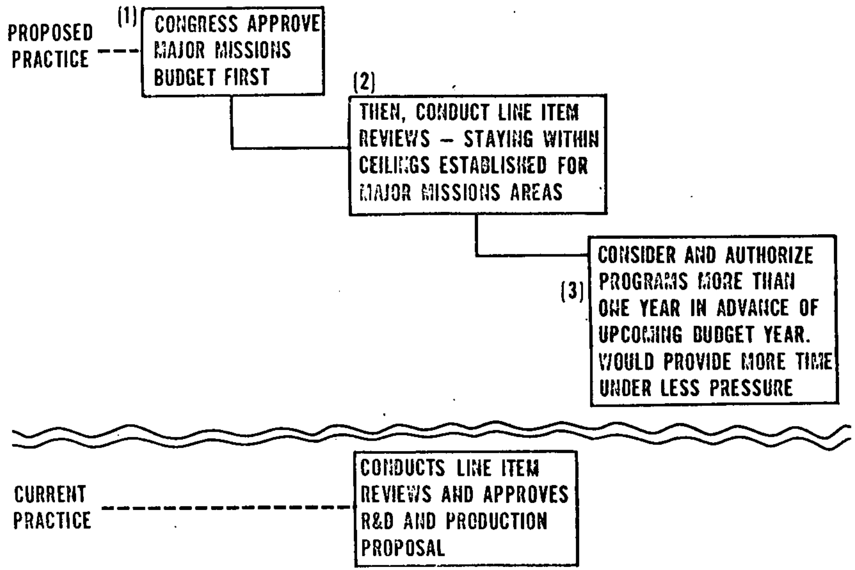
SEVERAL YEARS WILL BE REQUIRED TO IMPLEMENT THE RECOMMENDATIONS WHICH SUPPORT THESE OBJECTIVES

A. MAKE THE RIGHT DECISION AT THE OUTSET

1. OSD, SERVICE AND CONGRESS SHOULD AGREE ON:
   - OPERATIONAL MISSION NEED
   - COST LIMITS

   (THIS IS ENVISIONED IN DRAFT DIRECTIVE 5000.2)
2. PROVIDE SECDEF BETTER FACTS FOR DECISIONMAKING
   - STRENGTHEN DSARC STAFF
3. EXTEND THE SPAN OF AUTHORIZATIONS.
4. STRENGTHEN CONGRESSIONAL REVIEW
   - THESE PROPOSALS ARE IN CONSONANCE WITH THE JOINT STUDY COMMITTEE ON BUDGET CONTROL

ILLUSTRATION OF REVISED CONGRESSIONAL REVIEW PROCESS



B. AVOID PITFALLS WHICH HISTORY SHOWS HAVE LEAD TO SLIPPAGES AND OVERRUNS

5. AVOID CONCURRENT DEVELOPMENT AND PRODUCTION

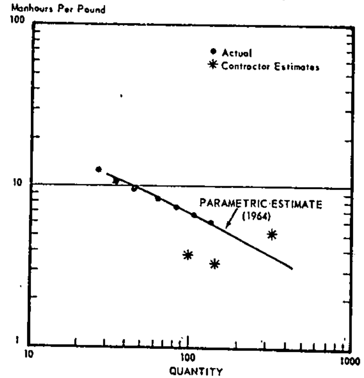
6. STRESS MAXIMUM, BUT AUSTERE, DESIGN COMPETITION
   - SMALL DESIGN TEAMS
   - SMALL EXPERIMENTAL SHOPS
   - DESIGN TO COST
   - INCREMENTAL DESIGN
   - AUSTERE PROTOTYPES
   - MINIMUM DOCUMENTATION
   - CONTINUOUS SUBSYSTEM DEVELOPMENT

B. AVOID PITFALLS . . .CONT'D

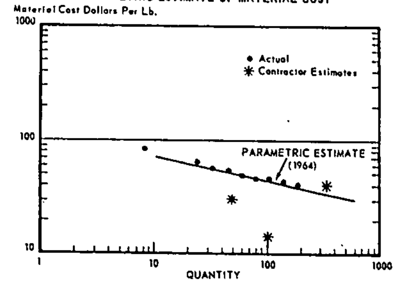
7. ENCOURAGE EFFECTIVE TEAM PERFORMANCE BETWEEN THE GOVERNMENT AND THE CONTRACTOR DURING DEVELOPMENT
8. EMPHASIZE "LIFE CYCLE COSTING" TO IMPROVE COST-EFFECTIVENESS STUDIES AND DECISIONS
9. CONTINUE TO IMPROVE COST ESTIMATING TECHNIQUES
   - INCLUDING THE USE OF PARAMETRIC ESTIMATES

PARAMETRIC ESTIMATES CAN BE HELPFUL IN PREDICTING TOTAL COSTS

PARAMETRIC ESTIMATE OF MANHOURS REQUIRED



PARAMETRIC ESTIMATE OF MATERIAL COST



C. STRENGTHEN THE MANAGEMENT OF THE ACQUISITION PROCESS

10. PROGRAM MANAGERS AND PROCUREMENT SPECIALISTS

    UPGRADE THEIR COMPETENCE, STATURE AND TENURE

11. TEST AND EVALUATION

    ESTABLISH A SEPARATE ORGANIZATION IN EACH SERVICE INDEPENDENT OF DEVELOPER AND USER

12. DEPUTY SECRETARY FOR MISSION ANALYSIS AND SYSTEMS ACQUISITION

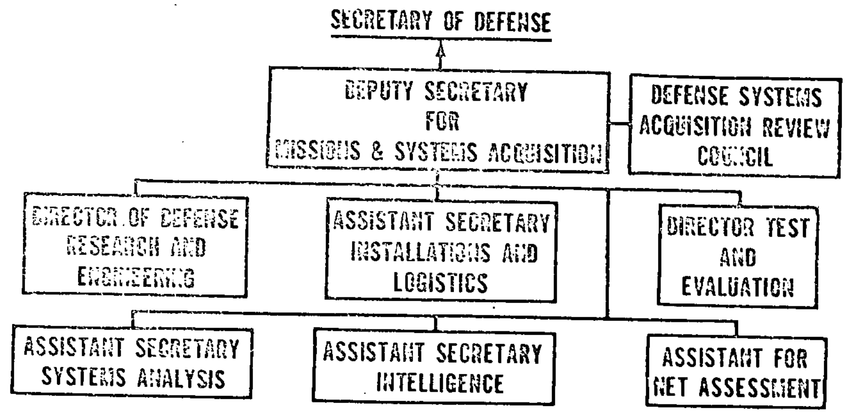
    NEW POSITION HAS BEEN AUTHORIZED

13. THE INDUSTRIAL BASE

    IMPROVE THE PLANNING FOR MAINTAINING AN ADEQUATE DEVELOPMENT AND PRODUCTION INDUSTRIAL BASE

(ILLUSTRATIVE CHART)

GAO'S CONCEPT OF
DEPUTY SECRETARY OF DEFENSE FOR MISSION ANALYSIS AND SYSTEMS ACQUISITION



SUGGESTED NEXT STEPS FOR THE RESPONSIBLE COMMITTEES

1. WORK WITH DOD AND OMB IN DEVELOPING AND TESTING TECHNIQUES OF STRENGTHENING CONGRESSIONAL REVIEW – STRESSING MISSION BUDGETS.

2. PRESS FOR ADOPTION OF THE PROPOSALS OF THE COMMISSION ON GOVERNMENT PROCUREMENT RELATED TO R&D, SYSTEMS ACQUISITION, AND GENERAL PROCUREMENT PRACTICES.

3. ARRANGE FOR PERIODIC REVIEWS OF DOD PROGRESS IN IMPLEMENTING OTHER IMPROVEMENTS

APPENDIX II

REPRESENTATIVE SUMMARY COMMENTS FROM AUTHORITATIVE SOURCES

On causes of cost growth

Dr. Alexander Flax, president of the Institute for Defense Analyses, notes for example, that "on the average, costs for the heavier, more-complex class of combat aircraft have increased by a factor of 10 about every 18 years." Although some of this increase is attributable to inflation, he notes that:

"* * * most of the increase is attributable to increasing technological complexity in airframe, engines, accessories, and avionics; by increases in size and weight and by more costly materials, processes and fabrication techniques. There have, of course, been corresponding increases in performance, speed, range, load-carrying capability and also increase in military mission capabilities such as accuracy of navigation and precision of weapon delivery."

Further he says that the quickening pace of technology for airframes, engines, and avionics has led to ever more frequent and expensive requirements, to pay the "price of entry" into new materials, processes, design approaches, manufacturing methods, and operational techniques.

The former Deputy Secretary of Defense, David Packard, in addressing the Armed Forces Management Association dinner in 1970 said, "The Defense Department has been led down the garden path for years on sophisticated systems."

The Brookings Institution [1] observes that "Between 1950 and 1968 the real cost of the average bomber and military transport plane increased three times and of the average fighter nearly eight times." These increases are attributed principally to the higher performance demanded of each system and the accompanying system complexity needed to achieve it. Brookings warns that the cost-number tradeoff cannot continue indefinitely.

ON CONSEQUENCES OF COST GROWTH

Senator John Stennis, Chairman of the Senate Committee on Armed Services said:

"If we can afford a permanent force structure of only one-fifth as many fighter aircraft or tanks as our potential adversaries—because our systems are about five times more expensive than theirs—then a future crisis may find us at a sharp numerical disadvantage."

The Senate Committee on Armed Services expressed another concern, that "the multiplying cost of weapon system development and procurement is reaching such prohibitive levels that the country may be unable to afford some of the most vital weapon systems."

Deputy Secretary of Defense Kenneth Rush adds that "we too often reduce the number of units to stay within previous cost projections. We can no longer afford to reduce the quantity just because we need modern equipment to maintain our military posture."

John S. Foster, Jr., Director, DDR&E recently said that "We can no longer continue to buy adequate quantities of needed weapons if the unit procurement and lifetime costs of more weapons continue to soar."
ing system complexity needed to achieve it. Brookings warns that the cost-of the average bomber and military transport plane increased three times and of the average fighter nearly eight times." These increases are attributable principally to the higher performance demanded of each system and the accompanying system complexity needed to achieve it. Brookings warns that the cost-numbers tradeoff cannot continue indefinitely.

ON COST ESTIMATING

In a recent report on cost estimating for major acquisitions, we stated that:

"For the acquisition programs we reviewed, * * * [detailed] estimates were consistently understated. * * * Without realism and objectivity in the cost estimating process, bias and overoptimism creep into the estimates prepared by advocates of weapon systems and the estimates tend to be low."

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[1] Charles L. Schultze, Edward R. Fried, Alice M. Rivlin and Nancy H. Teeters, Setting National Priorities, the 1973 Budget published by the Brookings Institution, Washington, D.C., 1972.

The Blue Ribbon Defense Panel reported that:

"The implicit assumption that technical risks can be foreseen prior to commencement of development has proved wrong. * * * It follows that the belief that detailed pricing techniques for the total systems acquisition effort can be accomplished during Contract Definition is equally false. Only gross pricing techniques such as parametric pricing are likely to provide accurate forecasts of ultimate costs of weapons systems."

Mr. Packard states that "As an example, parametric cost estimates, which can predict costs within 10% or so, predicted that both the F–111 and the C–5A contract bids were much below what the costs were likely to be."

ON CHANGES IN REQUIREMENTS

Deputy Secretary Packard described these problems in the following words.

"* * * I have noted that another major contributor to cost growth consists of changes which we make in a program during both the development phase and the production phase. While I know there is a valid need for some changes, much improvement is possible in this area. Many of the changes of the type currently being made can be and must be avoided. This can be accomplished, in part, first by assuring that we do a better and more complete job of defining what we really needed in a system before entering full-scale development and, second, by the vigorous review and elimination of the many 'nice' or 'desirable' features which so often creep into these systems as they proceed through development and production."

On the subject of concurrency, he wrote:

"Almost without exception the programs in trouble had been structured so that production had been started before development was complete * * *. Of all the major programs which we examined, there was hardly even one which kept to the original schedule. In every case if more time had been taken to complete the development before production was started, the new weapon would in fact have been available to the forces just as soon but with fewer problems and at a lower cost."

GAO's 1971 report on system acquisition made the following points on engineering changes.

"Incomplete descriptions of initial performance specifications and changes required to bring system performance up to expected standards have resulted in substantial need for engineering changes. Of the $4 billion in engineering changes reported by the three Services, about $3.1 billion was accounted for by the Air Force for the F–111, the C–5A, and the Minuteman programs. Engineering changes totaling $1.8 billion were required to bring the F–111 and C–5A to expected standards, and $730 million involved changes in the Minuteman to upgrade the system to meet an increased threat."

APPENDIX III

SOLUTIONS TO WEAPON SYSTEMS ACQUISITION PROBLEMS PROPOSED BY VARIOUS AUTHORITIES

(*a*) In July 1970 the Blue Ribbon Defense Panel suggested five actions.

Introduce more flexibility.

Rely more on hardware development than on paper studies.

Increase the number of decision points in the acquisition cycle.

Develop subsystems and components not necessarily tied to a given system.

Avoid concurrency between development and production, ban total-package procurement, eliminate gold-plating, simplify paper work, etc.

(*b*) In 1970, NSIA found that basic improvements in weapons acquisition required:

Early consultation between DOD and industry "as to the state-of-the-art, schedules, costs, and attendant risks."

Use of cost-reimbursement contracts until all significant technical unknowns have been resolved.

Simplification of specifications.

Elimination of unnecessary layers of management and greater continuity in program manager assignments.

Reduction of management systems and reports.

The above proposals, issued on the same date as the Blue Ribbon Defense Panel report, closely parallel those of the Panel.

(*c*) GAO, responding to the growing concerns of the Congress, began a series of case studies of problems of cost growth, scheduling, and performance slippage in selected weapon systems.

In addition to these individual studies, overall reports to the Congress were published on February 6, 1970, March 18, 1971, and July 17, 1972, each entitled "Acquisition of Major Weapons systems" (B–163058).

The first two reports stressed the importance of:

More effective procedures in determining what weapon systems were needed in relation to DOD missions.

Better preparation and use of cost-effectiveness studies.

Strong management control over major systems programs.

The 1972 report (pp. 58 and 59) reiterated the importance of those actions but gave additional attention to (1) the need for appropriate testing and evaluation prior to key decision points in the acquisition cycle and (2) consistent and effective cost-estimating procedures. The 1971 report (p. 1) made the observation that:

"GAO has found that generally the newer weapon procurements are following a slower development pace and procurement practices are more conservative than those of earlier periods * * * evidence of the results of the changed concepts is not yet available to adequately assess them, but the outlook is brighter."

(*d*) The Commission on Government Procurement, after an intensive study, outlines a comprehensive group of proposals. Some of the Commission's key recommendations are:

Start acquisition programs with the Secretary of Defense's statement of needs and goals and responsibility assignments to agency components.

Begin annual congressional reviews with agency mission deficiencies and the needs and goals or new acquisition programs.

Create systems candidates by sponsoring the most promising industry proposals from all qualified sources.

Authorize and appropriate research and development funds for exploring system candidates by agency mission.

Maintain completion between the most promising system candidates by annual fixed-level awards and careful agency monitoring.

Choose preferred systems using mission performance test data and projected ownership costs.

Approve (by the agency head) systems chosen without competition and subject them to special controls.

Support full production decisions by independent and strengthened test organizations.

Use contracting function as an important tool of systems acquisition but not as a substitute for management control; use guidelines in lieu of detailed procurement regulations.

Unify policy and monitoring at top and intermediate management levels. These levels would integrate policy decisionmaking and monitoring functions, such as those now in Installations and Logistics and in Research and Engineering.

These proposals reconfirm and reinforce many of those made by other authorities in recent years. The Commission places great stress on measures needed to avoid the premature lock-in to a single-system approach without thoroughly evaluating the basic need for a new level of capability and what it is worth before less costly systems alternatives are eliminated. The Commission states that "one of the main reasons new defense systems have become increasingly complex and costly is that current acquisition procedure tend to say from the outset that they are the minimum kind 'needed'."

(*e*) The RAND Corporation, summarizing its many reports on system acquisition, said that, although cost-estimating methods could be improved, the result would be fewer unpleasant surprises about cost growth but would do little to improve the acquisition process itself. RAND believes that the following changes are necessary.

a. Separate the development phase from the production phase both sequentially and contractually.

b. Conduct the initial segment of development in an austere manner. Concentrate first on demonstrating system performance. Defer detailed production design and proof of reliability.

Appendix IV

SOLUTIONS TO WEAPON SYSTEMS ACQUISITION PROBLEMS UNDERWAY BY THE DOD

In the last several years, the DOD has begun new policies and procedures, highlighted by Directive 5000.1, to govern major acquisitions.

The Defense Systems Acquisition Review Council (DSARC) was established to formalize Secretary of Defense decisions on individual systems. This deliberating group advises, at critical milestones, on a system's readiness to move into the next phase of acquisition.

In many cases, DOD is requiring hardware demonstration with actual prototypes and relying less on paper analysis to support weapon program decisions.

Cost reimbursement type contracts are becoming the rule instead of fixed-price contracts. There is now more leeway to tradeoff among performance, time, and cost considerations.

DOD has begun separating development from production on programs already in progress, e.g., the F-15 and B-1 programs. Testing or "fly before buy" is being stressed.

The testing function is being separated from the developing function in the Services. An organization has been established in OSD to oversee testing. Its head reports directly to DSARC and the Secretary of Defense.

Parametric cost estimating is now required for new programs.

Supported by the three military departments a Cost Analysis Improvement Group was established in OSD to establish standards for cost estimating. It provides independent review of cost estimating to support DSARC reviews.

A "design to cost" acquisition strategy is being formalized.

A mixed capability force termed a "high-low force mix" is emerging. A small number of high performance weapon systems will augment larger standard force for less total costs. For example, the new XM-1 tank will be supplemented by the older M-60's.

Further tightening of control being considered by the Deputy Secretary of Defense is embodied in the proposed Directive 5000.2. It would:

Establish OSD-Service agreement on the operational need for a new system, and the limit of resources to support the need.

Plan a much more thoroughly advanced development analysis of system alternatives. It would be done before the system choice is made and before engineering development resources are committed.

COMMISSION ON GOVERNMENT PROCUREMENT

Mr. Staats. In December 1972, the report of the Commission on Government Procurement pointed out that Congress and agency heads lack adequate information on the basis for key decisions that lead to the acquisition of weapon systems. The Commission concluded that Congress is not provided the information necessary to interrelate the purpose of the new systems and the financial resources devoted to them, with national policies and programs. Instead, the data presented justified requirements for already defined solutions and annual budget increments that finance development and production.

The Procurement Commission recommended that new system acquisition programs start with the agency's statement of needs and goals that have been reconciled with overall agency capabilities and resources. It suggested that committees of the Congress begin budget and authorization hearings with a review of agencies' missions capabilities and deficiencies as they relate the requests for new acquisition programs.

CONGRESSIONAL ACTION

In 1974, Public Law 93-344, the Congressional Budget and Impoundment Control Act, provided that starting with fiscal year 1979 the budget presentation covering the entire budget (not just defense programs) shall include:

(1) A detailed structure of national needs which shall be used to reference all agency missions and programs;
(2) Agency missions; and
(3) Basic programs.

In that legislation, Congress also directed GAO to evaluate agency programs to determine whether those programs are effectively achieving their objectives and, in cooperation with OMB and the Congressional Budget Office, to help strengthen the budgetary and information systems.

Congress, in passing this legislation, made clear its intentions to relate budget requests to national policies, to agency missions in furtherance of those policies, and to specific programs supporting agency missions.

This interest in a mission oriented structure is also evident in the report of the Senate Armed Services Committee authorizing appropriations for defense for fiscal year 1977. In that report the Department of Defense is requested to provide a comprehensive study of the strategic nuclear national policy and how the various weapons in existence, and proposed, further that policy, and the comparative cost-effectiveness of each.

OFFICE OF FEDERAL PROCUREMENT POLICY

On April 6, 1976, the Office of Management and Budget issued circular A-109, entitled Major System Acquisitions, establishing a new policy for procurement consistent with both Congressional desires and the recommendations of the Commission on Government Procurement. This policy provides for (1) the expression of needs and program objectives in misson terms rather than specfic weapon systems to encourage innovation and competition in creating, explaining and developing alternative system design concepts; (2) the placing of emphasis on the initial activities of the system acquisition process to allow competitive exploration of alternative system design concepts; and (3) the communication with Congress early in the system planning and development process by relating major system acquisition programs to agency mission needs. These policies are to be followed by the civil agencies as well as the Department of Defense.

Senator Lawton Chiles, who served as a member of the Commission on Federal Procurement, as I did, and who is now Chairman of the Subcommittee on Federal Practices, Efficiency and Open Government of the Senate Committee on Government Operations, have been monitoring the implementation of the Procurement Commission recommendations and the actions of the Office of Federal Procurement Policy of the OMB. In July 1975, in testimony before the Subcommittee, Department of Defense officials stated that the Department had, in effect, implemented the key recommendations of the Procurement Commission in several recent acquisitions. At Senator Chiles' request, we are now examining three of the acquisitions cited by the Department of Defense—those that they had indicated did meet those specifications set forth by the Commission on Government Procurement—and were going to evaluate the extent to which they conform to the concepts suggested by the Procurement Commission. In particular, we are concerned with the identification of the need for the new systems, what alternatives were considered, and the extent of competition in the initial phase of the acquisitions. Our report to the Congress on this review should be available by August 31, 1976.

CURRENT GAO EFFORTS

We, in GAO, firmly believe that the Congressional consideration of funding and requirements for new weapon systems should be made in the context of the agencies' overall objectives, systems already in the inventory or in development, and long range budget implications. We also believe that it is the responsibility of the Department of Defense to make data available that would permit the Congress to examine proposed programs this way. Up to now, however, the Department of Defense has not generally presented such information to the Congress and weapon systems are reviewed by the various committees as individual items.

Because the Department of Defense has not been presenting information to the Congress in a broad mission-related format, GAO has undertaken to demonstrate, through a number of reports, the nature of the data required and the value to the Congress of having such information. We believe, however, that the Department of Defense has the basic responsibility for providing this information and that we could assist the Congress by analyzing the information presented by the Department.

The reports we are currently preparing are primarily compilations of information relating to the requirements for weapon systems obtained from various sources within the Department of Defense. For example, a typical report format includes:

A description of a military mission area as prescribed by the Department of Defense.

A summary of intelligence data available from DOD describing the enemy threat to be countered.

Operational characteristics of current and proposed U.S. weapon systems, pointing out strengths and weaknesses identified in DOD test, operational and other studies.

Short- and long-term funding impacts.

Suggested matters for congressional consideration.

One such report on the requirements for strategic airlift, was specifically requested by you and I would like to discuss it briefly at this point.

INFORMATION ON REQUIREMENTS FOR ADDITIONAL STRATEGIC AIRLIFT

Current U.S. conventional defense posture is based partly on the perceived necessity for a capability to transport troops and equipment to potential conflict areas throughout the world. National interests and policies pinpoint the European theater as the most critical area of concern. Specifically, military planners assume that Warsaw Pact Forces, because of certain advantages in geography and conventional capability, would strike first by launching a surprise attack. Defense officials consider a rapid reinforcement capability critical in deterring the actual outbreak of hostilities and in limiting initial Warsaw Pact advantages if war should occur. Airlift of additional U.S. forces and equipment would be the initial method of reinforcing forces already in Europe.

The Department of Defense has proposed some, and plans to propose other new programs to the Congress to increase the current airlift capability. These programs are estimated to cost in excess of $13 billion through the mid-1980's.

The Department of Defense, however, had not provided sufficient data, in our opinion, to enable the Congress to properly consider the needs for new and/or alternative airlift programs. The pertinent facts are that:

The current stated "requirement" to move 180,000 tons in 30 days is derived, in GAO's opinion, not from a demonstrable military need for 180,000 tons of cargo, but from the Air Force estimate of its current airlift capability. Defense's airlift "requirement" is, in reality, to move as much as possible in as short a time as possible.

The Defense Department desires to increase its capability to 370,000 tons. The estimated cost of programs to attain that capability is more than $3.5 billion.

Other airlift programs being proposed or considered will cost about $9.5 billion.

In addition to the fact that the Department of Defense has not fully documented its needs, it is possible that the airlift program may not be attainable because:

There is a serious question whether aircraft can operate for the number of hours per day projected by the Air Force.

The number of aircraft estimated by the Air Force to be available may be substantially overstated because of the number that would be grounded at any one time for modification, overhaul, and maintenance.

The availability of sufficient airfields in Europe to accommodate a massive airlift during a conflict situation is open to question.

It is not clear that there would be sufficient fuel available in Europe to refuel aircraft for the return trip to the United States. During the last Arab-Israeli war, U.S. airlift aircraft took on as much fuel (in pounds) in Israel as the weight of the cargo delivered.

There is no question of the need for U.S. military forces to be able to respond quickly to real or potential conflicts in various parts of the world. Airlift, while providing rapid response, however, is expensive and can transport only a relatively small portion of the total requirements.

It has been a longstanding policy of the Joint Chiefs of Staff not to provide congressional committees or GAO with specific data on airlift requirements on the grounds that such data was too sensitive. In order for the Congress to be able to properly evaluate the $13 billion in programs relating to airlift, however, it is essential that a comprehensive study of the alternatives of airlift versus sealift versus prepositioning be accomplished and presented to the Congress. We are recommending that, as a minimum, the Department of Defense should identify (1) the airlift requirement in terms of specific items and weights and required delivery dates, (2) the costs, and the advantages and disadvantages of alternatives such as increased prepositioning of supplies and equipment; and (3) the timeliness and availability of sealift.

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Mr. Chairman, you will recall in this connection that we sent to you on March 2 of this year a letter which outlined in detail the negotiations that we had undertaken with the Department of Defense subsequent to receiving your letter to obtain this kind of information. And I think it would be useful to have that letter inserted in the record at this point.

Senator PROXMIRE. Very good. Without objection that will be done.

[The letter follows:]

MARCH 2, 1976.

Hon. WILLIAM PROXMIRE,
Chairman, Subcommittee on Priorities and Economy in Government, Joint Economic Committee, U.S. Senate

DEAR MR. CHAIRMAN: On June 24, 1975, you requested, in your capacity as Chairman of the Subcommittee on Priorities and Economy in Government of the Joint Economic Committee and as a member of the Defense Appropriations Subcommittee, that we make a comprehensive review and analysis of military airlift requirements over the next five years. We understand that Senator John L. McClellan, Chairman of the Subcommittee on Defense, is also interested in this matter.

We recently briefed a member of your staff on the status of our work. This letter confirms the matters discussed.

On July 3, 1975, we notified the Secretary of Defense in writing that we were beginning work on the congressional request. On August 13, 1975, after preliminary work in Washington, D.C., and at Scott Air Force Base, Illinois, we requested—through the Military Airlift Command—access to the Joint Strategic Capabilities Plan and certain airlift briefing documents. We had been told by knowledgeable Air Force officials that review of these plans and documents was essential to our work.

On August 29, 1975, the Secretary for the Joint Chiefs of Staff told the Air Force that they could release to us certain briefing documents, but we were not granted access to the Joint Strategic Capabilities Plan. Our examination of the documents which were furnished showed them to be too general and lacking the information we considered necessary to respond to your request.

We, therefore, met with representatives of the Office of the Joint Chiefs of Staff on September 30, 1975, and explained that we had reviewed the documents furnished and that we still felt a need for access to the Joint Chiefs' documents originally requested. These representatives then suggested that the type of information we required was available from alternative sources and we did subsequently receive some additional statistics on the total tonnage of outsize cargo. This information, however, was insufficient for us to validate airlift requirements.

On November 5, 1975, we wrote to the Secretary of Defense and again requested access to the Joint Chiefs' planning documents. The Deputy Secretary of the Joint Chiefs of Staff responded on November 21, 1975, and advised us that although they wanted to comply with our request for information, release of the Joint Strategic Capabilities Plan was not considered appropriate. We were told that it was a long established policy of the Joint Chiefs of Staff not to grant blanket access to these sensitive war plans to anyone outside the military establishment. However, we were offered additional briefing documents and specific pieces of information contained in the plans which the Deputy Secretary felt could satisfy our requirements.

On December 10, 1975, we were briefed by representatives of the Joint Chiefs of Staff and subsequently in December we did receive copies of the briefing documents referred to in the Joint Chiefs' letter of November 21. This information from the Joint Chiefs of Staff, although not as complete as we had hoped for, would have enabled us to begin validating requirements had we been able to obtain additional data from the Department of the Army.

Our efforts to validate Army requirements were subsequently stymied when officials of the Department of the Army told us that much of the data we required had been furnished to the Joint Chiefs of Staff for inclusion in the Joint Strategic Capabilities Plan. The officials said the data was now the property of the Joint Chief and only they (the Joint Chiefs) could grant access to it.

We, therefore, met again with representatives of the Joint Chiefs of Staff on February 12. It was the consensus of these representatives that we could not do the type of analysis you requested without access to the Joint Strategic Capabilities Plan. However, they reiterated their policy not to grant access to the plan outside the military.

Representatives of the Joint Chiefs did tell us that the Department of Defense and the Joint Chiefs are jointly preparing for the House Armed Services Committee a study that will deal with airlift requirements. The study, entitled "Mobilization and Deployment Review", is scheduled for delivery to the Committee on March 15. The representatives of the Joint Chiefs believe the study would answer many of the questions you have concerning airlift requirements. Accordingly, you may wish to request copies of the study from the Committee.

Since there is nothing more we can do without access to the Joint Strategic Capabilities Plan, we are terminating work on the military requirements phase of your request. We will, however pursue the matter of access to the plan with appropriate congressional committees, particularly the House and Senate Armed Services Committees.

Sincerely yours,

ELMER B. STAATS,
Comptroller General of the United States.

Mr. STAATS. We recently issued two other reports presenting information on requirements in the areas of field army air defense and sea control. I will just describe each of these very briefly.

FIELD ARMY AIR DEFENSE

The systems acquired for field army air defense are intended to deter or defeat airborne threats, in the form of enemy missiles and planes, to U.S. forces in the forward and rear areas of the war theater. The Air Force shares this responsibility with the Army.

The report presents DOD's description of the nature and scope of the threat, the air defense environment, the strengths, and weaknesses of present capabilities and the plans for upgrading the defenses.

Since no one system can be completely effective, an array of short range and longer range systems are needed. The short range systems are the Chaparral and Redeye missiles, and the Vulcan gun. The longer range systems are the Basic Hawk, Improved Hawk, and Nike Hercules. Systems are now in development which are due to replace each of the current systems.

The Roland II, a system developed jointly by the West Germans and the French, is to replace the Chaparral. The Stinger missile will replace the Redeye. Prototypes are to be developed to determine the configuration for a new gun. The SAM-D is slated to replace both Hawks and the Nike Hercules. Funds continue to appear in defense budgets to improve some of the current systems until they can be replaced.

Through fiscal year 1975 the Army spent nearly $5 billion to acquire its current systems. Army planning documents project about another $11 billion to modify the existing systems and complete the acquisition of the new systems. The most expensive of the new systems is SAM-D, estimated at $6 billion. followed by Roland, $2.1 billion; the new gun program, $1 billion: Stinger, $840 million, and a Command and Control system, $140 million. Modification costs of existing systems are projected at over $700 million.

The issues we suggested for consideration by the Congress are the following:

Whether the Department of Defense should present a comprehensive overview of the mission area to the Congress, rather than just data on individual systems;

Whether realistic requirements, both as to performance and quantities have been established;

Whether both Army and Air Force capabilities were taken into consideration in formulating air defense requirements;

Whether, in view of anticipated budget levels, it is reasonable to anticipate being able to fund the number of new systems planned.

SEA CONTROL

Now, on sea control, according to the Department of Defense, the primary mission of the Navy is to control waters essential to the operations of the U.S. forces and to sealanes of communication. Sea control functions include fleet air defense, antiship and antisubmarine warfare.

Our report provides an overview of how the DOD views the mission, describes the strengths and weaknesses of the U.S. and Soviet Navies and includes the costs involved in sea control.

Present major procurement programs include about $14 billion for fleet aircraft, $16 billion for surface ships, $8 billion for submarines and $6.2 billion for shipboard combat systems.

The Navy places more emphasis on sea control than any other nonnuclear mission. The fiscal year 1976 budget, for example, requests $17 billion. In our opinion, the information required by the Congress in reaching its judgments about the sea control forces needed are:

Whether the Soviet Navy is a defensive force or whether it constitutes a worldwide threat to the United States.

How the Soviet naval forces compare with the U.S. forces.

What the most likely conflict situations are, and what the least likely are.

As you can see, our aim in this type of reporting is not to make military judgments, but to help assure that the information furnished to the Congress is complete, objective, and in the proper perspective.

We hope that information on requirements for related systems will be useful to the Congress in reviewing the "front end" of the system acquisition process. This is the most appropriate time for the Congress to become involved, as the Commission on Government Procurement pointed out. The front end is the stage when new systems are still conceptual, requirement statements have not yet been fully developed and alternate solutions are still viable.

That concludes our prepared statement. We would be happy now to respond to any questions.

Senator PROXMIRE. Would you like to read to us the digest of the Field Army Air Defense report? It is new, I understand, it has just been released and declassified, and it is only three short pages.

Mr. STAATS. The report we released this morning?

Senator PROXMIRE. Yes, sir.

Mr. STAATS. This is a digest of a report to the Congress entitled the "Field Army Air Defense."

GAO has prepared this summary of the field Army air defense mission area to provide (1) information useful to the Congress in its authorization of major weapon systems for tactical air defense and (2) an overview of budgetary implications.

The assessment of potential enemy capabilities and the weapons needed by U.S. forces to counter those capabilities are matters to which expert military judgment must be applied. GAO does not make those types of judgments.

Data relating to the potential enemy threat and the costs, capabilities and methods of employment of weapons systems were extracted from Department of Defense documents.

Field Army air defense systems are intended to protect high value targets and ground combat forces from enemy air attacks.

The primary air threat to U.S. ground forces would occur in the event of a conventional war in Europe. Intelligence estimates for 1985 project the Warsaw Pact frontal aviation force at about [deleted] aircraft.

Trends in Soviet aircraft development and deployment show increasing emphasis on all weather capabilities, improved electronic and navigation aids, better ordnance and ground attack missions. Initial attacks would probably be directed against high value targets, such as forward air defense units, airfields, command and control centers, and tactical nuclear storage facilities. After completion of initial operations, frontal attack aircraft would be used in direct support of Warsaw Pact attacking ground forces.

Current United States air defense capabilities are relatively limited when compared to the threat posed by current and projected Warsaw Pact aircraft.

This next is classified, so it is blank here.

These systems represent an investment of about $5 billion.

This refers to ground-to-air systems currently deployed. And this is our recommendation.

The Army should present to the Congress during the authorization and appropriation hearings a comprehensive overview of the air defense mission area. This presentation should be made as a mission area budget presenting, among other things, a description of the mission area, what it is intended to achieve in terms of defense strategy and tactics, the significance of the achievement, the weapon systems needed, and the priority for funding each requirement within the mission area.

Some issues which we think should be considered by the Congress are:

Despite large expenditures, US Army Forces and military targets appear to be vulnerable to air attack in the future, particularly from aircraft at low altitudes. Army efforts to overcome these mission deficiencies have been primarily characterized by study after study—but there has been little real progress toward solving the problems. Also, the indecisiveness, the lack of a clear goal, and a plan to reach the goal appear to have diffused the efforts and the funding. Sufficient joint effort within the Office of the Secretary of Defense and the Services has not been made to determine overall (multiservice) requirements for air defense systems. In reviewing future requests for funds for air defense systems, the Congress may therefore wish to consider whether the Office of the Secretary of Defense and the Army:

Have established realistic requirements for the air defense mission, both as to the capabilities and quantities;

Have fully considered the lessons learned from the Arab-Israeli conflict of 1973;

Have considered the feasibility of financing the number of new systems planned, in view of reasonable peacetime budget restraints and other high priority Army requirements;

Should present to the Congress a comprehensive overview of the air defense mission rather than justifications for individual systems. Such an overview should include current efficiencies, interrelationships of various air defense systems, and life cycle costing of new systems, and consideration of alternative solutions to air defense problems;

And finally, have taken Air Force capabilities and mission into consideration in formulating Army air defense requirements.

In the Defense Department's comments with respect to our report, they took issue with GAO statements regarding the indecisiveness and lack of clear goals and planning. The Department recognizes that deployment of effective air defense systems in the future is dependent on the availability of funding and on solution of the technological problems but believes that it will reach its goals. In GAO's opinion, however, there is need for greater effort within the Office of the Secretary of Defense and the services to improve management of weapon system acquisition problems for this mission area.

Senator PROXMIRE. Thank you, sir.

Mr. Staats, unfortunately there is another rollcall, but I think I can ask you one or two questions before I have to run and then I will come right back.

Before discussing the findings in your report I would like to clarify the matters which you were able to analyze and which you were prevented from analyzing. Is it correct that you were not able to analyze whether the aircraft requirement as currently defined is reasonable, that is whether the military needs to move as much cargo as it says it needs to move in order to defend our interests and allies in Europe?

Mr. STAATS. Mr. Chairman, this refers to the letter which we have inserted in the record of our correspondence with the Defense Department which we sent to you in our letter of March 2. And we will ask Mr. Gutmann to respond to that.

Senator PROXMIRE. Mr. Gutmann, go ahead.

Mr. GUTMANN. Mr. Chairman, we have not been able to determine precisely that the Department of Defense has indeed developed a specific requirement for airlift. We have talked with representatives of the Joint Chiefs of Staff. And they have advised us that by and large the 180,000 tons that they plan to lift, have the capability of lifting with the present aircraft, are not really a requirement in the sense of something that has been developed through a strategic plan, a specific plan for meeting a given need in a part of the world, but instead the 180,000 tons is simply the capability that they feel exists right now.

Senator PROXMIRE. Are they saying that what they have done is, they figure we want to get everything we possibly can to Europe in the event of an invasion by the other side?

Mr. GUTMANN. Yes, sir.

Senator PROXMIRE. And this is what they think they could get, is 180,000 tons?

Mr. GUTMANN. 180,000 tons, yes, sir. And the enhancement program, the programs that they have in mind, would bring the capability to 370,000 tons.

Senator PROXMIRE. So it is double?

Mr. GUTMANN. By their calculation——

Senator PROXMIRE. Is there any rhyme or reason behind that?

Mr. GUTMANN. No, sir; not that we have been able to find. The information, if it does exist, has not been provided to us.

Senator PROXMIRE. It sounds as if when they define this capability they define it in terms of how much they think they could carry if they used every plant available to the maximum.

Mr. GUTMANN. Yes, sir; that seems to be the case in this particular case.

Senator PROXMIRE. And then they stress that.

Mr. GUTMANN. Yes, they stress that.

Senator PROXMIRE. For instance, as I understand it, in the C–5A they have got 77 C–5A's. But for the next 8 years they are going to have 10 of those C–5A's out of operation because they have to work on the wings.

Mr. GUTMANN. That is correct.

Senator PROXMIRE. That means only 67 are available. Now, on the basis of all of our experience, if they could have 50 of those operational they would be doing extremely well, and better than they have ever done in the past. However, they project that they will be able to use 70 planes. There is no way they can have more than 67 if every single plane were operational, which is not only unlikely, but virtually impossible.

Mr. GUTMANN. That is correct, Mr. Chairman. Of course, the same applies to their calculation with respect to the use of the C–141. They have assumed that the C–141 would be available, all of the fleet would be available for the 30 days in which they would lift 180,000 tons. And the experience has shown that there is a percentage of the aircraft that would be down for various periods of time at any given time for maintenance of a variety of types.

Senator PROXMIRE. And that is only part of it, because as I understand it you have indicated that the availability of landing strips, the availability of fuel, so that they could return.

Mr. GUTMANN. Yes, sir.

Senator PROXMIRE. That would be a limiting factor that would reduce the capability of providing anything like 180,000 let alone 370,000 tons.

Mr. GUTMANN. Yes, sir.

Mr. STAATS. Mr. Chairman, it might be helpful at this point to read from my report which was released this morning on the question that you are addressing to Mr. Gutmann.

On an average day during 1976, only 43 C–5A's and 178 C–141's were flyable. MAC officials said some of the aircraft in nonflyable status were undergoing minor maintenance and could have been returned to a flyable status quickly. During December 1975 and January 1976, an average of 33 C–5A's were in flyable status and 8 more—a total of 41—could have been made available within 48 hours. MAC officials indicated that it would have taken 60 days to make as many as 52 C–5A's available for operation.

Senator PROXMIRE. I would like to follow up on this. Unfortunately the rollcall is almost half through, so I am going to have to run, and I will be right back.

[A short recess was taken.]

Senator PROXMIRE. As you know, Mr. Comptroller, the request for this inquiry was made on June 24, 1975, relating to my request. Can you briefly describe the efforts you made to obtain access to the information needed to do the analysis, and the response you got from the Air Force, the Joint Chiefs of Staff, and the Department of Defense?

Mr. STAATS. Mr. Stolarow.

Mr. STOLAROW. Basically, yes, as Mr. Staats has pointed out our first contact was with the officials of the Military Airlift Command to attempt to determine how they arrived at the requirements for airlift and for new aircraft. In essence we were told that those were based on Joint Chiefs of Staff planning documents.

We next went to the Joint Chiefs of Staff to various officials and attempted to get definitive information that will enable us to determine whether the requirements for certain types of aircraft and the numbers that were being proposed were reasonable in view of the war plans and the Joint Chief of Staff plans. This is where we ran into difficulties. The Joint Chiefs' policy was that plans such as that are sensitive, and would not be released outside the Joint Chiefs of Staff. They did eventually provide us with a listing of equipment that was scheduled to be moved that basically makes up the 180,000 tons. But there was no way to relate that to specific units or to specific times when such equipment would be required in Europe, and how it was to be employed. So, yes, there is a total listing of equipment that we have that totals 180,000 tons, but we have really no way of knowing——

Senator PROXMIRE. I understand why this shouldn't be released publicly and why this has to be classified, and why the GAO might have to keep this in confidence. But isn't your agency cleared for classified information so that you should be able to get this and analyze it, and then it can be determined what will be disclosed, then come to conclusions based upon what the facts are?

Mr. STOLAROW. We even made an offer to the Joint Chiefs of Staff that we would not in any way disclose any of this information, but if we could review it and reach some conclusions as to the reasonableness of it, that was all we wanted to do; in other words, we would not publish it in any way or release it outside of the Joint Chiefs of Staff. And we were refused that type of access.

Senator PROXMIRE. In view of the record of the GAO, which has been, as far as I know, absolutely impeccable, there have been no leaks. What was their reasoning for not cooperating?

Mr. STOLAROW. A longstanding Joint Chiefs of Staff policy not to release that information.

Senator PROXMIRE. Mr. Staats, what was your reaction to this?

Mr. STAATS. I guess our basic point in all the work we are trying to do here is to demonstrate the need for Congress to have this kind of information if it is to make the judgments on the requirement being presented by the Department of Defense. We are obviously not responsible, nor are we equipped to make the judgments on military requirements. The Joint Chiefs of Staff have a statutory role to advise the President and the Congress by law with respect to military requirements. I should think that the Congress, in order to pass judgment as it must on these requirements in terms of the financial support for them, must have this kind of information.

Senator PROXMIRE. How do we know whether that $13 billion is enough, or too much, unless we have some basic information of this kind, or unless our agents, acting in complete confidentiality, can get enough information so that they can make a judgment so that we can place some reliance on it?

Mr. STAATS. I have dealt with military budgets for a good many years. And the tendency has been to say, it is our job to give you our best judgment as the Joint Chiefs of Staff as to what we need. And the Congress and the President have to tell us whether we can afford it. The question of the makeup of those requirements and how they arrive at them and what alternatives they considered and rejected, these are the things that we think Congress can make judgments about, and should be approaching the authorization and appropriation requirements of due process in that way. That was the burden of what we testified before the House Armed Services Committee back in March of 1973, following a very detailed, comprehensive study of this matter by Mr. Gutmann and the members of his staff. And this was the essential point made by the Commission on Government Procurement. And this was the essential point made by the Rand Corp. And this was the essential point made by the Fitzhugh Blue Ribbon Panel back at the beginning of the Nixon administration. So this is nothing that we have invented, and I think it represents the consensus really of everyone who has seriously studied the question of the determining of strategic and other mission requirements.

Senator PROXMIRE. Would you say the responses you got delayed the preparation of the report? If so, by how many weeks and months did they delay it?

Mr. STAATS. Mr. Stolarow.

Mr. STOLAROW. Several months.

Senator PROXMIRE. Doesn't the law give the GAO a statutory right of access to the information and the records you requested? Aren't the Defense officials violating the law by denying you access?

Mr. STAATS. The statute is very clear. We do have access to information. But as in the case of some other agencies, this does not necessarily guarantee that we have that right, or guarantee that we are going to get it. Technically I believe I am correct in the statement that the Department of Defense is required to supply this kind of information unless there is a statement of executive privilege, which is by the President himself.

Senator PROXMIRE. Has that statement ever been made?

Mr. STAATS. No, sir.

Senator PROXMIRE. Do you think it would be helpful if the law were amended to provide criminal penalties to those denying GAO access to this information so that it would be enforceable and effective?

Mr. STAATS. We recommended legislation, Mr. Chairman, to the Congress, which we have not been able to get action on, which would enable us in cases where there is a legal argument against giving this information, that the matter be adjudicated in the courts, so that the courts would rule on it.

Senator PROXMIRE. How about criminal penalties? Do you think the answer is to rely on the courts instead?

Mr. STAATS. I doubt if you would need criminal penalties. The criminal penalties, however, have been imposed by the statute upon executive agency personnel, and indeed in the case of the recent Energy Policy Act, upon GAO personnel if they release information of a confidential nature.

Senator PROXMIRE. By the way, is it correct that your staff has been told by the staff of the Joint Chiefs of Staff that the document you requested was so sensitive that it was not even shown to the Secreary of Defense?

Mr. STAATS. I cannot testify as to that.

Mr. STOLAROW. I am advised that is correct, sir. Let's ask Mr. Asby.

Mr. ASBY. I am Felix E. Asby, Assistant Director, GAO.

In a conference with a representative of the Joint Chiefs of Staff, when I asked him specifically about access to details and backup information relating to airlift requirements, he stated to me generally, I think this is approximately a direct quote, that this information is so sensitive that we would not even release it to the Secretary of Defense.

Senator PROXMIRE. Do you believe that the Defense Department has data that would demonstrate the reasonableness of the aircraft mission requirement, or is it possible that either the data does not exist, or if it does exist, it wouldn't justify the requirements?

Mr. STAATS. Well, not having access to all the information, I don't believe we can really testify on that point. I think we can testify to the point that the Congress has not received that information. And it seems to me that our proper role here is to give the Congress the best advice we can as to the kinds of information which should be provided by the agencies in support of their authorizations under the financial requirements.

Senator PROXMIRE. Isn't it also true that following your letter to me in March, along the lines of the access to data problems, remember, my staff visited the Joint Chiefs of Staff and was told that the data needed was not in the joint strategic capabilities plan, it was in another document, and that my staff reported that to your staff?

Mr. STOLAROW. That is correct, sir.

Senator PROXMIRE. Were efforts made to obtain access to this other document, and what was the result?

Mr. STOLAROW. I believe we did get the document that was referred to, but it too, did not have the kind of detail that would enable us to make an evaluation of the reasonableness of the airlift requirement.

Senator PROXMIRE. Before I yield to Senator Taft, I would like to ask you if this reflects a double standard. For example, where defense and nondefense programs are concerned, if HUD requested funds for building 2 million homes for low-income families, don't you believe that they would at least be required to demonstrate the need for such a program to show figures proving the families needed the homes and that they could be built?

Mr. STAATS. I think I see what you mean by a double standard.

Senator PROXMIRE. I realize that there is quite a different classification for the Defense Department. They are right in providing classification, of course. It would be of enormous value to our potential adversaries if much of this information were disclosed. Nevertheless, looking at it from the standpoint of the basis on which Congress is going to judge whether the expenditures it makes are reasonable or not, should be more or should be less, we need the same kind of complete information one way or another from the Defense Department as we need from domestic agencies.

Mr. STAATS. I find it very difficult to understand why at least the basic considerations cannot be provided to the committee which have the responsibility, the armed services, and the Appropriations Committees in particular, to answer at least what appears to be a basic question. For example, on airlift, the question of the capability providing that much airlift on airfields which would be used by other NATO countries. It is a question of physical volume. And then there is a question of materials handling, equipment on the craft to be landed in those airfields. And then there is a question of refueling those aircraft to come back to the United States. These are the kinds of questions that it seems to me are perfectly logical and reasonable issues which also have a fundamental bearing upon the requirement. And the requirement becomes your capability. You do as much as you can through airlift, and you provide through sealift and by prepositioning the additional requirement. But to the best of our knowledge, that kind of data and that kind of analysis has not been provided to the Congress.

Senator PROXMIRE. Senator Taft.

Senator TAFT. Thank you, Mr. Chairman.

Mr. Staats, I certainly think you are correct—and let me say that as a member of the Armed Services Committee, I have been very concerned with the fact that it seems to me that since I have been on the committee, a couple of years ago now, there has been an insufficient examination by the committee itself of the conceptual aspects of the defense budget in many categories—sealift-airlift is certainly one of them—and I am encouraged when I think there is some shame in that attitude in the committee itself. The committee of the Senate is currently, I believe, about to embark on a fairly exhaustive staff study by a subcommittee on the sealift and airlift question. The questions with regard to sealift and airlift have been raised in the language of the committee report this year. So I am very sympathetic to information about it.

Let me ask this: Do you have any evidence that the committees themselves, either the Armed Services Committee or the Appropriations Committees, have asked for a mission related or a conceptual analysis of this particular program in connection with the Defense Department budget submitted to them?

Mr. STAATS. Let me respond and if I may, ask my associates to elaborate, and if any information is incorrect, they will correct it.

To the best of our knowledge, and my personal knowledge, the details of the kind of conceptual analysis that we are talking about here has not been supplied.

Let me ask Mr. Gutmann to respond further. The Senate Armed Services Committee has made some requests in this area. And I believe we have had also a request in GAO on airlift from Senator McClellan.

Mr. GUTMANN. Senator, I am unaware of any inquiry by the Senate Armed Services Committee to the Department of Defense on airlift and sealift needs. But we were very much interested in seeing that in connection with the military procurement authorization bill in the hearing this year that the committee asked the Department of Defense to provide a comprehensive study of the strategic nuclear national policy, and how the various weapons in existence and proposed further that policy, and the comparative cost effectiveness of each. This supports of course what you just said, Senator, about the growing interest in the Congress in this area and obtaining the kind of information and analysis from the Department of Defense that would enable you to satisfy yourself that there is indeed a requirement for the systems and programs that are being proposed.

Mr. STAATS. The Congressional Budget Act does provide, I think, some encouraging news here, in that as stated in my statement, beginning in fiscal 1979, the President is required to submit the entire Federal budget on the basis of a detailed structure of national need which shall be used to reference all agency missions and programs, and a statement of the agency missions and then a statement of basic programs to support those missions. Now, the reason for 1979 rather than 1978 was simply to provide more time to put this into place.

I think that gives us a handle on which to press forward in the direction we think we need to press forward. I guess I would have to be fairly candid that we have been a little disappointed that this kind of information has not been requested more frequently by the authorizing Appropriations Committee. The tendency has been, in my experience, that they will come forward with a specific weapons requirement like the B-1, or AWACS, but it is not related to existing capabilities, and it is not provided on the basis of what alternative options have been considered and why those options were not acceptable to them. There may be other considerations such as cost, and there may be political considerations in a foreign policy sense that might bear upon that decision. And it seemed to me that Congress takes the responsibility ultimately for those judgments anyway. And it is a question of what kind of information and options have been made available to Congress on which to make that judgment.

Senator TAFT. I couldn't agree more strongly with that viewpoint, and on the committee a number of members have indicated their dissatisfaction in the lack of objective analysis of the problems we are trying to face in our overall defense budget.

Just as a matter of record, I note from the report of the Armed Services Committee on this year's procurement bill, on page 18 it states:

> As a result of the Committee's review of this strategic mobility area, it is requested that the Secretary of Defense take a personal recognition of this problem and direct an overall coordinated study of the mobility requirements of this country to meet its NATO commitments. The mobility requirements should be developed to reflect the varying warning times that our best intelligence can estimate.
>
> This study should consider, but not be limited to, the following factors in the development of mobility requirements: basic manpower and equipments of our field commanders; material and equipment available in NATO countries for possible use of U.S. forces; prepositioning of U.S. forces and equipment; reconsideration of U.S. Army and Air Force early deployment needs; the relationship between airlift and sealift capability and the better use of sealift capability; the alert status of forces in the United States that are earmarked for early deployment to NATO; and the relief of dependents of U.S. forces stationed in NATO.

And so forth.

So I think that we are on the track if we can get the Defense Department to move in this direction.

I am a little concerned about the testimony here this morning that in fact the information on this is apparently not going to be available to the Secretary of Defense, which I think somewhat stretches credibility. I think the Secretary would be very interested to learn of this if indeed it is true. And I wonder if the witness who testified on that effect would elaborate a little further as to whether any reasons were given as to what was involved here. I wonder realistically if what was involved really was not a statement that this was a draft paper or something of that sort which has not been thoroughly worked out at the Joint Chiefs level, if they were not ready yet to submit as Joint Chiefs their views to the Secretary on this subject.

Mr. Asby. I think the thrust of the answer related to the specifics that we were asking about concerning the support and the detail as to the airlift requirements, what needed to be airlifted, and in what particular time frame. For example, during the first week, and what sort of units needed to be supplied so that we could then apply the table of organization and equipment to the different units for a schedule of deployment. And the reply that we received about the highly sensitive nature, I suspect, was triggered by our inquiry as to what units needed to be deployed in the first several days of the European encounter. And at this point is when I received the answer, that this really is highly sensitive, the information as to what units we are going to deploy first, and in fact it is so sensitive that we will not release it to anyone.

Senator Taft. In regard to this entire area, Mr. Chairman, I treated with it in some detail in my white paper on defense earlier this year. I do note from that that the GAO did report to the Congress on airlift operations of the Military Command during the 1973 Middle East war, and I think certain conclusions can be drawn. I just point out that a lot of the information is not classified, nothing in this paper is classified whatsoever, I have taken great care to make sure of that. And I just point out that you do have the general parameters: it isn't all—we point that the sea transport force can be mechanized, and the air transport force basically cannot be without the sea transport equipment. An armored division weighs 50,013 tons and requires 74,534 tons per month of supplies. In a high intensive conflict such as a NATO war would be, the entire airlift force of the United States, applied solely to the task of moving and supplying one such division, even under ideal circumstances, probably could not accomplish this in a 1-month period. And then I cited the information, most of which I think came from the report to the Congress that I just mentioned.

The airlift to Israel moved 22,487 tons between October 13 and November 14, 1973. According to the GAO, this movement utilized 24 percent of our active airlift capability (MAC). Seventy-four percent of the materiel sent to Israel went by sea. In terms of the heavy equipment required by an armored or mechanized force, the GAO notes that "the quantities delivered were not significant enough to have affected the war's outcome," but that "most of this cargo did not arrive until after the cease-fire or until after the first ship had arrived." During the Mideast airlift of October 1973, only 29 tanks were airlifted to Israel in 30 days. Only 14 outsized pieces of equipment—such as tanks and artillery pieces—were delivered before the cease-fire. It should be noted that in a full mobilization, our total airlift capacity would be augmented by the Air Force Reserve, the National Guard, and CRAF forces. However, it is not clear that our ability to move heavy forces with outsized equipment would be materially increased by this augmentation.

This shows, I think, certainly the desirability of having comprehensive information of this type available to us when we in the Armed Services Committee are trying to make the decisions as to how to implement particularly individual weapons systems. For instance, on the AMST, which I believe the Senate has taken out of the bill that is now going to Congress, I have had no satisfactory indication from the Defense Department as to just how the AMST would be used in the NATO role. It is not a long-range aircraft, it is a short-field aircraft. And some of the decisions we are making now, I think, in the defense area are going to be related more perhaps than they ever have before to an adequate explanation of the concepts or the mission relation of the particular weapon system involved.

We have got upcoming right now in conference in another field, some very important conceptual questions where I think the mission relation, for instance, to the strike cruiser to me has not been adequately documented at all as yet. It is better than it was last year when we dropped it very quickly because of that, but we haven't as yet had really any full study or consideration on that. I think the committee is justified in making a judgment.

Thank you.

Senator PROXMIRE. Mr. Staats, although you were denied access to the data you needed for a complete analysis, you do say in the report that you understand the airlift mission is based on the desire "to transport as much as possible as soon as possible." Now, in predicating the mission on that kind of a desire, isn't the Defense Department being unrealistic in refusing to recognize the finite limitations of resources both here and in Europe, and isn't it also possibly overstating the amount of cargo that needs to be transported?

Mr. STAATS. I guess we have to qualify again to some degree that we did not have all the information which presumably they have. But that is the way it appears to us.

Senator PROXMIRE. What I am talking about is just the concept, the notion that you transport as much as possible, as soon as possible. It has a certain kind of rudimentary logic to it. But at the same time when you think about it you ought to know what you are talking about. And if you don't know what you are talking about——

Mr. STAATS. We are also saying something a little more than that. Even if you accept that, then if you don't answer the question of what are the finite limitations, you still have not ended up with a definition.

Senator PROXMIRE. That is right. As much as possible as soon as possible also has to be related to what is possible.

Mr. STAATS. That is right.

Senator PROXMIRE. Now, the amount of cargo to be airlifted is being overstated. Is it possible that the numbers and types of aircraft needed are also overstated?

Mr. GUTMANN. Yes, sir. The absence of a requirement that is computed independently of the available hardware would suggest that. It is not a desirable relationship between the two. And there could be overestimates on both sides.

Senator PROXMIRE. According to the report the Joint Chiefs of Staff explanation of the mission amounts to a capability requirement rationale; that is, they believe 180,000 tons of cargo can be airlifted to Europe in 30 days, and therefore that is the requirement.

Mr. GUTMANN. Yes, sir, that is the statement. And of course we have reservations about whether or not they can lift 180,000 tons.

Senator PROXMIRE. That is right. Aside from the upside down nature of that report, isn't it correct that your approach shows the Air Force says it cannot presently airlift 180,000 tons in 30 days?

Mr. GUTMANN. Yes, sir.

Senator PROXMIRE. Isn't it also true that the Defense Department has also failed to demonstrate that it needs to airlift that amount of cargo in that time?

Mr. GUTMANN. We have not seen the basis for any such requirement.

Senator TAFT. Mr. Chairman, might I just ask a question on that point.

You haven't seen any evidence that it doesn't, it is neither way; is that correct?

Mr. GUTMANN. That is correct, yes. We don't know.

Mr. STAATS. We can't say that it doesn't exist, because we haven't seen all the evidence.

Senator TAFT. Based on the figure I just put in the record, the report of the 3d Armored Division, 60,000-plus tons a month would be required.

Senator PROXMIRE. At the same time I think you would agree, Senator Taft, that the position now in Europe is unlike Israel, where we have troops stationed. We have an enormous amount of material there, ammunition, and everything. But we still would have to supply a lot.

Mr. STAATS. You see, they are talking now about 370,000 tons in the first 30 days. And it is that higher figure that we are particularly addressing our question to.

Senator PROXMIRE. Were you able to obtain any information about why DOD feels it is necessary to double the airlift mission requirement; that is, to go from 180 to 370?

Mr. GUTMANN. No, sir, we don't have that information.

Mr. STOLAROW. The only thing that comes close to that is the statement that has been presented in some of the hearings to other committees that an increase in airlift capabilities would limit the initial advantages of the Warsaw Pact for any increase in capability, and it is desirable to limit any advantage that the Warsaw Pact has.

Senator PROXMIRE. Their logic seems so awkward. When they cannot justify or explain how they can provide the smaller amount, 180,000 tons in a month, how can they provide twice that, more than twice that?

Let's look at the current capability a moment. You say an underlying assumption is that 70 C–5A's and 234 C–141's would be used an average of 10 hours per day during the entire 30-day airlift. I discussed that briefly in my opening statement, and I guess we had a little exchange on that. But give us the details on why that is an unrealistic assumption?

Mr. GUTMANN. In the report just recently issued we have made some, presented some computations, bearing upon the availability of those aircraft. And we stated that on an average day during 1975 only 43 C–5A's and 178 C–141's were flyable. The military airlift——

Senator PROXMIRE. You say 43 C–5A's. They assume 70 C–5A's would be available, and you say only 43 were available on an average day. And you say how many C–141's?

Mr. GUTMANN. On the C–141's, 178 out of a total of 234.

Senator PROXMIRE. And they say 234 would be used?

Mr. GUTMANN. Yes.

Senator PROXMIRE. Now, what assumptions are made about the C–5A and the C–141 for the enhanced mission? How about the 10 hours a day?

Mr. STOLAROW. The 10 hours a day does not appear to be reasonable either, based on peacetime flying rate of about 2½ hours a day, and Air Force testimony that might be the most they might expect to do is double that in a wartime situation.

Senator PROXMIRE. Maybe 5 hours a day?

Mr. STOLAROW. Five hours a day would probably be reasonable.

Senator PROXMIRE. And they have doubled it again in making this assumption?

Mr. STOLAROW. Yes, sir.

Senator PROXMIRE. Once again I want to recapitulate and make sure we have this in the record. Will you briefly describe the role of the C–5A and the C–141 during the 1973 Mideast airlift, and give the number of aircraft and daily utilization rates that were achieved. Do you have information on that?

Mr. GUTMANN. I think it would be best if we provided that information for the record, Senator.

Senator PROXMIRE. All right.

[The information requested was later supplied as follows:]

Airlift to Israel, 1973

Number of aircraft committed:	
C–5	51
C–141	177
	Hours per day
Daily utilization rate for number of aircraft committed:	
C–5	2.95
C–141	2.33

Senator PROXMIRE. The report mentioned the possibility that there might not be enough European bases to take the number of aircraft to be used in an airlift. Did you ask the Defense Department about this, and if so, what was the response?

Mr. ASBY. Yes, Mr. Chairman, in conversations within the past month we specifically addressed this question to the representatives of the Joint Chiefs. And they have plans and programs listing all of the airfields that are available in Western Europe. And it is our belief that most of these airfields are expected to be utilized in the 20-plus day advance warning period. However, we find in the Military Airlift Command that some of the airplanes, the C–5A's in particular, could not land fully loaded or take off except on extra long fields. This reduced the number of airfields that would be available, and also the question of how many airfields would actually still be left to operate from, and which ones would have sufficient materials handling equipment, fuel, space, et cetera, to enable the full number of airlift aircraft to operate along with all of the other aircraft, fighter aircraft, tactical aircraft, tactical airlift, et cetera, which would have to operate in a limited number of fields during the same period of time.

Senator PROXMIRE. And on this basis your conclusion was what again as to the availability of fuel for this C–5A which takes a longer runway?

Mr. ASBY. The conclusion, sir, is that adequate consideration has not been given to the saturation.

Senator PROXMIRE. I see. You didn't come to any conclusion as to how many could land, you just said adequate consideration has not been given, so we don't know, and perhaps the Defense Department doesn't know, is that it?

Mr. ASBY. We think that could be the case, sir.

Senator PROXMIRE. You also mentioned the possibility that not enough fuel would be available, too, in Europe for the cargo planes to return to the United States. In the 1973 Mideast war did our cargo planes take on enough fuel in Israel to return to the United States, or was it only enough to get to the Azores and other bases?

Mr. STOLAROW. I believe, sir, that most of them could take on enough fuel, because they were not loaded with cargo, to return to the United States. Some would have had to land at the Azores even on the return trip.

Senator PROXMIRE. My question was the availability of fuel in Europe.

Mr. STOLAROW. In Israel there was sufficient fuel to refuel the aircraft. In a conflict situation in Europe, with the number of tactical aircraft that require refueling, and the vulnerability of stocks of fuel and pipelines, we just don't think that there has been enough study given to the fact of whether there would be fuel available for the airlift, or where it would come from.

Senator PROXMIRE. Did you ask the Department of Defense about the fuel question?

Mr. ASBY. Yes.

Senator PROXMIRE. And what was their response?

Mr. STOLAROW. They believed that they would have enough fuel.

Senator PROXMIRE. Did they document that at all?

Mr. ASBY. No sir. The current plan, Mr. Chairman, is that in the event of a Warsaw Pact confrontation, that a number of other location staging points would be utilized, bases in Spain or in England; locations of this sort would be used. A C–5A airplane flying to France and to Western Germany then would fly out to an air base in England, refuel in England and fly back.

Senator PROXMIRE. The report seems to be critical of the proposal to spend $680 million to stretch the C–141's on the ground that it would result in only an increased capability of 4,700 tons in the first 30 days with the entire fleet of C–141's. Can you explain how the stretch program can produce only that much increased capability, and why you believe this would not be a cost effective program? Is that because you would only stretch it to 5 hours from $2\frac{1}{2}$?

Mr. STOLAROW. That is part of it, sir. The other part is based on the type of loads that might be utilized and the distances that are flown. It is possible that the stretch would only give a small increase in the number of pounds that could be carried.

Second, most of these aircraft have already reached more than half of their life span in utilization. So that even by stretching them you do not increase the available flying hours for those aircraft, and an expensive program may not really provide that much capability.

Senator PROXMIRE. I was thinking that in a short period, however, you could do that, 30 days.

Mr. STOLAROW. It depends upon when the conflict would occur. If we go another 10 years without a war, then we would get no benefit.

Senator PROXMIRE. What about the cracks that have turned up in tests of the C–141? Is it possible that this problem might not require a wing fix similar to the C–5A?

Mr. STOLAROW. That has not been really resolved yet as far as we know. They are studying that. The Air Force right now does not believe that it is as serious as the C–5 problem.

Senator PROXMIRE. Is it correct that the Air Force proposes to reimburse airlines for modifying cargo planes to be used in an airlift, including payments to airlines that have already completed their modifications?

Mr. STOLAROW. That is their intention.

Senator PROXMIRE. Would such payments be legal in your judgment?

Mr. STOLAROW. I am not sure, sir.

Senator PROXMIRE. Will you give us an opinion for the record?

Mr. STAATS. We could give you an opinion for the record. But my understanding is that there was an exchange of letters. And they feel that there is a moral commitment in view of that. I am not sure that they even argue that there is a legal commitment.

Mr. STOLAROW. No, they don't claim a legal commitment.

Mr. STAATS. But in any event, we will be glad to examine the law on the subject.

[The following information was subsequently supplied for the record:]

The question refers to the proposed Civil Reserve Air Fleet (CRAF) modification program, under which the Air Force would enter into contracts with participating commercial airlines to reimburse them for the costs of modifying aircraft to a cargo capable configuration. In our opinion, specific congressional authorization would be required before the Air Force could properly enter into any such contracts and make payments thereunder. This is because we have found no existing statutory authority which the Air Force could rely on to formally implement the CRAF modification program. Of course, the Air Force could obtain sufficient authority through the appropriations process but to date it has not been successful by this means. That is, if Congress approves and includes funds for the implementation of the CRAF modification program in an appropriation act, then clearly the program would be authorized to the extent of the funds appropriated during their period of availability, and the Air Force could enter into contracts with the airlines to that extent.

With respect to reimbursement of modification costs incurred in anticipation of congressional authorization, so long as costs clearly related to current CRAF program needs which were incurred in anticipation of congressional authorization of the currently proposed program are specified in the authorizing legislation as proper for payment, reimbursement of such costs would not be legally objectionable. Without such specific authorization, however, such costs, as well as any modification costs not clearly related to current program needs, could not be reimbursed.

Consistent with our opinion, the Air Force General Counsel's Office has informally advised us that no reimbursements will be made without properly executed contracts and no contracts will be entered into without specific funds being appropriated therefor.

Senator PROXMIRE. Briefly compare the size, performance, and characterization and cost of the C–5A, the 747 cargo plane, and proposed new advanced cargo aircraft.

Mr. STOLAROW. We have some information on that. The advantage of the C–5 over any other aircraft is that there are a few pieces of outsized equipment that can only be carried on the C–5 and not on any other aircraft that is flying today.

Senator PROXMIRE. How about the disadvantages of the C–5A compared to the 747 cargo planes?

Mr. STOLAROW. I don't know of any disadvantages, other than the problems that they have had and the costs that would be required to bring them into a full operational capability.

Senator PROXMIRE. The outsized equipment that only the C–5A can carry because of the way they are made, is that essential to be airlifted in the first 30 days of a conflict? Are they any indications as to whether that is already prepositioned?

Mr. STOLAROW. That is one of the questions that gets back to the reasonableness of these requirements. And we don't have an answer to it.

Senator PROXMIRE. What are these items, tanks, helicopters?

Mr. ASBY. Yes, sir. The outsize items are primarily heavy equipment items such as M–16 tanks, bridge launchers, tank recovery vehicles, big and large and heavy construction type equipments, and things of this sort. And some helicopters.

Senator PROXMIRE. The M–60 tank can fit on a 747, can't it?

Mr. ASBY. No, sir, not a standard freight or commercial version. To take an M–60 tank, I believe, would require what has been termed an outsized 747, which would necessitate lifting the entire upper superstructure of the 747 approximately 48 inches. And this would allow enough clearance to have a nose-opening door that would then accept the M–60 tank through the door.

Senator PROXMIRE. So you can modify the 747 to take at least part of that outside——

Mr. ASBY. Yes, sir. Boeing has in fact, I believe, presented the Air Force with an offer to sell them some airplanes of this sort.

Senator PROXMIRE. Have you had any opportunity to determine whether that is cost effective?

Mr. ASBY. No, sir, we have not done any study of that.

Senator PROXMIRE. Isn't it correct that after \$1½ billion to \$2 billion spent fixing the C–5A there is no assurance that it will perform satisfactorily?

Mr. GUTMANN. There has been a lot of money spent on that aircraft. First, we never could get assurance that a piece of equipment is going to perform satisfactorily until you put it in operation. There are problems with it, the wing and the cargo door, as you know. The Air Force also, as you are aware, thinks very highly of the aircraft. But it is going to be expensive in modifications.

Senator PROXMIRE. Why is the C–5A now suffering from corrosion?

Mr. GUTMANN. I am not aware that it is immune to corrosion.

Senator PROXMIRE. It is listed in the report as one of the problems.

Mr. GUTMANN. It is now suffering, you say?

Senator PROXMIRE. That is what your report tells us.

Mr. ASBY. I think that had to do, sir, with the location and placement of certain relief stations in the aircraft. I seem to recall the explanation having been given that some modifications were being made to these relief stations which would preclude any further corrosion in those areas.

Senator PROXMIRE. Are the rear cargo doors still sealed in all C–5A's?

Mr. STOLAROW. Yes.

Senator PROXMIRE. I just have a few questions on the Field Army Air Defense, that report that just came in this morning. Your report on the Field Army Air Defense mission is sharply critical of the Army for indecisiveness, lack of a clear goal, and poor planning. Can you describe briefly in concrete terms what you mean by this criticism. Is the Army continuing to spend funds on ground to air missiles and other weapons that are not adequate as compared to Soviet weapons, and is the Army developing new weapons that would be applicable?

Mr. STOLAROW. We believe that the Army really has not looked at the overall picture the way we would like them to. One guess as to the reason for that is that their SAM–D program is one of their major programs in the Army that gets a lot of emphasis and priority for funding. And it appears that they may be overemphasizing the SAM–D program at the expense of others. For example, in looking at the lessons learned in the last Arab-Israeli war the Egyptian forces took a heavy toll of Israeli aircraft with a gun, a 23-millimeter gun, radar directed gun, against low flying aircraft. It was very effective in combination with other weapons. Very little effort has been put out by the Army, our Army, in developing a gun to replace the VULCAN, which is not effective.

Senator PROXMIRE. The gun is cheaper than a missile?

Mr. STOLAROW. Yes; a gun is cheaper. But the point that has to be made is that there has to be a balance to cover the different speeds and types of aircraft attack, both high and low altitude. The SAM–D system which is currently being tested is primarily a high altitude system, and it is very complex and very costly. At the same time there is not enough, to us, it doesn't appear——

Senator PROXMIRE. You say indecisiveness on the part of the Army, but at the same time you say they seem to have made up their minds on the SAM–D and are overemphasizing it. What do you mean by indecisiveness?

Mr. STOLAROW. The fact that they have put a lot of time and effort into many paper studies and have really not moved ahead with making a decision and doing something, which leaves the Army in pretty bad shape right now as far as the air defense is concerned.

Senator PROXMIRE. Did you find the same kind of reasoning of capability, equal requirements justification in this areas as in the airlift mission?

Mr. STOLAROW. No; I don't think so.

Senator PROXMIRE. Did you encounter any access to records problems in this area? Did they let you have the information you had to have to get——

Mr. STOLAROW. We had no problems of access to information.

Senator PROXMIRE. You indicate that there is a problem of interservice cooperation and coordination with the Office of the Secretary of Defense. Is each Service procuring weapons without sufficient regard to what the others are procuring? Is there duplication?

Mr. STOLAROW. That is really hard to say. In the field army air defense——

Senator PROXMIRE. What do you mean by the lack of cooperation, coordination with the Secretary of Defense?

Mr. STOLAROW. We couldn't really determine how much consideration was being given by the Army in its requirements for air defense systems to the F–15 program, for example, where the Air Force was buying a highly sophisticated and expensive aircraft, part of whose role would be air superiority and protecting the Army.

Senator PROXMIRE. Why couldn't they determine that?

Mr. STOLAROW. I don't believe that they really have tried to study how much impact the F–15 would have on their air defense requirements so as to determine really what kind of weapons they would need and in what numbers. We have seen some Air Force studies which, for example, indicated that a squadron of F–15's would be far more cost effective weapons than several batteries of SAM–D missiles. But that also really needs to be examined. The tradeoffs—if you are buying an F–15, for example, how does that impact on the other Services' requirements for defensive systems? We really haven't seen that kind of study or effort being made by the Department of Defense.

Senator PROXMIRE. And finally, I note the report states, initial Soviet attacks would probably be directed against high value targets, including airfields. In view of the inadequacy of our present air defenses in Europe, what does it say about the airlift program? Has this problem been adequately considered by those responsible for the airlift mission?

Mr. STOLAROW. I don't believe so.

Senator PROXMIRE. Mr. Staats, I understand that the Senate Defense Appropriations Subcommittee will have a hearing tomorrow on the subject of strategic airlift. Could you provide me with a full list of information you were denied access to by the Joint Chiefs so that I can make an official request for this data for you through the Defense Subcommittee. I am a member of that Defense Appropriations Subcommittee. And I need that memorandum by 10 o'clock tomorrow.

Mr. STAATS. We will get it to you by the end of the day.

Senator PROXMIRE. Mr. Staats, this is, as usual, a very, very competent briefing on your part. And I am grateful to you. I think it indicates a most disturbing situation. Perhaps the most shocking is that the Joint Chiefs have refused on the basis of your testimony this morning to make essential data available to the Secretary of Defense.

Appalling. What kind of civilian control do we have over the military with that kind of attitude?

Mr. STAATS. What we are trying to do here is to——

Senator PROXMIRE. The Congress is one thing, and we should get that information. The Secretary of Defense after all, we have often encountered an arrogance on the part of the executive department. But here the executive department, the military won't even tell the boss. And after all, nobody acts for the President with respect to defense matters more than the Secretary of Defense does. That is his job. That is like saying DOD won't make data available to the President or any elected official.

Mr. STAATS. Though we can't get all of the information, Mr. Chairman, we think that these studies we are presenting demonstrate the value and the need for these kinds of analyses which should be requested, in all frankness, by the armed services and the Appropriations Committees.

Senator PROXMIRE. That is right. I think the point Senator Taft makes is very helpful. We should request that.

Mr. STAATS. What we can get is valuable, even though we can't get all the background that the Joint Chiefs have.

Senator PROXMIRE. And I think this is a most constructive recommendation that you have, that we put this into the total mission requirement, and examine the mission itself, whether it is reasonable or not, and whether it makes sense, whether it is logical. And we can't really appraise the need for a weapon system until we know what the purpose of it is and know it fully.

Mr. STAATS. That is correct.

Senator PROXMIRE. Let me just ask, do you believe legislation would be desirable to require the Department of Defense to present information about the budget request in the context of the missions and also to require DOD to justify the mission requirements?

Mr. STAATS. Yes, indeed. And if the purpose and the intent of the Congressional Budget Act is carried out, this would be a statutory requirement in 1979.

Senator PROXMIRE. You say it is already in the Budget Act?

Mr. STAATS. Yes, for fiscal 1979.

Senator PROXMIRE. And it applies specifically to the Defense Department?

Mr. STAATS. All agencies. I want to be careful to say, though, that even though it is a statutory requirement, valuable as that is, that it will not serve the entire purpose until the committees formulate the specific questions that they want the Defense Department to address themselves to. Otherwise, you are likely to get just a lot of words, and still the conclusion that they have come up with themselves.

Senator PROXMIRE. That is good advice. And I think what I will do is, I will forward that on in the form of a letter to Senator Stennis of the Armed Services Committee, and to Senator McClellan of the Appropriations Committee, as well as the appropriate chairmen in the House.

Thank you very, very much.

Mr. STAATS. Thank you.

[Whereupon, at 12:15 p.m., the subcommittee was adjourned, subject to the call of the Chair.]

ECONOMICS OF DEFENSE PROCUREMENT: THE C-5A AND STRATEGIC MOBILITY

WEDNESDAY, DECEMBER 21, 1977

Congress of the United States,
Subcommittee on Priorities and
Economy in Government of the
Joint Economic Committee,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10 a.m., in room 5302, Dirksen Senate Office Building, Hon. William Proxmire (chairman of the subcommittee) presiding.

Present: Senator Proxmire.

Also present: Richard F. Kaufman, general counsel; William Chastka, assistant clerk; Mark Borchelt, administrative assistant; Ron Tammen, legislative assistant; and Stephen J. Entin, minority professional staff member.

Opening Statement of Senator Proxmire, Chairman

Senator Proxmire. The subcommittee will come to order.

This hearing is a continuation of the strategic mobility hearings which we began in 1976. The earlier hearings could not be completed partly because of the refusal of Defense Secretary Donald Rumsfeld to testify or to designate anyone else to do so. I am thus pleased that the Defense Department under the new administration is willing to engage in a dialog about its proposals to enhance airlift capabilities for a possible war in Europe and other mobility programs.

I want to emphasize my commitment to a strong NATO alliance and to a powerful, unmistakable conventional deterrent to a war in Europe. If the facts and analyses show that we need to enlarge our capability for reinforcing our troops and allies in Europe, I will support such action.

I will not support costly new programs unless there is a demonstrable need for them. If there is a need, I want to know the particulars so that I am in a position to judge how much and what kind of additional effort is required.

"Gut" feelings and emotions are not enough to protect the taxpayer from the bureaucratic tendency to solve problems by throwing money at them.

Two sets of problems were disclosed in the earlier hearings. One was that the Defense Department has refused to give GAO and the committee staff documents showing the justification for the doubling of airlift capabilities proposed by former Defense Secretary James

Schlesinger. I am convinced, as is GAO, that the reason access was denied was because the justification simply did not exist. The decision was made to spend billions to enhance airlift capabilities before a systematic study was made demonstrating the need and a coordinated approach.

The second problem disclosed was that the programs proposed by Secretary Schlesinger were a hodgepodge of uncoordinated, noncost-effective activities.

Almost every outside expert who has examined these programs has his own candidate for the biggest turkey. Some say it is the AMST, a cargo plane with a mission to move infantry carriers and tanks from one part of the battlefield to another, at an estimated 20-year cost of $16 billion.

Others choose the proposal to "stretch" the C–141 aircraft. That program would cost an estimated $677 million and would add only a minor amount of cargo capacity for a European emergency.

My own choice happens to be the proposal to spend $1.3 billion to fix the wings of the C–5A, although a good case can be made that Monday's decision to select the DC–10 as the new advanced tanker-cargo aircraft is an even worse decision because it insures the necessity of yet another aircraft not too long from now to replace the C–5.

In any event, apart from the relative shape or misshapes of the proposals made, Congress and the public are confronted with a funny-looking flock of birds.

I would say to our first two witnesses that your work is cut out for you to demonstrate how these proposals, first made in 1974, can be justified today.

Our witnesses are John P. White, Assistant Secretary of Defense for Manpower, Reserve Affairs and Logistics, and Lt. Gen. Arthur J. Gregg, Director for Logistics, Joint Chiefs of Staff.

Gentlemen, you may proceed with your statements and then we will get into the questions.

Mr. White, you may proceed with your statement, and then we will hear from General Gregg; then we will have questions.

STATEMENTS OF HON. JOHN P. WHITE, ASSISTANT SECRETARY OF DEFENSE FOR MANPOWER, RESERVE AFFAIRS AND LOGISTICS, AND LT. GEN. ARTHUR J. GREGG, DIRECTOR FOR LOGISTICS, JOINT CHIEFS OF STAFF, ACCOMPANIED BY MAJ. GEN. CHARLES F. G. KUYK, JR., DIRECTOR OF OPERATIONAL REQUIREMENTS, RESEARCH AND DEVELOPMENT, HEADQUARTERS, U.S. AIR FORCE

Mr. White. Thank you, Mr. Chairman.

In my prepared remarks I will bring you up to date on the actions DOD has taken since the hearings this subcommittee held in June 1976, go over the current status and cost of the proposed mobility improvement programs with you, and discuss some of DOD's views on strategic mobility and the reinforcement of Europe. Finally, I will recount how the current mobility program was developed.

With me today, as you mentioned, are Lieutenant General Gregg, the Director for Logistics, the Joint Chiefs of Staff, and Maj. Gen.

Charles F. G. Kuyk, Jr., Director of Operational Requirements, Research & Development, Headquarters, U.S. Air Force.

Following my remarks, Lieutenant General Gregg will discuss the Joint Chiefs of Staff's views of strategic mobility and address some of the specific concerns raised in the hearing of 1976 and your letter that requested this hearing. He will also touch on the strategic mobility study which was completed in February of this year and supports our current mobility program. I would add, however, that we constantly evaluate DOD programs to insure the assumptions and planning data are current. Also, we are still working the DOD fiscal year 1979 budget submission, so by necessity our comments will reflect the fiscal year 1978 President's budget submission and the study submitted to Congress in February of 1977.

Shortly after the hearing this subcommittee conducted in June of 1976, the Senate Armed Services Committee requested that the Secretary of Defense take a personal view of the mobility problem and direct an overall coordinated study of the movement requirements to meet our NATO commitments.

The committee further recommended that the study consider the following factors in the development of requirements: Manpower and equipment needs of the field commanders; material and equipment available in NATO countries that could be used by U.S. forces; forward stationing of U.S. forces and prepositioning of equipment; reconsideration of the U.S. Army and U.S. Air Force early deployment needs; the relationship between airlift and sealift; better use of sealift; the alert status of U.S. forces; and the relief of dependents of U.S. forces stationed in Europe.

In addition to these considerations, the committee requested that the Secretary of Defense report to Congress on possible courses of action to meet the requirements.

The study was completed in February 1977 and submitted to Secretary Brown. He endorsed the study as appropriate to initiate the program to alleviate our national strategic mobility problem.

I will not go into the specifics of the study since it will be discussed immediately following my remarks. However, I do want to tell you that the completed study was sent to both the Armed Service and the Appropriation Committees of each House, the Congressional Budget Office, and the General Accounting Office. This was done to share with the Congress and GAO the analysis done to identify the mobility requirements and the options developed to satisfy the requirements. We also invited the staffs to review the study backup material to gain an understanding of how the requirements and mobility options were developed. We will continue to inform the Congress of the problem and the proposed alternatives.

General Gregg will further address the information that we have furnished the Congress and the GAO.

I would now like to discuss some of the views we did in DOD have regarding the need for strategic mobility.

During the first 25 years of the NATO alliance we have depended upon nuclear superiority as our main deterrent to conflict. However, as we enter an era of "rough equivalence" with the Warsaw Pact, we must also have conventional forces adequate to deter or, if deterrence fails, counter a pact attack. Without adequate conventional forces, the threshold of nuclear war could be lowered to an unacceptable level. We believe that we can acquire and maintain the necessary forces at an affordable cost. Of course, this requires that the NATO alliance work together more closely and that our allies contribute their fair share.

As you will see from the study results, we are now taking advantage of the transportation resources of other NATO countries. We are working on using even more, thereby reducing the cost to the United States.

To make this conventional deterrence work, several improvements to NATO's capabilities are required. First, we must achieve a high state of readiness, so we can respond quickly to Warsaw Pact threats. This involves making the units more combat ready through better equipment and levels of manning, as well as more realistic training and better positioning of units in the field.

Our second major task is to make our separate national forces fully capable of multinational operations. To this end Secretary Brown has launched a set of major long-term initiatives to strengthen NATO's deterrent posture. One of these initiatives deals with reinforcement. We are working with each NATO country and through the alliance to bring about a major improvement in NATO's ability to reinforce against a Warsaw Pact attack.

Specifically, we are examining the use of NATO civil aircraft, increased commitment of NATO ships and improvements in transportation planning and reception capability.

Third, we must be able to move our forces more quickly. This is the essence of our efforts to improve our strategic mobility. With short warning time and the very large quantity of men and equipment that must be moved, this job is difficult. Our analyses revealed that rapid reinforcement requires a mix of resources.

Since DOD initiated the mobility improvement program back in 1973, there has been considerable discussion and numerous studies about the appropriate mix of mobility forces required—airlift, sealift, and pre-positioning. Depending upon the scenario you measure against, the answer comes out differently. For example, if you use a very short-warning assumption for the NATO problem, then strategic lift forces are not the total answer; you must have most of the forces in place through pre-positioning or forward stationing.

Given the increasing concern regarding "short warning," we believe substantial increases in pre-positioning for NATO are appropriate. However, even with these improvements in pre-positioning, airlift improvements remain essential to move the force required to meet the threat in the early parts of the war. Airlift must move the roundout equipment for the POMCUS units, the required TAC air, and the forces and resupply required above the pre-positioned levels, particularly until sealift can also become effective.

Airlift also serves as a good hedge against greater than expected losses to our pre-positioned units and is essential for non-NATO contingencies where we must respond quickly but cannot position troops or equipment. Given the size of the threat, the numerous contingencies and significant uncertainties that we face, a balance of pre-positioning, airlift, and sealift is required. The programs we are pursuing to improve our reinforcement and mobility capabilities provide a mix of mobility forces adequate to respond to a range of scenarios both in intensity and warning time.

PRE-POSITIONING

In addition to the airlift and sealift enhancements which I will describe in more detail later, we are working hard to reconstitute our existing pre-positioned unit sets of equipment, commonly called POMCUS. We have a program to fill the existing shortages in POMCUS for reforger and 2-plus-10 units. Counting the four divisions that are forward stationed in Europe, this will give us seven divisions that can be available early on. In addition, we are studying the possibility of putting additional division sets in Europe. Implementation of this program would further increase our early combat capability in Central Europe. Of course, we would want to see parallel readiness improvements by our allies.

AIRLIFT

For strategic airlift, there are three basic improvement programs. The first is not so much an improvement program as it is the preservation of an existing capability. The C–5A, which is the only aircraft that can carry very large and heavy military equipment, has a wing problem. In fiscal year 1979 we will continue fabrication of two prototype test kits. When completed, the test results will enable us to determine the magnitude of the problem and how best to proceed. Thus far $102 million for design work on the C–5A wing modification has been appropriated. Rewing of the aircraft, so-called Option H, would cost approximately $1.3 billion.

Since 1973, when the airlift enhancement program was started, the Department of Defense has striven to make substantial improvement on the existing airlift capability before purchasing additional aircraft. Three areas appeared fruitful. First, we could fly the existing strategic airlift C–5 and C–141 aircraft at higher wartime daily utilization rates. Additonal spare parts for this program would cost about $400 million.

Next, we looked at ways to improve the utility of our airlift aircraft. In the case of the C–141 we found that for the NATO scenario the aircraft was filled up with large bulky cargo before it reached its weight-carrying capability. We reasoned that an improvement in the C–141 volumetric capacity could pay dividends. By stretching the C–141, an increase in carrying capacity for unit equipment of almost 30 percent is possible.

We have completed the prototype of the C–141 and at this point the program is ahead of schedule and below our cost estimate. Originally we estimated $41.5 million for the prototype. It was completed for $38 million. The total program cost for the C–141 stretch and refuel program is estimated at $611 million.

Finally, we were aware of a large number of civil passenger aircraft that could increase the airlift available in the event of war at a fraction of the cost of acquiring new aircraft. To be useful they have to be modified. We hope to provide a wartime cargo-carrying capability to about 100 aircraft in the civil wide-bodied passenger fleet. The first funding, $7.5 million, was made available in fiscal year 1978.

In addition to improving our strategic airlift capability by modifying existing assets, we are pursuing two major development programs—a wide-bodied, long-range, tanker cargo aircraft, and an aircraft to modernize our tactical airlift fleet. The advanced tanker cargo aircraft, ATCA, program involves the procurement of a number of wide-bodied type of aircraft, either DC–10's or 747's, which will increase our flexibility for scenarios other than NATO to deploy forces at long ranges without dependence on overflight or enroute basing rights. These aircraft would be used as tankers for the deployment of fighter aircraft and aerial refueling of cargo aircraft. They could also be used for carrying cargo or a combination of fuel and cargo.

Tactical airlift provides the in-theater support of our forces that have been deployed. The advanced medium STOL aircraft, AMST, of which we have built and tested four prototypes, is one of the candidates for tactical airlift modernization. Variants of the C–130 are also being considered to satisfy this tactical airlift requirement. The AMST aircraft is designed to carry large Army combat vehicles over short distances into airfields with short runways.

We are continuing to evaluate the pros and cons of each of these alternative aircraft for modernizing our tactical airlift fleet. So far we have invested $236 million in research and development in the AMST. Since the number and type of aircraft have not been determined, we do not have a final program cost.

In the course of many hearings, these airlift programs have been subjected to critical review by both Houses of Congress. These reviews have caused DOD to reevaluate each program. We believe these reviews have reinforced the validity of the improvements we are pursuing.

SEALIFT

Early in my remarks I mentioned our efforts to acquire additional NATO shipping. As a result of our previous work with our NATO allies, we have a commitment of approximately 200 militarily useful cargo ships. These ships would account for about 40 percent of the total tonnage we need to deliver to NATO during the first 6 months.

The latest improvement in this program was a change in planning that will allow for the use of these ships starting at NATO mobilization day versus D-day. This has enabled us to program for the movement of very large tonnages of equipment and cargo that previously showed up as a shortfall for which the U.S. lift was needed. We are continuing our work with the NATO allies to identify even more ships, possibly as many as 600, that would be of use in a NATO deployment.

In addition to these improvements we have a three-phased Navy sealift enhancement program.

First is the military sealift command, MSC, readiness funding whereby the Navy budgets to retain an organic surge capability within MSC. Second, we are making improvements to the National Defense Reserve Fleet to provide a ready pool of ships to support DOD requirements. In conjunction with the Maritime Administration (MARAD), we have initiated a 5-year program to upgrade existing ships to a condition which will allow them to be on berth for loading within 10 days after callup. Third, the sealift readiness program provides for the early availability of existing U.S.-flag commercial ships in the first 10 days of a contingency. Since initiation of these programs in fiscal year 1977, $28 million has been appropriated. Over the next 5 years an additional $75 million are programed.

As you can see, our strategic mobility program blends forward stationing, pre-positioning, airlift, and sealift. We have structured a balanced program to take advantage of the inherent strengths of each. Given our basic belief that we should not tailor our forces to a single scenario, the selection of specific mobility options is very hard. It is unwise to provide only for a quick response through airlift or pre-positioning because the ability to sustain the effort would be forfeited.

Sealift, while relatively inexpensive when compared to airlift, does not provide for reinforcement in the very early part of the war. Too much reliance on pre-positioning raises other problems: Penalties in support of non-NATO contingencies, large management difficulties in storage and maintenance, possible delays in marry-up of the troops and equipment, and potential vulnerability to enemy interdiction. We have developed a program that considers the benefits and disadvantages of all of these systems, pre-positioning, airlift, and sealift.

I would like, Mr. Chairman, if we may, to turn to General Gregg, and have him provide his testimony.

Senator PROXMIRE. Fine.

General GREGG. Mr. Chairman, I am Lt. Gen. Arthur J. Gregg, Director for Logistics, the Joint Staff. I am honored to appear before your subcommittee to discuss economic issues in military airlift and the relationship of airlift to the total strategic mobility equation.

With your permission, I would like to submit my prepared statement for the record and use my time to present a condensed version.

Senator PROXMIRE. I am delighted to do that, and we will have the prepared statement printed in full in the record at the end of your oral statement.

General GREGG. I will divide my remarks into two parts: First, I will address the general issues raised in your hearing of June 8, 1976, and tell you what we have accomplished since that time. Second, I will discuss the areas of interest which you identified in your letter of November 17, 1977. Specifically, I will talk about release of data to Congress and the General Accounting Office, the process used in developing our mobility requirements, and the views of the Joint Chiefs of Staff on strategic mobility as expressed in the strategic mobility requirements and program study.

In the latter, I will concentrate my remarks on your immediate concerns regarding airlift requirements and their justification and tradeoffs we have examined between airlift, sealift, and pre-positioning programs.

Mr. Chairman, in the previous hearing, you stated that Congress and the General Accounting Office must be provided sufficient data to judge the reasonableness of our requirements and recommendations.

We clearly understand your position, and have sought to work very closely with Congress and the General Accounting Office to provide the necessary data on which to evaluate our programs.

We appreciate and support the necessity of Congress being provided access to appropriate information so that accurate judgments, conclusions, and decisions can be made.

We can satisfy any reasonable request for data by providing appropriate documents, extracts, and briefings as required. However, as a long-established policy, the JCS do limit access to sensitive war plans. This policy is not intended to construct a stumbling block to legitimate congressional inquiry, but rather it is a very necessary accommodation to national security. Indeed, to construct, or appear to construct, an atmosphere of less than total candor in providing information would be self-defeating.

Recognizing your concerns in this area, and our responsibility to the American public, we have provided and shall continue to provide essential information to the General Accounting Office and to the Congress.

To this end, in our recently published report on strategic mobility requirements and programs, we have spelled out our requirements in detail and have worked very closely with the General Accounting Office for several months to amplify the rationale supporting our recommendations.

In past testimony, there has been some discussion about requirements and capabilities leading to the statement that "the DOD requirement is the same as capability," or that "the requirement is to move as much as possible as soon as possible."

These statements suggest the need for a fuller understanding of our force development process, and I would like to trace that process for you in some detail.

First, let me review the broad parameters from which we have derived our mobility requirements. The starting point, of course, is our national interests. The defense of the United States is our No. 1 priority, followed by the defense of NATO. We also need the capability to protect our interests in other areas of the world. Threats to these interests and our strategy to meet the same translate into specific scenarios.

It is our job to recommend force levels to counter the threat in the various scenarios.

In our overall planning process, we consider several levels of forces with associated risks and affordability.

First, minimum risk forces. Those which are unconstrained by fiscal, manpower, logistic, or other considerations.

Second, a prudent risk force level. Those which are constrained by judgment of reasonable attainability.

Below that level are the programed forces, those which are constrained by imposed budget limitations.

Finally, current forces, our forces in being which represent actual capability used for operational planning.

From this discussion, it is apparent that the ideal situation would occur when we were able to meet the minimum risk force levels. This is seldom possible. We must base our operational plans on the current forces and then seek through our programing actions to improve these forces with the prudent risk level as our goal.

The prudent risk requirements are input into the DOD planning, programing, and budgeting system. However, because DOD programs, just as other agencies, are developed under fiscal constraints, we do not always have what is required.

It should be emphasized, however, that while the prudent risk force level is our goal, we must plan our mobility assets against more realistic level of programed forces.

I would like to direct my remaining remarks to the conclusions and recommendations of our strategic mobility requirements and program study, and to your specific questions relative to requirements and tradeoffs.

First, airlift requirements and their justification. As we look at defense of NATO, it becomes apparent that we need a balanced posture of forward deployed forces, pre-positioning and strategic lift. No single approach can reasonably satisfy our requirements.

We have programed substantial increases in our pre-positioning and are also improving our sealift capability.

Additional airlift is required to move the roundout equipment for the POMCUS units, the tactical air units, and the additional combat forces necessary in the very early time periods.

Added to the very large volume of cargo that must be moved by air, there is the problem of having the correct mix of airlift. As you are aware, the C–5 cargo aircraft is designed to move our very heavy equipment, such as tanks and other outsize cargo.

However, as matters stand today, to achieve a balanced deployment, we must plan to use the C–5 to move some oversize equipment since we do not have enough oversize capability. The C–141 stretch and the CRAF modification programs are designed to improve our oversize capability and freeup the C-5 to move outsize cargo.

We examined airlift, sealift, and pre-positioning programs and made cost-effective tradeoffs separately for each program and combined mobility options to meet the programed and prudent risk requirements.

In these tradeoffs, we examined the cost of mobility programs and their contribution to risk reduction. We examined pre-positioning as a means of improving our responsiveness and reducing the early lift requirements.

We looked at pre-positioning more combat and support forces and selected portions of these forces. Pre-positioning of combat forces is a cost-effective way to improve our posture in NATO, and, as Mr. White said, we plan to do more.

However, it is only a partial solution. There are real and practical limitations on the amount of equipment which we would plan to pre-position because of vulnerability, problems in finding real estate, sources of equipment to be pre-positioned, and limited flexibility in the use of such equipment.

Thus, pre-positioning in NATO must be in proper balance with forward-deployed forces and strategic lift—air and sea.

We examined sealift alternatives to help solve our NATO reinforcement problem. The examination included alternatives which would provide a more responsive U.S. sealift. We also looked to our NATO allies for commitment of more ships and earlier availability of these ships. While we must plan to move substantial tonnage by sealift, it cannot provide the responsiveness we require in the first few weeks of a conventional war.

In our study, we found that the most cost-effective way of improving our sealift capability would be to rely more on our allies for this support. We are seeking commitments for more and earlier NATO ships. Our current plan calls for NATO ships after hostilities begin. The Maritime Administration is working through the NATO civil planning committees to obtain a larger pool of ships, which could be made available beginning on mobilization day. This sealift would give us the sustaining capability which we need, but it is not a suitable alternative to our early reinforcement problem.

STRATEGIC AIRLIFT

In airlift, we examined alternatives to the C–5. Either a new aircraft or a modified wide-bodied aircraft would be more than twice as expensive as the programs proposed to preserve the C–5. We examined both the CRAF MOD and the C–141 Stretch program to provide the necessary oversize capability to balance outsize deliveries.

We found that both were required. CRAF MOD is cost effective, but because of its limitations we must also have the C–141 Stretch. The CRAF MOD is not capable of carrying all types of cargo that can be carried in the C–141.

In addition, the CRAF is not as flexible, especially in availability for nonmobilized missions.

We need both to do the jobs required.

We examined the attendant costs of additional crews and war reserve materiel to increase the wartime productivity of our organic strategic airlift force. We found that increased utilization rates reflect a cost-effective method of enhancing the productivity of both the C–5 and the C–141 aircraft.

In summary, from our detailed examination of the mobility alternatives, we have concluded that the programs in the fiscal year 1978 budget are cost effective and a necessary step in meeting our defense objectives.

The mix of mobility forces programed, we will meet our objectives in building toward a prudent level of risk, provide a hedge against short warning in NATO, and give us the flexibility needed for other contingencies.

Specifically, with regard to strategic airlift programs, we found the following:

The C–5 wing MOD is essential to retain the capability for timely deployment of combat units. It is the only aircraft in existence which can accomplish the movement of tanks and large caliber artillery pieces.

Increased utilization rates are a cost-effective method of enhancing the productivity of existing resources. The C–141 Stretch modification will increase the oversize cargo capability of aircraft by 30 percent without increasing operating costs.

The CRAF modification provides expended bulk and oversize capability at minimum procurement and operational costs.

Coupled with the C–141 Stretch program, it provides an oversize capability to match the outsize lift of the C–5 and provides for the balanced deployment of combat forces.

Mr. Chairman, this concludes my remarks, and we will be happy to respond to your questions.

Senator PROXMIRE. Thank you very much, General Gregg. I want to thank both you and Mr. White for coming before us at this time.

[The prepared statement of General Gregg follows:]

PREPARED STATEMENT OF LT. GEN. ARTHUR J. GREGG

Mr. Chairman, Gentlemen, I am Lt. Gen. Arthur J. Gregg, the Director for Logistics, the Joint Staff. I am honored to appear before your committee to discuss economic issues in military airlift and the relationship of airlift to the total strategic mobility equation. It is my conviction that the strategic mobility of the United States forces has thus far been a powerful influence in maintaining peace in the world. It is essential that we retain and enhance the capacity to selectively place our forces where they are needed, when they are needed, and to sustain and build that force as required.

I will present may statement in two parts: First I will address the general issues raised in your hearing of 8 June 1976 and tell you what we have accomplished since that time. Secondly, I will discuss the areas of interest which you identified in your letter of 17 November 1977. Specifically, I will talk about:

Release of data to the Congress and the General Accounting Office,

The process used in developing our mobility requirements, and

The views of the Joint Chiefs of Staff on Strategic Mobility as expressed in the Strategic Mobility Requirements and Programs Study.

In the latter, I will concentrate my remarks on your immediate concerns, regarding airlift requirements and their justification, and trade-offs we have examined between airlift, sealift, and pre-positioning programs.

I have reviewed last year's testimony and the background which led to that hearing. From my review, the two major issues which appeared unresolved were the need for JCS to make appropriate data available to Congress and the GAO and the validity of our mobility requirements.

RELEASE OF DATA

Mr. Chairman, in the previous hearing you stated that Congress and the GAO must be provided sufficient data to judge the reasonableness of our requirements and recommendations. We clearly understand your position and have sought to work closely with the Congress and the GAO to provide the necessary data on which to evaluate our programs. We appreciate and support the necessity of Congress being provided access to the appropriate information so that accurate judgments, conclusions, and decisions can be made. We can satisfy any reasonable request for data by providing appropriate documents, extracts, and briefings, as required.

However, as a long established policy, the JCS does limit access to sensitive war plans. This policy is not intended to construct a stumbling block to legitimate Congressional inquiry, but rather it is a very necessary accommodation to national security. Indeed, to construct, or appear to construct, an atmosphere of less than total candor in providing information would be self-defeating. Recognizing your concerns in this area and our responsibility to the American public, we have provided, and shall continue to provide, essential information to the GAO and to the Congress. To that end, in our recently published report on Strategic Mobility Requirements and Programs, we spelled out our requirements in detail and have been working closely with the GAO for several months to amplify the rationale supporting our recommendations.

DEVELOPMENT OF THE MOBILITY REQUIREMENTS

In past testimony there has been some discussion about requirements and capabilities, leading to statements that "the DOD requirement is the same as capability" or that "the requirement is to move as much as possible as soon as possible." These statements suggest a need for a fuller understanding of our force development process and I would like to trace that process for you in some detail.

First, let me review the broad parameters from which we derive our mobility requirements. The starting point, of course, is our national interests—defense of the United States is our number one priority followed by the defense of NATO.

We also need the capability to protect our interest in other areas of the world. The threats to these interests and our strategy to meet the same translates into specific scenarios. It is our job to recommend force levels to counter the threat in the various scenarios.

In our overall planning process we consider several levels of forces with associated risk and affordability.

Minimum risk forces—Those which are unconstrained by fiscal, manpower, logistic, or other considerations;

Prudent risk forces—Those which are constrained by judgment of reasonable attainability;

Programmed forces—Those which are constrained by imposed budget limitations; and

Current forces—our forces in being which represent actual capability—used for operational planning.

From this discussion it is apparent that the ideal situation would occur when we are able to meet the minimum risk force levels—this is seldom possible. We must base our operational plans on the current forces and then seek through our programming actions to improve these forces with the prudent risk level as our goal. These prudent risk requirements are input into the DOD Planning, Programming, and Budgeting System. However, because DOD programs, just as other agencies, are developed under fiscal constraints we do not always have what is required. It should be emphasized, however, that, while the prudent risk force level is our goal, we must plan our mobility assets against the more realistic level of the programmed forces.

STRATEGIC MOBILITY REQUIREMENTS AND PROGRAMS STUDY

Because conventional reinforcement of NATO, in a general sense is the most demanding, and since we consider reinforcement of Europe a priority task, we have examined this scenario in considerable detail. As in all scenarios, the threat is the driving force in the development of requirements. In NATO we see an increasing potential for a conventional attack by the Warsaw Pact Forces. NATO must be prepared to counter such increases if we are to maintain a conventional deterrence. It is in this context, that we have studied the reinforcement problem. The level of U.S. Forces which we recommend to the Secretary of Defense accounts for the contribution of our Allies and represents the JCS judgment of a prudent level of risk.

These levels of forces and their time phasing, when coupled with the necessary support and sustaining resupply, constitute our mobility requirements.

Dr. White has provided you with a status report on our proposed airlift improvement programs and has also discussed other areas of interest which you asked to be covered. Therefore, I would like to direct my remaining remarks to the conclusions and recommendations of our Stategic Mobility Requirements and Program Study, and to your specific questions relative to requirements and trade-offs.

AIRLIFT REQUIREMENTS/JUSTIFICATION

First, airlift requirements and their justification. As we look at the defense of NATO it becomes apparent that we need a balanced posture of forward deployed forces, prepositioning, and strategic lift—air and sea. No single approach can reasonably satisfy our requirements. We have programmed substantial increases in our pre-positioning and are also improving our sealift capability. Addional airlift is required to move the roundout equipment for the POMCUS units, the tactical air unts, and additional combat forces necessary in the very early time periods.

Added to the very large volume of cargo that must be moved by air, there is the problem of having the correct mix of airlift. As you are aware, the C–5 cargo aircraft is designed to move our very heavy equipment, such as tanks and other outsize cargo. However, as matters stand today, to achieve a balanced deployment, we must plan to use the C–5 to move some oversize equipment since we do not have enough oversize capability.

The C–141 Stretch and the CRAF MOD Programs are designed to improve our oversize capability and free-up the C–5 to move outsize cargo. In our efforts earlier this year, we accomplished an extensive review of priorities and equipment for movement. In this review we looked at the equipment scheduled for movement and the priority of movement. It was our purpose to move only what was absolutely necessary, particularly in the early time period when premium transportation was required. This review resulted in a tonnage reduction of 7 percent in the first 30 days. Having satisfied ourselves that the requirements remaining were the minimum necessary, we then examined alternative programs to determine the size and mix of mobility forces which would allow us to achieve our objectives.

TRADE-OFFS

We examined airlift, sealift, and pre-positioning programs and made cost-effectiveness trade-offs separately for each program and combined mobility options to meet the programmed and prudent risk requirements. In these trade-offs we examined the costs of mobility programs and their contributions to risk reduction. The risk involved the amount of forces the Warsaw Pact has in relation to the NATO Alliance.

Pre-positioning

We examined pre-positioning as a means of improving our responsiveness and reducing the early lift requirements. We looked at pre-positioning more combat and support forces and selected portions of these forces. Pre-positioning of combat forces is a cost-effective way to improve our posture in NATO and, as Dr. White said, we plan to do more. However, it is only a partial solution. There are real and practical limitations on the amount of equipment which we would plan to pre-position—vulnerability, problems in finding real estate, sources of equipment to be pre-positioned, and limited flexibility in the use of such equipment. Thus, pre-positioning in NATO must be in proper balance with forward deployed forces and strategic lift—air and sea.

In addition, pre-positioning is not possible in all areas of the world where the United States may need to project forces. For these contingencies a ready organic airlift and sealift capability is mandatory.

Sealift

We examined sealift alternatives to help solve our NATO reinforcement problems. The examination included alternatives which would provide more responsive US sealift. We also looked to our NATO Allies for commitment of more ships and earlier availability of these ships. While we must plan to move substantial tonnage by sealift, it cannot provide the responsiveness we require in the first few weeks of a conventional war. In our study, we found that the most cost-effective way of improving our sealift capability would be to rely more on our allies for this support. We are seeking commitment of more and earlier NATO ships. Our current plan calls for NATO ships after hostilities begin. The Maritime Administration is working through the NATO civil planning committees to obtain a larger pool of ships, which could be made available beginning on Mobilization Day. This sealift would give us the sustaining capability which we need but it is not a suitable alternative to our early reinforcement problem.

Strategic airlift

In airlift we examined alternatives to the C–5. Either a new aircraft or a modified wide-bodied aircraft would be more than twice as expensive as the programs proposed to preserve the C–5. We examined both the CRAF MOD and the C–141 Stretch Program to provide the necessary oversize capability to balance outsize deliveries. We found that both were required. The CRAF MOD is cost effective but because of its limitations we must also have the C–141 Stretch. The CRAF MOD is not capable of carrying all types of cargo that can be carried in the C–141. In addition, the CRAF is not as flexible especially in availability for non-mobilized missions. We need both the do the jobs required. We examined the attendant costs of additional crews and War Reserve Materiel to increase the wartime productivity of our organic strategic airlift force. We found that increased utilization rates reflect a cost-effective method of enhancing the productivity of both the C–5 and the C–141 aircraft.

Our efforts last year concentrated on strategic mobility options, however, we did consider the benefits of tactical arilift augmentation and aerial refueling.

Other airlift programs

The Advanced Medium STOL Transport (AMST) is a prototype program designed to provide a suitable replacement aircraft for our aging tactical airlift fleet. We believe the high-speed wide-bodied STOL technology the AMST offers is vital if airlift is to keep pace with evoling battlefield doctrine. It should be noted that the tactical airlift force is sized and structured on the basis of meeting airlift requirements within a theater of operations. However, as this program matures, we plan to use the AMST to augment the strategic airlift force as we now do with the C-130.

Past history has taught us a great deal about long-range deployments and perhaps one of the most important lessons we learned was the impact of being denied access to foreign refueling and staging locations. Our study showed there is a definite requirement for long-range, high-offload, aerial refueling tankers to support strategic mobility operations. As advanced tanker becomes the key to reducing our dependence on en route support and overseas bases for both airlift aircraft and tactical air combat forces. A program has been developed which proposes the acquisition of aircraft capable of performing long-range, high-offload missions. This modernization program—the Advanced Tanker/Cargo Aircraft (ATCA)—will possess the capability for both aerial refueling and cargo carrying. Our studies to date have documented the benefits to be gained by using these aircraft in a refueling mode to improve airlift payloads and provide long-range projection of forces by airlift when en route bases are denied.

SUMMARY

In summary, from our detailed examination of the mobility alternatives we have concluded that the programs in the FY 1978 budget are cost effective and a necessary step in meeting Defense objectives. The mix of mobility forces programmed will meet our objectives in building towards a prudent level of risk; provide a hedge against short warning in NATO, and give us the flexibility needed for other contingencies.

Specifically with regard to strategic airlift programs we found the following:

The C-5 Wing MOD is essential to retain the timely deployment of combat units. It is the only aircraft in existence which can accomplish the movement of tanks and large caliber artillery pieces. Without its unique outsize capabilities we cannot aerially deploy complete fighting units. Therefore, we believe it is absolutely essential to continue the wing modification program to preserve the unique capabilities of this aircraft.

Increased utilization rates reflect a cost-effective method to enhance productivity of existing resources. Important steps in achieving this goal are the programming of necessary crews and spare parts. We will continue to work to relieve other constraints to achieving the highest possible utilization of our existing resources.

The C-141 Stretch modification will increase the oversize cargo capability of the aircraft by 30 percent without increasing operating costs. This equates to an addition of 90 C-141 aircraft without the attendant support costs of aircreiws maintenance, and spares. The modification incorporates aerial refueling whch, will extend its range and enhance our capability to meet contingencies. We believe this is a cost-effective, viable program which should be pursued.

The last major airlift enhancement effort which I will address is the CRAF Modification Program. This initiative is not a substitute proposal for other ongoing efforts, rather it is an integral part of the total strategic airlift improvement program. It provides expanded bulk and oversize capability at minimum procurement and operational cost. Coupled with the C-141 Stretch Program, it provides an oversize capability to match the outsize lift of the C-5 and provides for the balanced deployment of combat forces.

Mr. Chairman, this concludes my prepared remarks and we will be happy to respond to any questions that you might have.

Senator PROXMIRE. As I said in my opening remarks, it is good to have this kind of candor and frankness, and I appreciate it a great deal.

Before I start with the questions, let me just get a little clearer picture of your background so I understand what your time and familiarity is with these programs.

Secretary White, you have been in your position since when?

Mr. WHITE. Since May of this year.

Senator PROXMIRE. What was your background before that?

Mr. WHITE. Before that, I was a senior vice president at the Rand Corp. in California, responsible for management of all Rand national security research programs.

Senator PROXMIRE. Did you work in this area as a vice president of Rand?

Mr. WHITE. Rand has a contract with the Air Force, and with other elements of OSD that concern themselves with airlift programs, yes, sir. So I was familiar with the program before I came to government.

Senator PROXMIRE. General Gregg.

General GREGG. I came to my present position on July 1 this year. Previous to that, I was the Deputy Chief of Staff, Logistics, U.S. Army in Europe. I have had about 27 years of logistics experience both in command and staff jobs.

Senator PROXMIRE. Most of that time with the Army in Europe, and where else?

General GREGG. With the Army in Europe. I have also served previous tours on the Department of the Army Staff and the Army Material Command here in Washington. I have also served in Korea, Vietnam, and three other tours in Europe.

Senator PROXMIRE. General Kuyk.

General KUYK. Sir, I am associated with the C–5 Wing MOD, the AMST and ATCA weapons systems requirements portion of the Air Staff. I have been in that job for a little over 2½ years.

Prior to that, I was in the Military Airlift Command for 4 years, finishing up with a 2-year tour as Wing Commander at Dover Air Force Base, the east coast C–5 Base.

Senator PROXMIRE. Secretary White, last year Comptroller General Staats said:

> The current stated requirement to move 180,000 tons in 30 days is derived in GAO's opinion not from a demonstrable military need for 180,000 tons of cargo, but from the Air Force estimate of its current airlift capability. Defense's airlift "requirement" is, in reality, to move as much as possible in as short a time as possible.

The capability, therefore, became the requirement.

My question is: What is the current stated requirement for airlift in case of war in Europe? Is it still to move 180,000 tons in 30 days? If that is not the requirement, what is the requirement?

Mr. WHITE. Let me first address the first part of your comment, Mr. Chairman.

I think there has been a lot of confusion about tonnage to Europe and what it was that was earlier developed in the Pentagon with reference to our capability to lift to Europe versus what the military judgment was with respect to what was required in Europe.

What is required in Europe depends obviously on scenarios and, critically, on warning time. We have developed different assessments of that requirement based on different assumptions about warning time.

Then we have matched, looked at those requirements, relative to what the capability is and what the capability will be in the future.

So we have been careful not to confuse or identify the requirements as the same as the capabilities.

I am afraid to be specific in terms of numbers because that would get us into classified material.

Senator PROXMIRE. Well, do you agree or disagree with GAO's conclusion in its 1976 report that the stated requirement for airlift is based not on a demonstrable need but a military wish to move as much as possible in the shortest time possible?

If you disagree, how do you explain the fact of the Joint Chiefs of Staff study purporting to demonstrate the need last February, 3 years after the proposals were submitted to Congress?

Mr. WHITE. I would disagree.

I cannot address the question of what Mr. Staats looked at in 1976, but I have looked at the current analysis, and as you know, there is a great deal of controversy in the community about how to do that. I am satisfied with the fact that, given the problems of uncertainty and the problems of warning, the JCS has come up with what is a valid and reasonable requirement.

Senator PROXMIRE. General Gregg, do you agree that good decision-making procedures require that the problem be analyzed and a demonstrable need documented before the decision is made to approve a new program?

General GREGG. Yes, sir, I do.

Senator PROXMIRE. Would you agree that that was not done in the case of the airlift program?

General GREGG. No, sir. My review of this subject would suggest to me that considerable research was done to identify the requirements and how best to proceed in meeting those requirements.

Senator PROXMIRE. Then that means that you disagree with the GAO conclusion that it was simply a matter of deciding what we could do and delivering that without determining what the need was. Obviously, if the need is more than 180,000 tons, you have got an overwhelming case for delivering what you can do. On the other hand, it is conceivable that the need might be less, and the need might change or vary, as it obviously does.

General GREGG. Perhaps I can amplify that a little bit, sir, without getting into the classified area.

First, I think that we have to appreciate the commander who makes an assessment of the threat faced by our forces, and then from that we must make some judgments of what is required in order to respond to that threat.

Then we must take a look at what assets he has available. The difference between what he must have available to respond to the threat and what he has available to him in the field, represents requirements.

After determining the requirement, we must then look at what our capability is today. What can we do with existing resources. And looking toward that greater requirement, what can we reasonably program toward achieving the additional resources which we have identified which is necessary to meet a threat.

I know that I am giving you the procedures we go through in making these analyses without giving you specific numbers, sir.

Senator PROXMIRE. Well, as I understand it, you decided in 1974 to double the requirement, but no study was submitted justifying the decision until, when, this year. That was done when Congress requested it.

General GREGG. Sir, I think it would be wrong to say that there was no study done to determine what the requirements were. It is a matter of a continuing process of assessing the threat, assessing what we need to meet that threat, and how best to go——

Senator PROXMIRE. You see, the problem I have, General, is that the GAO has spent a year looking for one, and couldn't find it, and said as far as they could determine, it didn't exist.

General GREGG. I think there is some validity in the fact that the very comprehensive study which was prepared and which I referred to in my prepared statement was completed in February of this year, but I think it would be wrong to suggest that that was the first attempt by the Department of Defense to analyze and to quantify what the real requirements are.

Senator PROXMIRE. Mr. Secretary, did the Joint Chiefs of Staff study state the current requirement in terms of tons to be airlifted within 30 days' warning time, and does the requirement differ from last year's description of it?

If so, can you explain the differences in terms of warning time——

Mr. WHITE. The study looks at warning time and then attempts to array the requirement in reference to delivery of tons done in terms of armored division equivalents over time, in reference to days of closure, and, therefore, examines our capability and requirement relative to what our answer will be in terms of capability to deliver forces to Europe over that time.

So, it looks at tons, and looks at armored division equivalents delivered over time as well. I am afraid I would have to turn to General Gregg for specific differences between this and last year's review.

Senator PROXMIRE. Well, last year they said there was a need to deliver 370,000 tons in 30 days. Did they make a study of that and change it? Is that still a requirement?

Mr. WHITE. The specific numbers, Mr. Chairman, are classified, but I don't think you will find, if you review the study, any wide differences in terms of requirements.

Senator PROXMIRE. Well, if the number is classified, that is it.

The problem here is that you are classifying numbers that were not classified last year.

Mr. WHITE. General Gregg will comment.

Senator PROXMIRE. Go ahead, General Gregg.

General GREGG. Sir, we were dealing with two numbers. I think the GAO dealt with two numbers.

The lower number represented our existing capability to deliver cargo to Europe in the first 30 days. The study identified a higher number which reflected our program and our airlift enhancement programs which would give us additional capability to deliver cargo to Europe during the first 30 days. But in neither case did this represent requirements. It represented, on the one hand, current capability, and in the second number, it represented a program enhancement of current capabilities.

Senator PROXMIRE. Well, you are saying, then, that those numbers are classified.

General GREGG. In my judgment, sir, they are classified.

Senator PROXMIRE. All right, Mr. Secretary, as recently as 1976, GAO and Members of Congress and others were able to discuss in public the airlift requirement for a European contingency with respect to tons required and the number of days.

What has changed since last year? Why is it proper for the public to know the facts in 1976 but improper for the public to know them in 1977?

Mr. WHITE. We haven't been thinking of the program in this analysis with respect to tons delivered. In my judgment, the question of what can be specifically delivered in combat capability would be classified information.

It is not just a question of numbers of tons lifted to Europe.

Senator PROXMIRE. Well, you see, the problem is that last year there was full discussion. This year there is not. I wondered why the change, why you considered it had to be classified now and it was not before?

I couldn't say it is not justified, I just want to know why it is.

Mr. WHITE. I understand, sir. I am informed by General Gregg——

Senator PROXMIRE. Let me read from the Appropriations Committee last year. This was unclassified, of course. It said:

> The committee notes the Department of Defense is seeking to double its airlift requirement from 180,000 tons of cargo in a 30-day period to 370,000 tons with a cost of $11 billion over 3 years. . . .

They refer to providing information to complete the examination of this. Was the committee incorrect in stating those numbers?

Mr. WHITE. No, sir. There is 180,000-ton capability now in the current force, and there is a projected capability of 370,000 tons in the enhanced program. Those are both unclassifid numbers.

One is current capability and one is our estimate of programed capability.

Senator PROXMIRE. Well, now, last year we were told that this was the requirement.

Mr. WHITE. I cannot speak to that, Mr. Chairman, It is not in my view, the requirement.

Senator PROXMIRE. Now, you are telling us this year that the requirement is classified so we cannot make an analysis and, therefore, we cannot use it.

Mr. WHITE. Yes, sir. We will provide it to you, Mr. Chairman.

Senator PROXMIRE. I appreciate that. Of course, the difficulty is, unless we can get the information and use it in debate and in discussion, and with our colleagues freely, it, of course, inhibits decisions on our part very seriously.

Mr. WHITE. Yes, sir; and I understand that problem full well.

Senator PROXMIRE. Now, Secretary White, when the facts were available to the public, the mobility proposals were subject to widespread criticism. The Senate Armed Services Committee said they were poorly justified and were largely a patchwork of lower priority programs.

Are they called secret now so the Congress will not have open discussion and criticism of your plans?

Mr. WHITE. No, sir. This administration has no intention of classifying anything except for strictly military purposes, and we will strive to provide you with everything in unclassified form that we can.

Senator PROXMIRE. General Gregg, I understand last Friday the General Accounting Office submitted a draft report from Comptroller General Staats, to be presented tomorrow to the Defense Department for security review.

He submitted a draft of his testimony to be considered by the Defense Department for a security review. Is that correct?

General GREGG. That is correct, sir. I have seen a copy of the proposed GAO statement, which was classified secret at that time. I have not seen the revised statement which reflects necessary changes to eliminate the classified data.

Senator PROXMIRE. Is it also true that you, in effect, censored Mr. Staat's testimony by deleting facts such as tonnage and warning times on the ground of secrecy? If so, doesn't that demonstrate that it is now the Pentagon's policy to withhold from the public the facts necessary to evaluate proposals?

General GREGG. I did not edit the statement, Mr. Chairman, but perhaps I can find out about it.

I am advised that the statement was submitted to the OSD public affairs for their review to remove from the statement that data which was considered classified.

I might say, sir, that this is a normal thing. I submitted my statement for the same kind of review. I would like to add, however, that all of the data contained in our study have been made available to the General Accounting Office, not only that, but we have given them briefings and we have had some very useful discussions with regard to the data in our study and the rationale we have used.

Senator PROXMIRE. Let me ask you this: Last year, the GAO study, was it submitted to you; or the testimony, I should say, submitted to you, and was it also modified for removing any classified information in it?

General GREGG. I am not aware of what occurred last year, but I can find out, sir.

I am advised that the statement which was made last year had not been submitted for our review.

Senator PROXMIRE. Now, this is a change in policy, then. How do you explain that? How do you justify it? It seems to me that we are getting under these policies less information than we got last year.

It is a program involving billions of dollars, and we have a responsibility toward determining how much to spend and where, and it is hard to do it without having this information available for discussion.

General GREGG. Sir, it is my understanding that the General Accounting Office has no specific requirement to submit their statement to us for a security review. In this instance, the persons preparing that statement had been working with us for several months.

They were well aware of which parts of our study contained classified data, and those parts which were unclassified, and in their judgment they felt that they would be best served by coming to us and asking for our assistance in reviewing that statement to remove any classified data.

That is as I understand it, sir.

Senator PROXMIRE. Let me ask Mr. Kaufman to follow up on that.

Mr. KAUFMAN. General, isn't it also correct that the reason GAO may have decided in their judgment to submit their statement for security review was that your aids and others in your office had been telling them for some weeks and months that much of the data which last year was available for public discussion was no longer available for public discussion, and that it was not classified?

General GREGG. Certainly I did not make such a suggestion, Mr. Kaufman, and I am unaware of anyone on my staff who made such a suggestion.

However, I can quite understand why the General Accounting Office would recognize some of that data as being classified, because it came in a study which had some classified data and sections in it, and they have been discussing with us various aspects of this study over a period of several months.

When I first saw the GAO statement, it was classified, sir.

Senator PROXMIRE. Let me use the C–5 aircraft as an example. You want to use $1.3 billion to fix the defective wings. You say this is necessary because it is the only thing that can carry outsize equipment such as tanks, and so forth.

The GAO is skeptical about the rewinging and advises the cost should be compared with costs of alternative methods, such as pre-positioning material, and so forth.

Are these cost alternatives discussed in the Joint Chiefs of Staff report? You discussed pre-positioning or an outsize C–147.

Are those substitutes discussed with respect to rewinging the C–5?

General GREGG. Yes, sir, but I must qualify that. We looked at the various alternatives, but we looked at the alternatives in combination. We did not go to an alternative that postulated all pre-positioning, or all sealift or all airlift.

We, in each case, looked at combinations of pre-positioning, sealift, airlift, in various combinations to determine what was the most cost-effective alternative.

Senator PROXMIRE. You see, what I am getting at is whether or not you considered a combination of fast sealift, of 747, of pre-positioning, and so forth——

General GREGG. Yes, sir, we did.

Senator PROXMIRE [continuing]. That would enable you to avoid this $1.3 billion additional expenditures in rewinging the C–5.

General GREGG. We looked at those alternatives in some detail and costed them out and our study shows that the preservation of the capability in the C–5 is warranted.

Senator PROXMIRE. Well, let me pursue it further, then. In the Middle East war of 1973, the C–5 was used extensively, but it delivered only a small number of outsized items from the time the airlift began to cease-fire, 11 days.

How much could be delivered in a European war in 30 days, and was this discussed in the JCS report?

General GREGG. The tonnage that we would be capable of delivering is discussed in the report.

Senator PROXMIRE. You see, the peculiar advantage of the C–5 is that it can carry the outsized equipment, and if only a relatively small number, only 14 outsized items were delivered by the C–5 in that 11-day period, it would seem that there were other methods that would be far more logical than something that would cost us $1.3 billion to fix.

General KUYK. General Gregg.

General GREGG. Yes.

General KUYK. Sir, I would like to try to explain that. I think during the Israeli airlift, it was certainly an unprogramed, unplanned, immediate reaction type of requirement that we were trying to meet.

During that period of time, the C–5's carried approximately half of the cargo that was delivered. The cargo to be moved was primarily bulk and oversize, and the C–5 was used to move what was there. As we see an operation in NATO, we plan it well ahead, and as we plan the cargo to be moved in a NATO exercise and NATO contingency, there is a significant amount of outsize cargo.

The major combat equipment of the Army is growing in size, and we see 35 to 40 percent of what would have to go in those early days to NATO to be, in fact, outsized to anything but the C–5.

Senator PROXMIRE. Well, what puzzles me is the fact that we do have a great deal of airlift capacity. The advantage of the C–5 is for outsize equipment. That is a peculiar, special advantage.

Absent that, we have other airlift capacity that is very substantial.

The question, again, is, Whether or not a $1.3 billion expenditure to rewing it is necessary in view of this particular experience?

I understand you said the airlift was unprogramed and unplanned. You mean there was no contingency plan for a Mideast war?

General KUYK. Sir, there was no Israeli airlift plan. As the equipment was required, we delivered what they called for, so that I think it is fair to say that it was not a planned Israeli airlift, and we were not moving our own forces.

It was a resupply of a foreign country, and in that sense we did not have a major amount of outsize cargo to be lifted. But of the total Military Airlift Command capability, the C–5 provides half of that total capability, and, therefore, in this operation the record would show that it did, in fact, carry half of the cargo.

Senator PROXMIRE. Could you tell us how many outsized items could be delivered in a 30-day period?

General KUYK. Sir, I believe your number of 14 is probably a very accurate number.

Senator PROXMIRE. No, no, no. That 14 was the amount delivered in the 11-day Arab-Israeli war. I am talking about how much could be delivered in a 30-day period to Europe.

General KUYK. Excuse me. Sir, as I understand the current plans, the amount of cargo to be delivered during the first 30 days is on the order of 35 to 40 percent of that firepower that is outsized to anything but the C–5.

Senator PROXMIRE. Can you give us any idea as to the number of items?

General KUYK. I cannot answer your question on the number of items. I can certainly get that for you, sir, but I cannot answer it today.

Senator PROXMIRE. You will get that for us. Is it classified or unclassified?

General KUYK. I will have to get the number, sir, and check it.

Senator PROXMIRE. All right.

[The following information was subsequently supplied for the record:]

Included in the total airlift and sealift requirement is approximately 10,000 outsize items that must be moved to Europe during the first 30 days. The C–5 force can deliver 4,818 of the outsize items at its maximum programed utilization rate during this period. The nature of the deployment problem to meet the threat in a timely manner requires that forces be deployed as quickly as possible using an appropriate mix of airlift and sealift. Airlift, which can be quickly employed with a high degree of flexibility, is most effective for early available combat fire-power units required during the initial phase of the deployment scheme.

With regard to the Israeli airlift, the C-5 transported almost half of the total tons airlifted while flying only 26 percent of the missions. Fifty-four missions, or 37 percent of the total C-5 missions, carried outsize cargo such as 19 M-60 tanks, 155mm Howitzers, 175mm guns, helicopters, etc.

Senator PROXMIRE. General Gregg, if the public isn't allowed to know the facts about the costs of rewinging of the C-5, isn't it impossible for the public to evaluate your proposal?

Do we have to take it on faith?

General GREGG. I don't think it has to be taken on faith.

Senator PROXMIRE. Well, as far as the public is concerned.

General GREGG. I would like to address that on two levels, sir. First of all, as far as the General Accounting Office and the Congress are concerned, appropriate data can be made available to include the classified sections.

Some of the information can be made available to the public generally. However, some of the specific numbers, I think we would be compelled to restrict in an unclassified release to the general American public.

Senator PROXMIRE. Let me see if I can get a general kind of an example and see if we can make progress on that.

Why wouldn't it make sense to buy modified new 747's instead of using over $1 billion to patch up the old C-5 fleet?

I understand the adapted-for-outsize-equipment version of the C-747 would cost $30 million to $50 million each. A number of them could be bought for the same amount as you plan to spend on the C-5 wings.

Why wouldn't you be better off with 26 new 747's and the existing C-5 fleet held in reserve for emergency use?

Do you want to comment, General Kuyk?

General KUYK. Yes, sir. We have reviewed the alternatives of buying 747's as a replacement for the C-5. We have looked at options in the vicinity of 26 in number, and we have discovered that it is not as cost-effective to go that way, because there are a couple of things involved.

First, the 747 must be modified to handle the outsized cargo, and that would require a substantial engineering modification. The airplane currently cannot take the outsize cargo, and the nose would have to be increased in size and raised approximately 4 feet to get the——

Senator PROXMIRE. I wonder about the nature and the wisdom of that analysis. In the first place, the modification of the wings of the C-5 is to give it a longer life.

General KUYK. Yes, sir.

Senator PROXMIRE. So you could use it in an emergency under any circumstances for a few weeks. So why wouldn't it be logical, rather than to spend that huge sum of over $1 billion to modify the wings, use the C-5 as an emergency and then, as I say, have this new fleet of 747's.

Wouldn't that be wiser, and wouldn't that give you a far greater potentiality?

General KUYK. Well, sir, among other things, it would leave us with a C-5 fleet that is on the ground which we could not use. We could not have our crews trained in it, and the possibility of being able to take it from not flying——

Senator PROXMIRE. What is the utilization rate of the C-5 now?

General KUYK. Currently at 1.8 hours per airplane per day. We intend to go to 1.5 during fiscal year 1978.

We think we have it down now to a bare minimum, and if we take it down to a lesser number we don't think we would have any chance of surging it to our objective of over 10 hours a day.

Senator PROXMIRE. Is there any study of that problem, of less utilization of the C-5?

General KUYK. We have reviewed going to lower numbers with the Military Airlift Command. We checked out that type of operation with the airlines.

Of course, the airlines operate routinely at approximately 10 hours a day, and there is just no data available that would indicate that it is a feasible operation for the C-5 to go from no flying up to those large numbers of flying hours.

Senator PROXMIRE. Will you make available to the subcommittee and to the GAO your study of the C-5 and the possibility of, instead, going the 747 route?

General KUYK. Yes, sir.

[The following information was subsequently supplied for the record:]

Attached are two unclassified studies entitled, "Outsize Alternatives to the C-5 Wing Modification," and "747 Aircraft as an Alternative to the C-5 Wing Mod."

Air Force

Headquarters, USAF
Asst. Chief of Staff

Studies & Analysis

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

UNCLASSIFIED

OUTSIZE ALTERNATIVES TO THE C-5 WING MODIFICATION

Briefer: **Major Richard W. Scott, jr.**

THIS DOCUMENT CONTAINS INFORMATION
THAT IS NO LONGER CURRENT

THIS PRESENTATION IS

UNCLASSIFIED

SLIDE 1 (TITLE)

THIS BRIEFING ADDRESSES NEW PRODUCTION AIRCRAFT CONSIDERED AS POSSIBLE OUTSIZE-CAPABLE ALTERNATIVES TO THE C-5 WING MODIFICATION.

PREFACE

- APRIL 1975 DSARC ON C-5 WING MODIFICATION
  - AF TO PROCEED WITH DESIGN AND FATIGUE TEST
  - DIRECTED TO LOOK AT ALTERNATIVE AIRCRAFT
  - DATA TO BE PRESENTED AT NEXT DSARC
- CURRENT STATUS - - DATA GATHERING FOR NEXT DSARC
  - ASD AND MAC
    - WING MODIFICATION PROCUREMENT OPTIONS
    - OPERATIONAL IMPACT
  - AF / SA
    - ALTERNATIVE AIRCRAFT OPTIONS
    - COST AND OPERATIONAL IMPACT

SLIDE 2

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SLIDE 2 (PREFACE)

AS A RESULT OF THE C-5 PROGRAM REVIEW CONDUCTED ON 3 APRIL 1975, THE AIR FORCE WAS AUTHORIZED TO PROCEED WITH THE DESIGN AND FATIGUE TEST PHASES OF THE C-5A WING MODIFICATION PROGRAM. THE AIR FORCE WAS DIRECTED TO EXAMINE STRATEGIC AIRLIFT ALTERNATIVES IN PARALLEL WITH THE DESIGN OF THE NEW C-5 WING AND TO PRESENT THE RESULTS AT THE NEXT DSARC.

AT THE PRESENT TIME A NUMBER OF MAJOR DATA-GATHERING EFFORTS HAVE BEEN UNDERTAKEN. THE AERONAUTICAL SYSTEMS DIVISION AND MILITARY AIRLIFT COMMAND HAVE CONDUCTED A JOINT EFFORT TO EXPLORE WING MODIFICATION PROCUREMENT OPTIONS AND THEIR OPERATIONAL IMPACT ON FORCE CAPABILITY. AIR FORCE STUDIES AND ANALYSIS HAS EXAMINED SEVERAL ALTERNATIVE AIRCRAFT OPTIONS AND THEIR ASSOCIATED COST AND OPERATIONAL IMPACT.

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SCOPE

- ONLY OUTSIZE-CAPABLE AIRCRAFT CONSIDERED AS ALTERNATIVES
- STUDY COMPARES LIFE-CYCLE COSTS OF WING-MODIFIED C-5 WITH ALTERNATIVE AIRCRAFT
- MEASURES OF MERIT - - COST OF PROVIDING EQUAL DAILY DELIVERY OF OUTSIZE CARGO TO EUROPE
  - CAPABILITY BENCHMARK IS 70 UE C-5 WING-MODIFIED FORCE
  - ALTERNATIVES PROVIDE EQUIVALENT OUTSIZE-CAPABILITY

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SLIDE 3

SLIDE 3 (SCOPE)

FOR THIS STUDY THE OPTIONS CONSIDERED WERE TO EITHER MODIFY THE C-5 WING OR PROCURE NEW AIRCRAFT. ONLY NEW OUTSIZE CAPABLE AIRCRAFT WERE CONSIDERED AS ALTERNATIVES TO THE C-5 WING MODIFICATION. THE ANALYSIS COMPARES LIFE-CYCLE COSTS OF THE WING MODIFIED C-5 WITH THE COSTS OF ALTERNATIVE AIRCRAFT.

THE MEASURE OF MERIT USED IN THE ANALYSIS IS THE COST OF DELIVERING OUTSIZE CARGO TO EUROPE. EACH OF THE ALTERNATIVE AIRCRAFT WOULD PROVIDE EQUIVALENT OUTSIZE DELIVERY CAPABILITY TO NATO AND OTHER MAJOR THEATERS SUCH AS NORTHEAST ASIA OR THE MIDDLE EAST.

THE TERM "OUTSIZE" IS USED TO DESCRIBE EQUIPMENT SUCH AS AN M-60 TANK THAT IS TOO LARGE TO FIT ON A C-141, 747 COMMERCIAL FREIGHTER, OR MODIFIED CRAF WIDEBODY.

OUTSIZE-CAPABLE ALTERNATIVES TO THE C-5 WING MODIFICATION

(NEW PRODUCTION AIRCRAFT)

AUSTERE C-5

OUTSIZE 747

(OUTSIZE DERIVATIVE OF 747 COMMERCIAL FREIGHTER)

MEDIUM STRATEGIC TRANSPORT (CONCEPTUAL)

SLIDE 4 (OUTSIZE-CAPABLE ALTERNATIVES TO THE C-5 WING MODIFICATION)

THE AIRCRAFT CONSIDERED AS ALTERNATIVES TO THE C-5 WING MODIFICATION ARE SHOWN HERE. THESE ARE ALL NEW PRODUCTION, OUTSIZE-CAPABLE AIRCRAFT. THE C-5 DERIVATIVE WAS SELECTED BECAUSE OF THE DEMONSTRATED CAPABILITY OF THE C-5 TO CARRY OUTSIZE EQUIPMENT. THE OUTSIZE 747 IS A COMPANY PROPOSED DERIVATIVE OF THE 747-200F COMMERCIAL FREIGHTER, WHICH HAS ONLY OVERSIZE CAPABILITY, AS DO THE PROPOSED CRAF MODIFIED AIRCRAFT OF THE AIRLIFT ENHANCEMENT PROGRAM. IT WAS SELECTED BECAUSE THE 747 HAS THE HIGHEST RANGE-PAYLOAD POTENTIAL OF ANY AIRCRAFT CURRENTLY IN PRODUCTION. THE MEDIUM STRATEGIC TRANSPORT IS A CONCEPTUAL, WIDE-BODY AIRCRAFT CAPABLE OF TRANSPORTING HEAVY, OUTSIZE EQUIPMENT OVER INTERCONTINENTAL DISTANCES.

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DESCRIPTION OF AUSTERE C-5

(LOCKHEED PROPOSAL)

- AUSTERE C-5 IS A NEW PRODUCTION "STRIPPED" VERSION WITH:
  - NO REAR CARGO DOOR
  - UPPER TROOP SEATS REMOVED
  - LEADING EDGE SLATS REMOVED
  - FIRE SUPPRESSION SYSTEM REMOVED
  - AUSTERE CREW COMPARTMENT
  - CROSSWIND LANDING GEAR ADJUSTMENT CAPABILITY DELETED
  - INTEGRAL WEIGHT AND BALANCE SYSTEM REMOVED
  - NEW WING

SLIDE 5 (DESCRIPTION OF AUSTERE C-5)

THE AUSTERE C-5 IS BASICALLY A "STRIPPED" MODEL OF THE C-5 PROPOSED BY THE BUILDER. THE REAR CARGO DOOR WOULD BE REMOVED FOR WEIGHT SAVINGS AND SIMPLICITY. IT WOULD HAVE NO LOADING TIP-OVER PROBLEM EVEN WITH AN M-60 TANK. UPPER TROOP SEATS WOULD BE REMOVED AND IT WOULD HAVE CERTAIN OF THE SYSTEMS DELETED WHICH INCUR HEAVY MAINTENANCE SUPPORT REQUIREMENTS. THESE INCLUDE THE CROSSWIND POSITIONING SYSTEM, INFLIGHT TIRE DEFLATION AND INTEGRAL WEIGHT AND BALANCE SYSTEM.

DESCRIPTION OF OUTSIZE 747

(BOEING PROPOSAL)

- NEW DESIGN BASED ON 747 COMMERCIAL FREIGHTER
  - REQUIRES EXTENSIVE ENGINEERING DEVELOPMENT
  - FLIGHT DECK RAISED 48" TO ACHIEVE OUTSIZE CAPABILITY
  - FLOOR REINFORCED TO ACCEPT HEAVY OUTSIZE EQUIPMENT

SLIDE 6 (DESCRIPTION OF OUTSIZE 747)

THE OUTSIZE 747 IS A COMPANY PROPOSED DERIVATIVE OF THE CURRENTLY PRODUCED COMMERCIAL FREIGHTER. IN ORDER TO GIVE IT AN OUTSIZE CAPABILITY, THE FLIGHT DECK WOULD BE RAISED 48", A LARGE OUTSIZE-CAPABLE NOSE DOOR WOULD BE INSTALLED, AND A HEAVY REINFORCED FLOOR WOULD BE INSTALLED. AS THIS IS ONLY A PROPOSED AIRCRAFT, EXTENSIVE ENGINEERING DEVELOPMENT WOULD BE REQUIRED PRIOR TO PRODUCTION. SINCE THE 747 FLOOR IS 18 FEET OFF THE RAMP, DIFFERENT LOADING PROCEDURES AND EQUIPMENT WOULD BE NEEDED THAN ARE PRESENTLY IN USE FOR THE C-5, WHICH COULD RESULT IN POSSIBLY INCREASED LOADING AND OFFLOADING TIMES.

DESCRIPTION OF MEDIUM STRATEGIC TRANSPORT

- CONCEPTUAL MEDIUM STRATEGIC DESIGN
  - REQUIRES EXTENSIVE DESIGN, TEST, AND EVALUATION
  - WIDE-BODY DESIGN
  - CAPABILITY TO CARRY HEAVY, OUTSIZE EQUIPMENT
  - CARGO COMPARTMENT COULD ACCOMMODATE 10 PALLETS
  - INTERCONTINENTAL RANGE
  - MAX GROSS WEIGHT -- APPROXIMATELY 400,000 POUNDS

SLIDE 7 (DESCRIPTION OF MEDIUM STRATEGIC TRANSPORT)

THE MEDIUM STRATEGIC TRANSPORT IS A CONCEPTUAL AIRCRAFT DESIGNED PRIMARILY FOR THE STRATEGIC DEPLOYMENT MISSION. THE AIRCRAFT WOULD BE CAPABLE OF TRANSPORTING A TANK TO EUROPE. AS THIS IS ONLY A CONCEPTUAL AIRCRAFT, CAPABILITY AND COSTS ARE ESTIMATES EXTRAPOLATED FROM CURRENT PLANNING FACTORS.

CHARACTERISTICS OF THE C-5 WING MODIFIED AIRCRAFT AND OUTSIZE CAPABLE ALTERNATIVES

	ALLOWABLE CABIN LOAD *	463 L PALLETS	SPEED KNOTS
C-5 WING MOD	235,000 LBS	36	440
AUSTERE C-5	254,000 LBS	36	440
OUTSIZE 747	266,000 LBS	46	490
MEDIUM STRATEGIC TRANSPORT	135,000 LBS	10	400

* 2.25 G

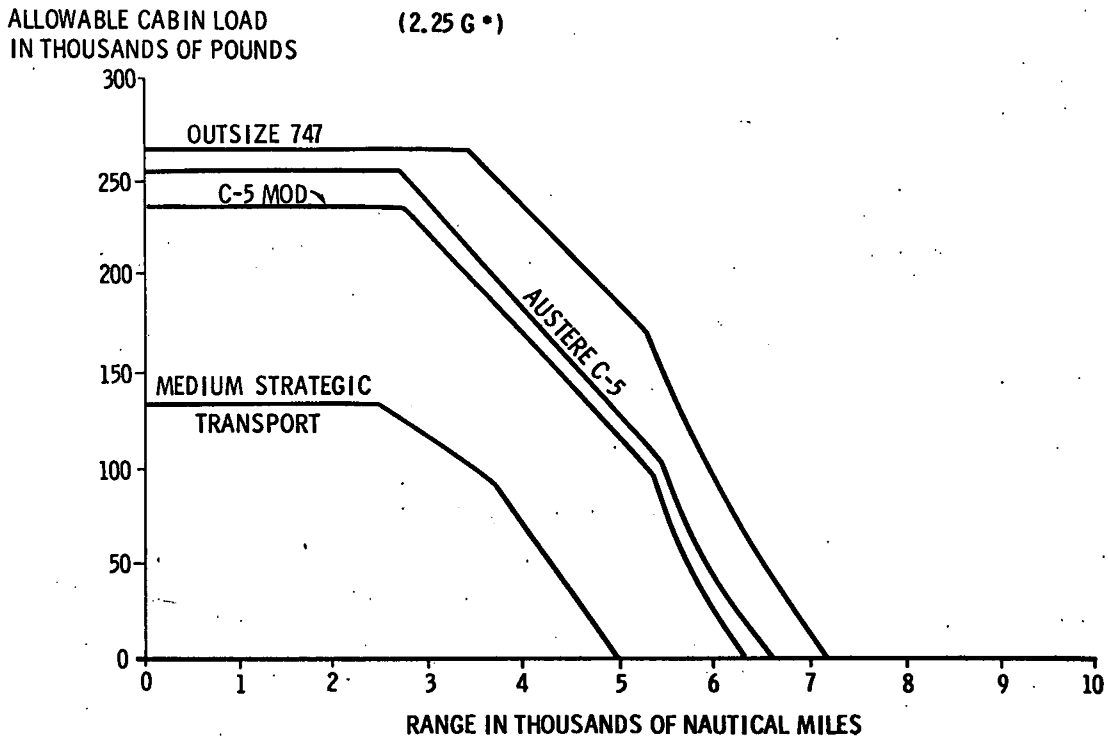
SLIDE 8 (CHARACTERISTICS OF THE C-5 WING MODIFIED AIRCRAFT AND OUTSIZE-CAPABLE ALTERNATIVES)

THIS CHART SHOWS THE PERFORMANCE CHARACTERISTICS OF THE ALTERNATIVES. THE C-5 AND 747 DERIVATIVES CAN CARRY TWO M-60 TANKS WHILE THE MEDIUM STRATEGIC TRANSPORT CAN CARRY ONE TANK. IN ADDITION, THESE AIRCRAFT COULD ALSO CARRY THE PROPOSED NEW TANKS FOR THE ARMY, THE XM-1 AND THE GERMAN MADE LEOPARD.

THE C-5s BOTH CARRY THREE DOZEN 463L PALLETS. THE 747 CARRIES 37 PALLETS ON THE MAIN CARGO DECK AND NINE ADDITIONAL PALLETS IN THE LOWER CARGO LOBE FOR A TOTAL OF 46. WHILE THE MEDIUM STRATEGIC TRANSPORT COULD CARRY 10 PALLETS.

ON THE NEXT SLIDE THE ALLOWABLE CABIN LOAD - RANGE ENVELOPES OF THE VARIOUS ALTERNATIVES WILL BE SHOWN.

UNREFUELED ALLOWABLE CABIN LOAD - RANGE ENVELOPES



SLIDE 9 (ALLOWABLE CABIN LOAD--RANGE ENVELOPES)

THIS SLIDE SHOWS THE UNREFUELED ACL--RANGE TRADEOFFS OF EACH ALTERNATIVE AIRCRAFT CONSIDERED. THE VERTICAL AXIS IS ALLOWABLE CABIN LOAD IN THOUSANDS OF POUNDS. THE HORIZONTAL AXIS IS RANGE IN NAUTICAL MILES. FOR REFERENCE, THE DISTANCE FROM GANDER TO MILDENHALL IS ABOUT 2,000 NAUTICAL MILES, AND THE DISTANCE FROM THE EASTERN US TO THE MIDEAST IS ABOUT 5,000 NAUTICAL MILES.

ADDRESSING THE ALTERNATIVES IN INCREASING ORDER OF CAPABILITY, THE MEDIUM STRATEGIC TRANSPORT HAS AN ACL WHICH IS A LITTLE OVER HALF THAT OF A MODIFIED C-5, WHILE THE 747 AND THE AUSTERE C-5 HAVE THE HIGHEST ACLs.

ALTHOUGH THESE CURVES REPRESENT UNREFUELED ACL-RANGE TRADE OFFS, EACH AIRCRAFT DOES HAVE THE CAPABILITY TO BE REFUELED IN FLIGHT. AS MENTIONED, EACH OF THESE AIRCRAFT COULD CARRY A TANK TO NATO. THEIR CAPABILITY TO TRANSPORT OTHER ITEMS IN THE NATO AIR DEPLOYMENT WILL BE SHOWN ON THE NEXT TWO CHARTS.

NUMBER OF ITEMS OF ARMY EQUIPMENT IN NATO AIR DEPLOYMENT*

ITEM	OUTSIZE	OVERSIZE	TOTAL
TANKS	432	198	630
APCs	206	1,526	1,732
REC VEH/ WRECKERS	387	38	425
ARTILLERY	240	531	771
TRUCKS/TRAILERS	1,040	16,704	17,744
HELICOPTERS	64	1,153	1,217
CONSTRUCTION EQUIP	250	301	551
JEEPS/TRAILERS	-	9,963	9,963
GRAND TOTAL	2,619	30,414	33,033

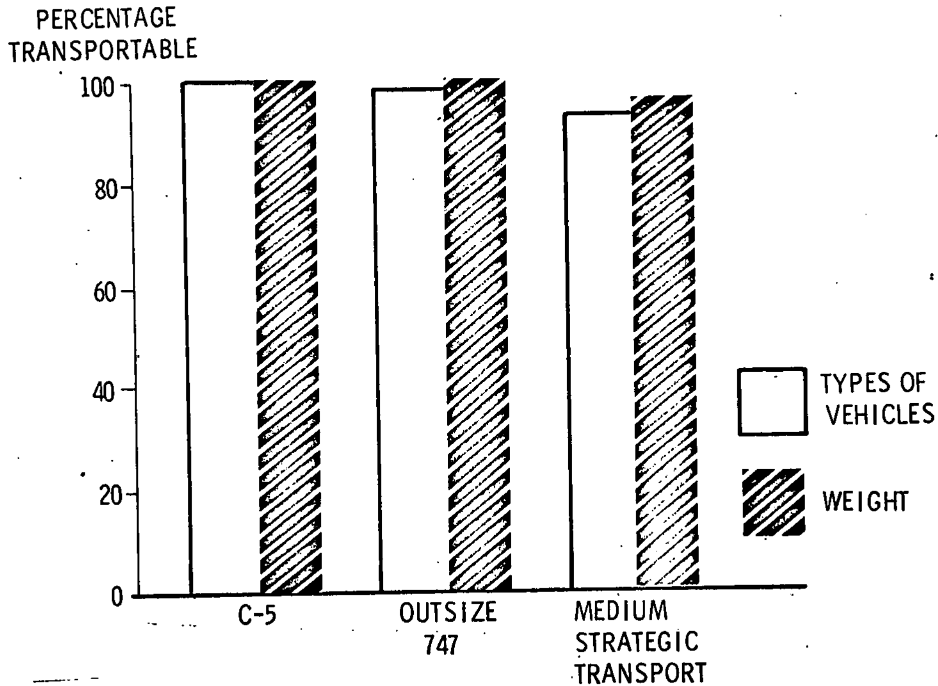
* BASED ON COMBAT FORCES PORTION OF AIR DEPLOYMENT IN JOINT AF/OSD AIRLIFT ENHANCEMENT STUDY.

SLIDE 10 (NUMBER OF ITEMS OF ARMY EQUIPMENT IN NATO AIR DEPLOYMENT)

THE NATO DEPLOYMENT EXAMINED WAS THE COMBAT FORCES PORTION OF THE NATO AIR DEPLOYMENT IN THE JOINT AIR FORCE/OSD STRATEGIC AIRLIFT ENHANCEMENT STUDY. IT CONSISTED OF FIVE DIVISIONS AND EIGHT BRIGADES PLUS 109 AIR FORCE SQUADRONS. THIS AMOUNTED TO 240 THOUSAND TONS OF EQUIPMENT, OF WHICH OVER 65 THOUSAND TONS WERE OUTSIZE EQUIPMENT.

SHOWN HERE ARE THE NUMBER OF ITEMS OF THE GENERAL TYPES OF ARMY EQUIPMENT IN THE DEPLOYMENT TO ILLUSTRATE THE MAGNITUDE OF THE TASK. THIS DEPLOYMENT IS BASED ON PROGRAM FORCES IN THE 1980s. IF PLANNED PREPOSITIONING OF EQUIPMENT, OR RECONSTITUTION OF POMCUS UNITS HAS NOT BEEN COMPLETED, AIRLIFT REQUIREMENTS COULD BE HIGHER.

COMPARISON OF CAPABILITIES OF ALTERNATIVE AIRCRAFT TO TRANSPORT OUTSIZE EQUIPMENT IN A DEPLOYMENT TO NATO



SLIDE 11

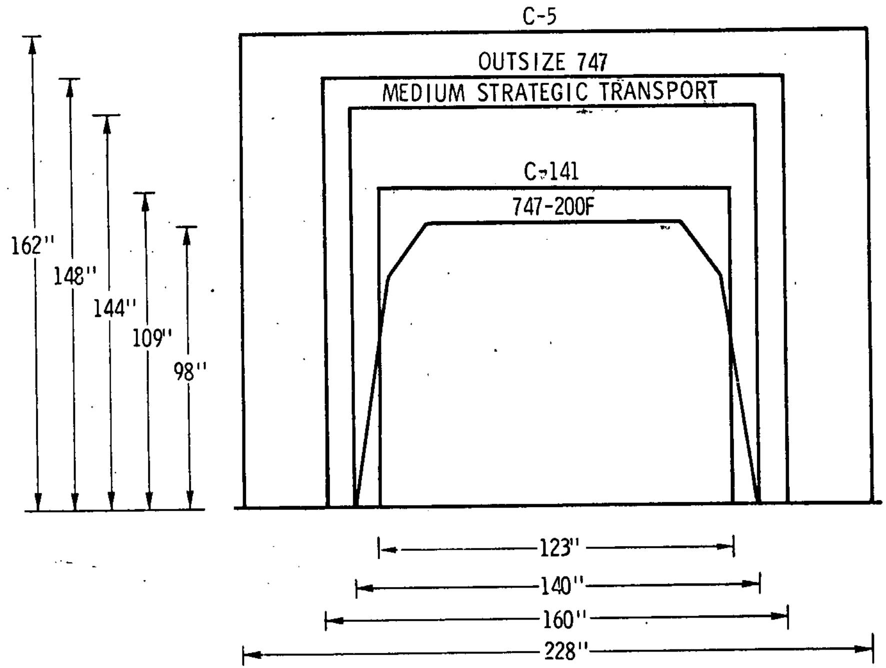
SLIDE 11 (COMPARISON OF CAPABILITIES OF ALTERNATIVE AIRCRAFT TO TRANSPORT OUTSIZE EQUIPMENT IN A DEPLOYMENT TO NATO)

THIS SLIDE COMPARES THE CAPABILITY OF THE C-5 AND EACH ALTERNATIVE TO CARRY THE OUTSIZE VEHICLES IN A NATO DEPLOYMENT IN THE 1980s.

THE CAPABILITY OF EACH AIRCRAFT IS DISPLAYED IN TERMS OF TYPES OF VEHICLES AND WEIGHTS. THE C-5 AND ITS DERIVATIVE CAN CARRY ALL THE EQUIPMENT IN THE DEPLOYMENT. NONE OF THE EQUIPMENT IS TOO HEAVY FOR THE OUTSIZE 747, BUT TWO TYPES OF EQUIPMENT, A CRANE AND A VAN, ARE TOO TALL TO FIT. THOSE ITEMS WOULD HAVE TO BE PREPOSITIONED OR DEPLOYED BY SURFACE. THE MEDIUM STRATEGIC TRANSPORT CAN CARRY ABOUT 93% OF THE TYPES AND ABOUT 96% OF THE WEIGHT OF VEHICLES.

THE REASON FOR THE DIFFERENCES IN CAPABILITY TO CARRY VARIOUS TYPES OF VEHICLES IS SHOWN ON THE NEXT SLIDE.

COMPARISON OF C-5, OUTSIZE 747, MEDIUM STRATEGIC TRANSPORT, C-141, AND 747-200F CARGO DOOR SIZES

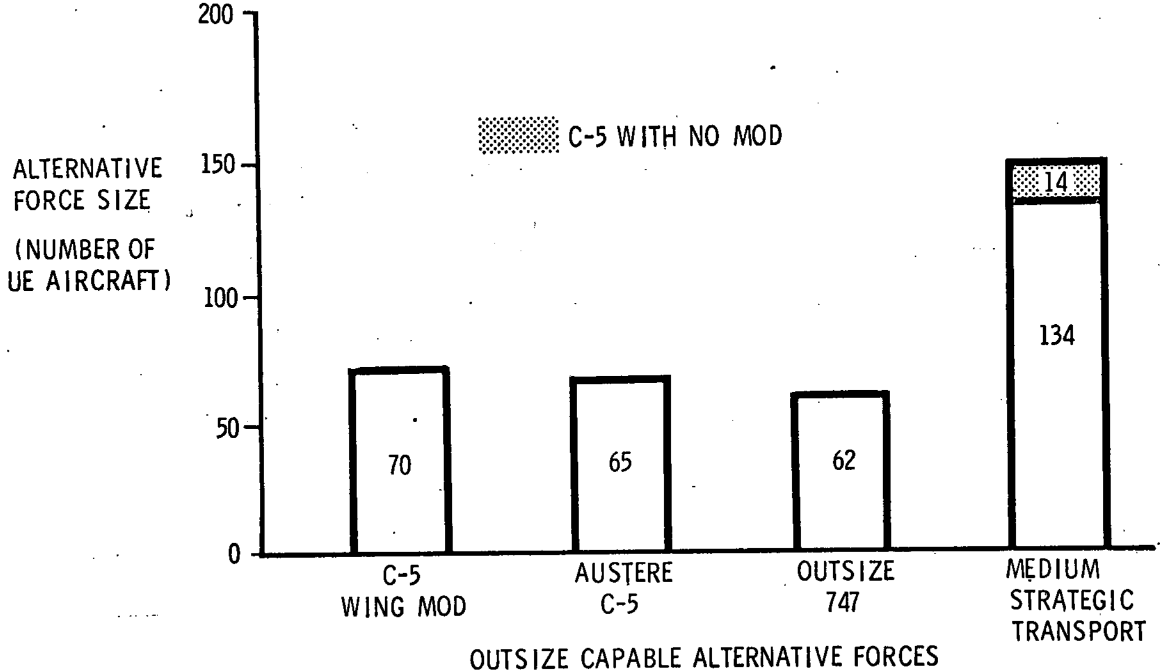


SLIDE 12 (COMPARISON OF C-5, OUTSIZE 747, MEDIUM STRATEGIC TRANSPORT, C-141, AND 747-200F CARGO DOOR SIZES)

THIS CHART SHOWS THE RELATIVE DOOR SIZES OF EACH ALTERNATIVE. AS CAN BE SEEN, THE C-5 CARGO DOOR IS THE LARGEST OF ANY AIRCRAFT INCLUDING THE OUTSIZE 747, AND THE MEDIUM STRATEGIC TRANSPORT.

FOR COMPARISON, THE C-141 AND THE 747-200F COMMERCIAL FREIGHTER ARE SHOWN HERE ALSO. BOTH OF THESE ARE TOO SMALL FOR OUTSIZE CARGO AND ARE LIMITED TO ONLY OVERSIZE CARGO. IN ADDITION, THE DOOR SIZE OF THE 747 ADVANCED TANKER CARGO AIRCRAFT (ATCA) CANDIDATE IS APPROXIMATELY THE SAME AS THE 747-200F, RESTRICTING THAT AIRCRAFT TO OVERSIZE CARGO AS WELL.

ALTERNATIVE FORCES WITH OUTSIZE CAPABILITY EQUAL TO THAT OF A 70 UE C-5 FORCE WITH WING MODIFICATION



SLIDE 13 (ALTERNATIVE FORCES WITH OUTSIZE-CAPABILITY EQUAL TO THAT OF A 70 UE C-5 FORCE WITH WING MODIFICATION)

THIS SLIDE SHOWS FORCE ALTERNATIVES OFFERING OUTSIZE-CAPABILITIES EQUAL TO THE 70 UE C-5 WING MOD FORCE. THE VERTICAL AXIS IS THE NUMBER OF UE AIRCRAFT. EACH BAR REPRESENTS ONE OF THE FORCES. AS A BASELINE THE C-5 WING MOD FORCE IS SHOWN ON THE LEFT. BECAUSE OF THE INCREASE IN ACL WITH THE AUSTERE C-5, WE COULD OBTAIN THE SAME CAPABILITY AS THE BASELINE FORCE WITH ONLY 65 UE AIRCRAFT. WITH THE EVEN LARGER ACLs OF THE OUTSIZE 747, THE FORCE SIZE COULD BE REDUCED STILL FURTHER.

BECAUSE THE DOOR SIZE OF THE MEDIUM STRATEGIC TRANSPORT IS SOMEWHAT SMALLER THAN THE C-5 AND OUTSIZE 747, IT COULD NOT CARRY ALL THE OUTSIZE EQUIPMENT IN THE DEPLOYMENT. TO COMPENSATE FOR THIS, 14 UE C-5 EQUIVALENTS WOULD BE NEEDED TO PROVIDE EQUAL CAPABILITY, AS SHOWN ON THE CHART.

THESE FORCE SIZES ARE BASED ON AN ASSUMPTION THAT EACH ALTERNATIVE FORCE CAN ATTAIN THE SAME DESIRED SURGE UTILIZATION RATE, AND THAT POTENTIAL DIFFERENCES IN LOADING, MAINTENANCE, AND OFFLOADING REQUIREMENTS CAN ALL BE ACCOMMODATED WITHIN PLANNED GROUND TIME.

UNREFUELED UE FORCES REQUIRED TO PROVIDE EQUAL LIFT CAPABILITY OF 70 C-5 AIRCRAFT OPERATING AT VARIOUS RANGES

	(NATO/NEA) 2,500 NM	(MID-EAST W/LAJES) 3,500 NM	(MID-EAST W/O LAJES) 5,500 NM
C-5 WING MOD	70	70	70
AUSTERE C-5	65	65	65
OUTSIZE 747	62	54	37
MEDIUM STRATEGIC TRANSPORT (+14 C-5)	134	153	-

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SLIDE 14 (UNREFUELED UE FORCES REQUIRED TO PROVIDE EQUAL LIFT CAPABILITY OF 70 C-5 AIRCRAFT OPERATING AT VARIOUS RANGES)

THIS CHART REFLECTS THE VARIOUS FORCE SIZES WHICH PROVIDE THE SAME CAPABILITY AT VARIOUS RANGES WITHOUT REFUELING. THE BASIC FORCE SIZES PREVIOUSLY SHOWN ARE COMPARED IN THE FIRST COLUMN. ALL AIRCRAFT CAN TRANSPORT THEIR FULL ALLOWABLE CABIN LOAD AT LEAST 2,500 MILES, REPRESENTATIVE OF A DEPLOYMENT TO NATO OR NORTHEAST ASIA.

AT THE 3,500 MILE DISTANCE IN COLUMN 2, TYPIFYING A DEPLOYMENT TO THE MIDDLE EAST USING LAJES, ALL OF THE AIRCRAFT EXCEPT THE OUTSIZE 747s ARE TRADING SIGNIFICANT AMOUNTS OF ACL FOR RANGE. AS A RESULT, IT NOW TAKES FEWER OUTSIZE 747s TO PROVIDE CAPABILITY EQUIVALENT TO THE 70 UE C-5 FORCE AND SLIGHTLY MORE MEDIUM STRATEGIC TRANSPORTS.

AT THE 5,500-MILE RANGE, THE DISTANCE TO THE MIDEAST WITHOUT LAJES, ALL AIRCRAFT ARE TRADING ACL FOR RANGE. THE OUTSIZE 747s ARE BECOMING RELATIVELY MORE CAPABLE THAN THE C-5s, AND THUS THE NUMBER OF 747s REQUIRED TO PROVIDE EQUAL CAPABILITY DECREASES FURTHER. 5,500 MILES EXCEEDS THE RANGE OF THE MEDIUM STRATEGIC TRANSPORT, AND IT IS THEREFORE NOT COMPARED.

APPROACH TO COST-EFFECTIVENESS COMPARISONS

- DETERMINE AND COMPARE THE LIFE-CYCLE COSTS OF EQUAL CAPABILITY ALTERNATIVES TO THE C-5 WING MODIFIED FORCE CAPABLE OF PERFORMING A NATO DEPLOYMENT IN THE 1980s.

SLIDE 15 (<u>APPROACH TO COST-EFFECTIVENESS COMPARISONS</u>)

THE APPROACH TO COST-EFFECTIVENESS WAS AS SHOWN HERE.

C-5 WING MODIFICATION ESTIMATES

(FY 1976 MILLIONS OF $)

	SPO	ICA
RDT&E	$ 151	$ 120
PROCUREMENT & INSTALLATION*	693	724
ACQUISITION	$ 844	$ 844

*NOTE: A PROCUREMENT AND INSTALLATION ESTIMATE OF $792 MILLION (FY 76) HAS BEEN MADE BY THE OSD/CAIG.

SLIDE 16 (C-5 WING MODIFICATION ESTIMATES)

THREE COST ESTIMATES FOR THE C-5 WING MODIFICATION HAVE BEEN PUBLISHED--ONE BY THE C-5 SYSTEM PROGRAM OFFICE (SPO), ONE IS AN INDEPENDENT COST ANALYSIS (ICA) DONE FOR THE AIR FORCE BY THE AFLC AND ASD COMPTROLLER OFFICES, AND THE THIRD BY THE SECRETARY OF DEFENSE COST ANALYSIS IMPROVEMENT GROUP (CAIG). THOSE ESTIMATES ARE SHOWN HERE IN MILLIONS OF FY76 DOLLARS. THE SPO AND ICA ESTIMATES INCLUDE RDT&E AS WELL AS PROCUREMENT AND INSTALLATION: HOWEVER, THE CAIG ESTIMATE DID NOT INCLUDE RDT&E. THE AIR FORCE ICA WAS USED IN THIS ANALYSIS AS THE MOST RECENT TOTAL ESTIMATE OF WING MOD COSTS.

COST METHODOLOGY

- DEVELOPMENT COSTS
- PROCUREMENT COSTS
- OPERATING AND SUPPORT COSTS

- LIFE CYCLE COSTS

SLIDE 17 (COST METHODOLOGY)

•COSTS WERE COMPUTED IN THREE BASIC ELEMENTS, DEVELOPMENT, ACQUISITION, AND OPERATING AND SUPPORT (O&S), THEN MERGED INTO A LIFE-CYCLE COST COMPARISON.

DEVELOPMENT AND PRODUCTION SCHEDULE

FY	76	77	78	79	80	81	82
	DEVELOPMENT					PRODUCTION	
AUSTERE C-5	1 BAILED AIRCRAFT					1 PER MONTH	
OUTSIZE 747	1 DEVELOPMENT AIRCRAFT					1 PER MONTH	
MEDIUM STRATEGIC TRANSPORT	3 DEVELOPMENT AIRCRAFT					2 PER MONTH	

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SLIDE 18 (DEVELOPMENT AND PRODUCTION SCHEDULE)

THIS SLIDE DEPICTS THE DEVELOPMENT AND PRODUCTION SCHEDULE WE ASSUMED FOR EACH AIRCRAFT WITH A DECISION TO PROCEED IN FY76.

THE C-5 DERIVATIVE WOULD USE A BAILED AIRCRAFT FROM THE PRESENT FORCE, CONFIGURED APPROPRIATELY FOR TESTING. IN ADDITION, A WING FATIGUE ARTICLE WOULD BE NEEDED. SINCE THIS ARTICLE WOULD BE A REPLACEMENT FOR THE PRESENT C-5 WING AND THE WING-MODIFICATION, A NEWLY DESIGNED WING WOULD BE NECESSARY.

IN THE CASE OF THE OUTSIZE 747, WE WOULD HAVE ONE DEVELOPMENT AIRCRAFT PRODUCED IN THE APPROPRIATE CONFIGURATION. AGAIN, A FATIGUE ARTICLE WOULD BE REQUIRED; IN THIS CASE A FUSELAGE, SINCE THAT ITEM WOULD HAVE TO BE CHANGED MOST IN THIS AIRCRAFT. THE MEDIUM STRATEGIC TRANSPORT WOULD HAVE THREE DEVELOPMENT AIRCRAFT SINCE THIS IS A COMPLETELY NEW AIRCRAFT.

APPROACH TO DETERMINATION OF ALTERNATIVE AIRCRAFT COSTS

ACQUISITION COSTS

- AIRFRAME -- RAND MODEL ADJUSTED TO ACCOUNT FOR:
  - EFFECT OF PRODUCTION LINE "GAP" FOR C-5
- ENGINES
  - RAND NELSON TIMSON MODEL TO PREDICT NEW ENGINE COSTS
  - AUSTERE C-5 ENGINES ASSUMED TO BE FROM PRESENT FORCE
- AVIONICS
  - 747 EQUIPMENT CONVERTED OR DELETED FROM COMMERCIAL AIRCRAFT AS REQUIRED
  - AUSTERE C-5 AVIONICS ASSUMED TO BE FROM PRESENT FORCE
  - MEDIUM STRATEGIC TRANSPORT AVIONICS FROM SPO
- SUPPORT AND SPARES
  - NORMAL FACTORS FOR NEW AIRCRAFT
  - SUPPORT AND SPARES MINIMAL FOR AUSTERE C-5

O&S COST -- COMPUTED FROM 1976 THROUGH 4/2000

- AFM 173-10 METHODOLOGY
  - C-5 STANDARD FACTORS
  - OUTSIZE 747 AND MEDIUM STRATEGIC TRANSPORT -- PARAMETRIC FACTORS

SLIDE 19 (APPROACH TO DETERMINATION OF ALTERNATIVE AIRCRAFT COSTS)

ACQUISITION COSTING WAS DIVIDED INTO FOUR AREAS: AIRFRAME, ENGINES, AVIONICS, AND SUPPORT AND SPARES. THE RAND MODEL WAS USED FOR AIRFRAME COSTS WITH ADJUSTMENTS FOR LINES CURRENTLY OPEN OR HAVING TO BE STARTED UP AGAIN.

NEW ENGINE COSTS WERE ESTIMATED FOR THE OUTSIZE 747 AND MST, WHILE ENGINES FROM THE CURRENT FORCE WERE ASSUMED AVAILABLE FOR THE AUSTERE C-5.

NORMAL SUPPORT AND SPARES WERE ASSUMED FOR THE OUTSIZE 747 AND MST, BUT MINIMAL FOR THE AUSTERE C-5 WHICH COULD USE IN-BEING ASSETS.

FOR COMPUTING O&S COSTS, THE FORCES WERE POSTURED FOR A 12.5-HOUR SURGE CAPABILITY AS SPECIFIED FOR THE C-5 IN USAF DECISION LETTERS D 75-2 AND 75-014. THE UNMODIFIED C-5s WERE ASSUMED TO HAVE A CREW RATIO OF 3.25 PER UE WITH A PEACETIME UTILIZATION RATE OF 1.5 HOURS PER DAY IN LINE WITH CURRENT PLANNING TO CONSERVE WING LIFE. A 4.0 CREW RATIO WITH A PEACETIME UTE RATE OF 2.16 HOURS PER DAY WAS ASSUMED FOR THE MODIFIED C-5 AND THE ALTERNATIVES. STANDARD FACTORS WERE USED FOR C-5 WING MODIFIED COSTS, WHILE PARAMETRIC ESTIMATES WERE USED FOR THE AUSTERE C-5 OUTSIZE 747 AND THE CONCEPTUAL MEDIUM STRATEGIC TRANSPORT, SINCE THESE AIRCRAFT DO NOT PRESENTLY EXIST, AND ACTUAL DATA IS NOT AVAILABLE.

ACQUISITION COST ESTIMATE OF C-5 WING MODIFICATION AND ALTERNATIVES

(FY 76 BILLIONS OF DOLLARS)

TYPE AIRCRAFT	C-5 WING MOD	AUSTERE C-5	OUTSIZE 747	MEDIUM STRATEGIC TRANSPORT
NUMBER OF ACFT	77	77	73	157
MISSION UE	70	65	62	134
FLYAWAY	$ .7	$ 3.8	$ 3.1	$3.1
SUP/SPARES	--	.1	.7	.6
PROCUREMENT	$ .7	$ 3.9	$ 3.8	$3.7
RDT&E	.1	.2	.3	.8
ACQUISITION	$ .8	$ 4.1	$ 4.1	$ 4.5

SLIDE 20 (ACQUISITION COSTS ESTIMATE OF C-5 WING MODIFICATION AND ALTERNATIVES)

ACQUISITION COSTS, WHICH INCLUDE THE BASIC FLYAWAY COST OF THE AIRCRAFT, SUPPORT AND SPARES, AS WELL AS RDT&E ARE SHOWN ON THIS SLIDE. ON THE BASIS OF ONLY ACQUISITION COSTS, THE C-5 WING MOD IS THE LEAST COSTLY ALTERNATIVE BY A SIGNIFICANT MARGIN; HOWEVER, THE RELATIVE COMPARISON CHANGES SOMEWHAT WHEN LIFE-CYCLE COSTS ARE CONSIDERED.

LIFE CYCLE COST COMPARISONS OF THE C-5 WING MODIFIED FORCE AND ALTERNATIVES

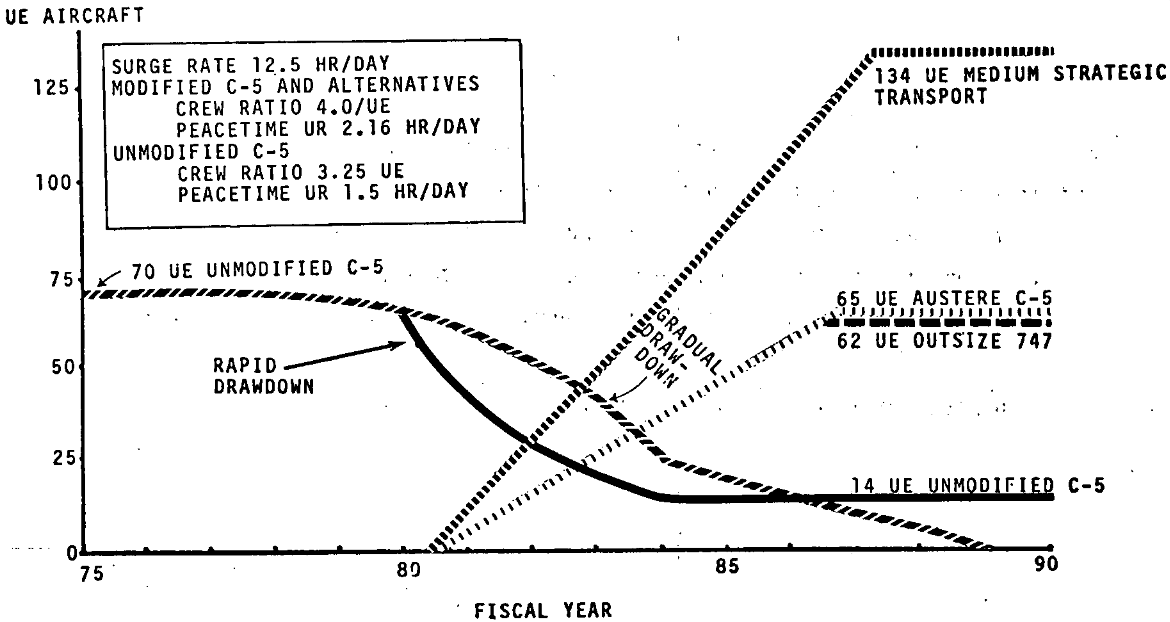
(FY 76 BILLIONS OF DOLLARS)

TYPE AIRCRAFT	C-5 WING MOD	AUSTERE C-5	OUTSIZE 747	MEDIUM STRATEGIC TRANSPORT
NUMBER OF AIRCRAFT	77	77	73	157
ACQUISITION	$ .8	$4.1	$4.1	$4.5
O&S	8.3	8.1	8.1	8.3
LIFE-CYCLE (25 YR)	$9.1	$12.2	$12.2	$12.8
DISCOUNTED 10% ANNUALLY	($3.3)	($5.2)	($5.2)	($5.5)

SLIDE 21 (LIFE-CYCLE COST COMPARISONS OF THE C-5 WING MODIFIED FORCE AND ALTERNATIVES)

LIFE-CYCLE COSTS WHICH INCLUDE ACQUISITION PLUS O&S ARE PORTRAYED HERE. THE RELATIVE DIFFERENCES ARE MUCH LESS DRAMATIC THAN A SIMPLE COMPARISON OF ACQUISITION COSTS. STILL, THE C-5 WING MOD IS ABOUT THREE BILLION DOLLARS LESS COSTLY THAN THE OUTSIZE 747 AND THE AUSTERE C-5. THE FIGURES IN PARENTHESES REFLECT LIFE-CYCLE COSTS DISCOUNTED AT AN ANNUAL RATE OF TEN PERCENT.

TIME PHASING OF ACQUISITION OF ALTERNATIVE AIRCAFT AND C-5 SERVICE LIFE EXHAUSTION



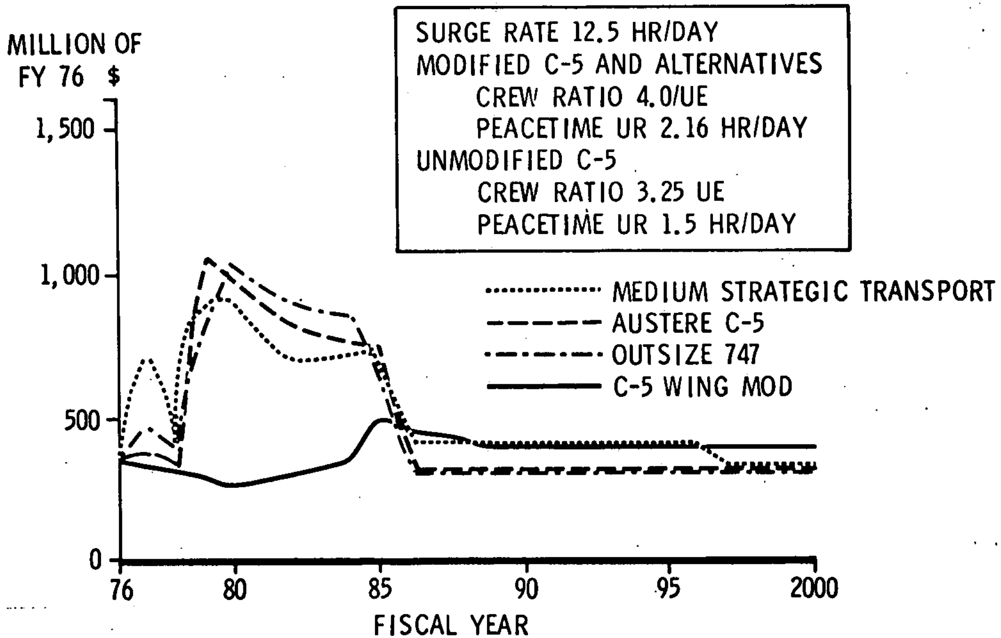
SLIDE 22L (TIME PHASING OF ACQUISITION OF ALTERNATIVE AIRCRAFT AND C-5 SERVICE LIFE EXHAUSTION)

THIS CHART REFLECTS THE TIME PHASING ASSUMED FOR ACQUISITION OF NEW AIRCRAFT AND SERVICE LIFE EXHAUSTION FOR THE UNMODIFIED C-5. AS PREVIOUSLY MENTIONED, ALL AIRCRAFT ARE ASSUMED TO BE MANNED FOR A 12.5-HOUR WARTIME SURGE CAPABILITY, WITH A 4.0 CREW RATIO AND A 2.16-HOUR PEACETIME UTILIZATION RATE FOR THE MODIFIED C-5 AND ALTERNATIVES, AND A SLIGHT LOWER CREW RATIO AND UTE RATE FOR THE UNMODIFIED C-5. WITH THIS POSTURE, THE C-5 FORCE WOULD HAVE A GRADUAL DRAW DOWN WITH WEAROUT OF THE LAST AIRCRAFT IN 1989. THE GRADUAL C-5 DRAW DOWN SCHEDULE MESHES WITH THE GRADUAL ACQUISITION OF AUSTERE C-5s OR OUTSIZE 747s. THE SERVICE LIFE OF MOST OF THE C-5s BEING EXHAUSTED BY THE TIME THE LAST NEWLY ACQUIRED AIRCRAFT IS INTRODUCED INTO THE INVENTORY.

WITH THE MEDIUM STRATEGIC TRANSPORT, THE UNMODIFIED C-5 FORCE IS DRAWN DOWN MORE RAPIDLY SO THAT THE 14 UE NEEDED TO COMPLEMENT THIS FORCE WILL BE AVAILABLE AS LONG AS POSSIBLE BEFORE SERVICE LIFE EXHAUSTION.

LIFE-CYCLE COST FUNDING PROFILES FOR C-5 WING MODIFICATION AND ALTERNATIVES

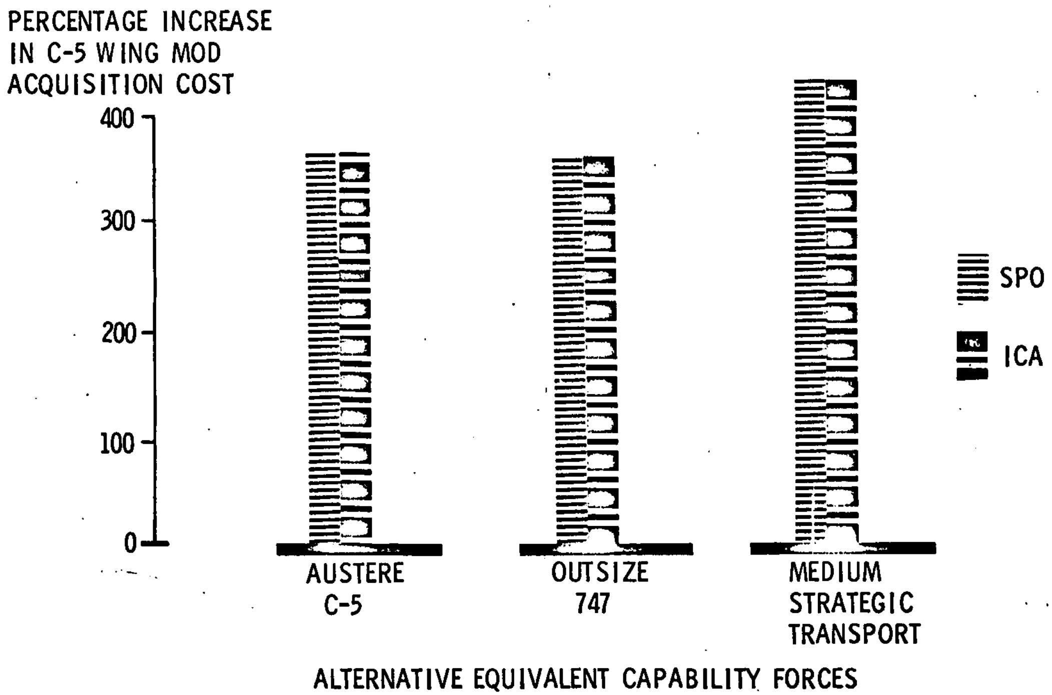
(FY 76 MILLIONS OF DOLLARS)



SLIDE 22R (LIFE-CYCLE COST FUNDING PROFILES OF C-5 WING MODIFICATION AND ALTERNATIVES)

THIS CHART SHOWS THE LIFE-CYCLE COST FUNDING PROFILES OF THE C-5 WING MODIFICATION AND ALTERNATIVES. THE PATTERN FOR ALL THREE AIRCRAFT IS THE SAME, A RELATIVELY SMALL INCREASE FOR R&D FUNDING, FOLLOWED BY A LARGER INCREASE DURING THE PROCUREMENT PHASE, AND A LEVEL OFF AFTERWARDS REFLECTING THE STEADY STATE OPERATING COSTS OF THE ALTERNATIVES.

COST INDIFFERENCE COMPARISON OF ALTERNATIVES TO VARIATION IN ESTIMATES OF C-5 WING MOD



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SLIDE 23 (COST INDIFFERENCE COMPARISON OF ALTERNATIVES TO VARIATION IN ESTIMATES OF C-5 WING MOD)

THIS CHART INDICATES THE PERCENTAGE BY WHICH THE ACQUISITION COST OF THE C-5 WING MODIFICATION WOULD HAVE TO INCREASE TO MAKE THE LIFE-CYCLE COST OF THE WING MODIFIED C-5 FORCE EQUAL THE LIFE-CYCLE COSTS OF THE ALTERNATIVES.

THE CLOSEST ALTERNATIVES, THE OUTSIZE 747 AND THE AUSTERE C-5, WOULD NOT BE COST-EFFECTIVE SUBSTITUTES UNTIL THE ESTIMATED COST OF THE MODIFICATION INCREASED MORE THAN 300%.

OBSERVATIONS

- C-5 WING MOD IS MORE COST-EFFECTIVE THAN ANY OUTSIZE ALTERNATIVE CONSIDERED
    - AND WOULD BE AT ANY COST WITHIN MORE THAN 300% OF THE CURRENT ESTIMATES
- THE ALTERNATIVES IN ORDER OF COST-EFFECTIVENESS APPEAR TO BE:
    - OUTSIZE 747/AUSTERE C-5
    - MEDIUM STRATEGIC TRANSPORT

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SLIDE 24 (OBSERVATIONS)

THESE ARE THE OBSERVATIONS OF THE STUDY.

Air Force

Headquarters, USAF
Asst. Chief of Staff

Studies & Analysis

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

747 AIRCRAFT

As An Alternative To The

C-5 WING MOD

Briefer: Maj Richard W SCOTT

THIS DOCUMENT CONTAINS INFORMATION THAT IS NO LONGER CURRENT

THIS PRESENTATION IS UNCLASSIFIED

19 MAR 1976

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SLIDE 1 (747 AIRCRAFT AS AN ALTERNATIVE TO THE C-5 WING MOD)

THIS BRIEFING REPORTS THE RESULTS OF AN ANALYSIS COMPARING THE 747 AS AN ALTERNATIVE TO THE C-5 WING MOD.

PURPOSE

THE PURPOSE OF THIS STUDY IS TO EXAMINE THE COSTS, RISKS, AND BENEFITS OF DEFERRING THE C-5 WING MODIFICATION BY PURCHASING BOEING 747 COMMERCIAL FREIGHTERS WITH A SUM EQUAL TO THE COST OF THE C-5 WING MOD.

SLIDE 2 (PURPOSE)

THE PURPOSE OF THE ANALYSIS IS AS SHOWN HERE.

OVERVIEW OF BRIEFING

- BACKGROUND
- DESCRIPTION OF ALTERNATIVES
- COMPARISONS OF ALTERNATIVES
  - WEAROUT DATES
  - CAPABILITY
  - COST
  - RISK
- OBSERVATIONS

SLIDE 3 (OVERVIEW OF BRIEFING)

IN THIS BRIEFING, I WILL FIRST BRIEFLY COVER THE BACKGROUND OF THE C-5A WING PROBLEM. I WILL THEN SHOW COMPARISONS OF THE ALTERNATIVES CONSIDERED, INCLUDING ASSOCIATED WEAROUT DATES, CAPABILITY, COST, AND RISK, AND WILL CONCLUDE WITH OBSERVATIONS.

BACKGROUND

- C-5 SERVICE LIFE GOAL -- 30,000 HOURS
  - CRACKS DISCOVERED IN WINGS OF FLIGHT TEST AIRCRAFT (JANUARY 1970)
- AF SCIENTIFIC ADVISORY BOARD RECOMMENDED TEST OF NEW FATIGUE ARTICLE
  - GENERAL CRACKING IN NEW TEST ARTICLE AT 15,000 HOURS (JUNE 72)
- INDEPENDENT STRUCTURAL REVIEW TEAM FORMED (DECEMBER 1971)
  - WING LIFE COULD BE EXTENDED BY USAGE CHANGE OR MODIFICATION
  - DEVELOPED OPTIONS TO EXTEND WING LIFE INCLUDING OPTION H MOD
- SECRETARY OF AIR FORCE SELECTED MAJOR MOD AS PERMANENT MEASURE TO EXTEND WING LIFE (MARCH 1973)
- AFSC ASD DIVISION ADVISORY GROUP CONVENED (JUNE 1974)
  - RECOMMENDED IMPLEMENTATION OF MODIFICATION BY 8000 HOURS
- CONTRACT FOR C-5 MOD DESIGN SIGNED (DECEMBER 1975)

SLIDE 4 (BACKGROUND)

AS YOU MAY KNOW, THE ORIGINAL SERVICE LIFE GOAL FOR THE C-5 WAS 30,000 HOURS. HOWEVER, CRACKS WERE DISCOVERED IN THE FATIGUE ARTICLE AND THE FLIGHT TEST AIRCRAFT EARLY IN THE PROGRAM. AS A RESULT, THE SCIENTIFIC ADVISORY BOARD RECOMMENDED TESTING A NEW ARTICLE, AND IT ALSO CRACKED.

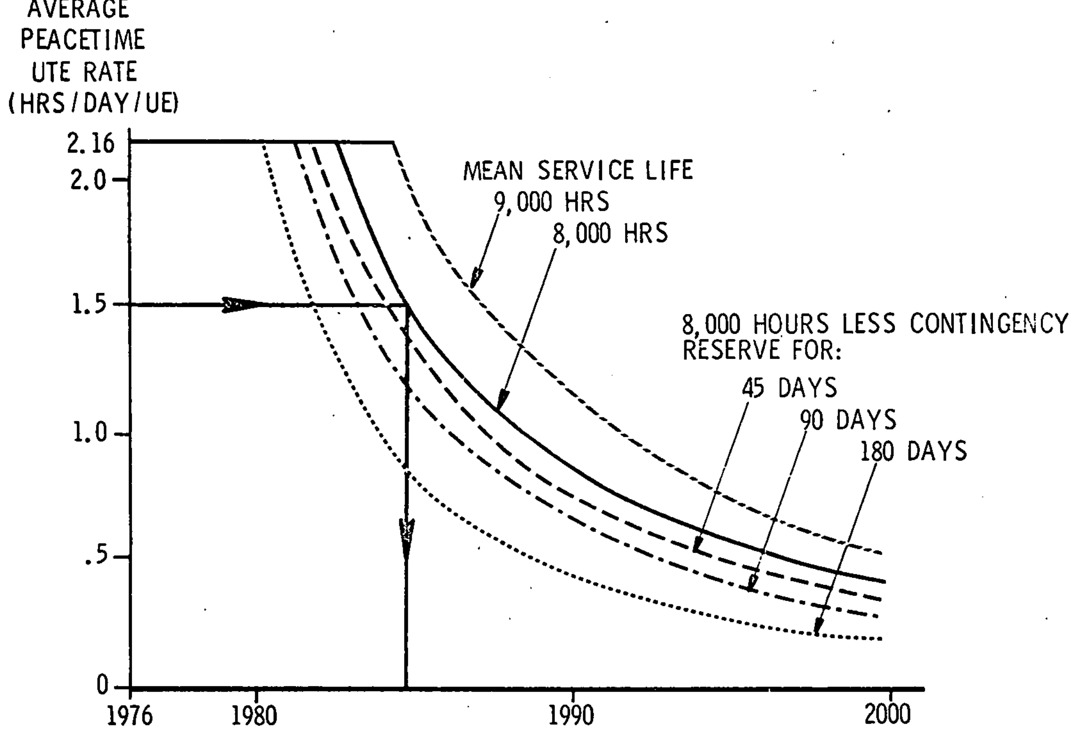
FOLLOWING THAT, AN INDEPENDENT STRUCTURAL REVIEW TEAM RECOMMENDED A NUMBER OF OPTIONS TO EXTEND SERVICE LIFE, ONE OF WHICH WAS WING MODIFICATION.

IN MARCH 1973 THE SECRETARY OF THE AIR FORCE SELECTED THE OPTION H WING MODIFICATION AS THE MEANS BY WHICH SERVICE LIFE OF THE AIRCRAFT WOULD BE EXTENDED.

THE ASD ADVISORY GROUP RECOMMENDED IMPLEMENTATION OF THE MOD BY 8,000 HOURS, AND THE DESIGN CONTRACT WAS SIGNED IN DECEMBER 1975.

THE IMPACT OF AN 8,000-HOUR SERVICE LIFE LIMITATION ON PEACETIME OPERATIONS WILL BE SHOWN ON THE NEXT SLIDE.

C-5 FORCE SERVICE LIFE PROJECTIONS

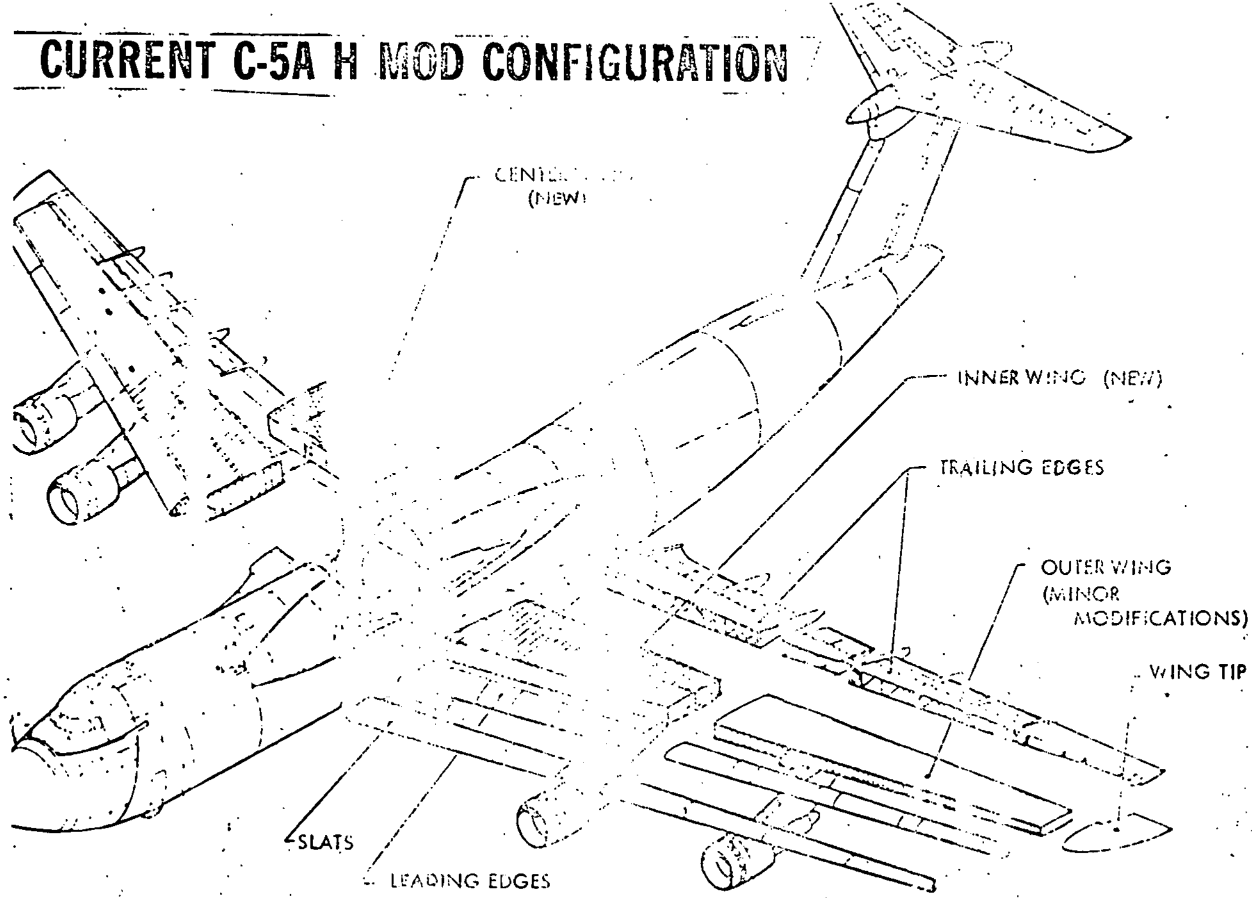


SLIDE 5 (C-5 SERVICE LIFE PROJECTIONS)

THIS CHART DESCRIBES THE EFFECT OF DIFFERING PEACETIME UTILIZATION RATES ON THE PROJECTED C-5 WEAROUT DATE. AVERAGE DAILY UTILIZATION RATE PER UNIT-EQUIPPED AIRCRAFT IS SHOWN ON THE VERTICAL AXIS, AND WEAROUT DATE ON THE HORIZONTAL AXIS. THE AVERAGE SERVICE LIFE REMAINING IS PRESENTLY ESTIMATED BY THE SPO AT 8,000 HOURS AS SHOWN BY THE SOLID CURVED LINE. AT 2.16 HOURS PER DAY, THE MAC MINIMUM UTE RATE FOR A 4.0 CREW RATIO (2.25 ACTIVE/ 1.75 RESERVE), the 8,000-HOUR SERVICE LIFE WEAROUT OCCURS IN 1982. AT A LOWER UTE RATE, SUCH AS THE 1.5 HOURS PER DAY SHOWN ON THE CHART, THE SERVICE LIFE WOULD EXTEND TO THE END OF 1984. HOWEVER, IF A DEPLOYMENT RESERVE WERE DEDUCTED TO ALLOW FOR A NATO CONFLICT, AS SHOWN BY THE DASHED LINE, THE USEABLE SERVICE LIFE WOULD BE EXHAUSTED EARLIER, DEPENDING ON HOW MUCH RESERVE WAS DESIRED (45 DAYS/39,375 HOURS; 90 DAYS/70,875 HOURS; 180 DAYS/133,875 HOURS). AS SHOWN BY THIS CHART, LARGE EXTENSIONS IN SERVICE LIFE WEAROUT DATE WOULD REQUIRE A CONSIDERABLE REDUCTION IN THE PEACETIME UTILIZATION RATE.

THE NEXT CHART SHOWS A DIAGRAM OF THE PROPOSED WING MODIFICATION.

CURRENT C-5A H MOD CONFIGURATION

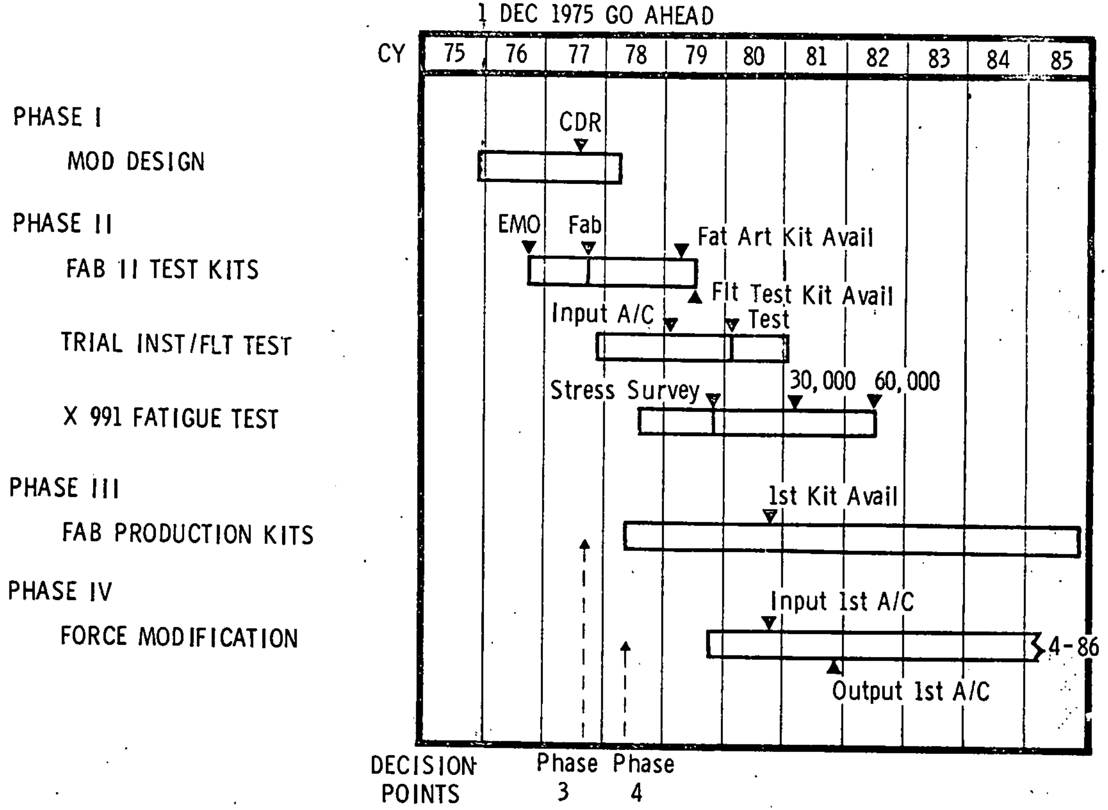


SLIDE 6 (CURRENT "H" MOD CONFIGURATION)

THIS SHOWS THE PROPOSED C-5 WING MODIFICATION WHICH INVOLVES REPLACING THREE MAJOR PIECES OF THE WING--THE CENTER AND TWO INNER SECTIONS-- AND A MODIFICATION TO THE OUTER SECTIONS OF THE WING.

THE BASIC MODIFICATION SCHEDULE, AS SHOWN ON THE NEXT SLIDE, CALLS FOR FORCE MODIFICATION BEGINNING IN 1980.

PROPOSED H MOD SCHEDULE



SLIDE 7 (PROPOSED "H" MOD SCHEDULE)

THIS CHART SHOWS THE CURRENT BASIC "H" MOD SCHEDULE. THERE ARE FOUR MAIN PHASES. PHASE ONE IS THE MODIFICATION DESIGN. PHASE TWO INVOLVES BUILDING TWO TEST KITS AND CONDUCTING SUBSEQUENT FLIGHT AND FATIGUE TESTING WITH THEM. THE THIRD AND FOURTH PHASES INCLUDE FABRICATION AND INSTALLATION OF THE PRODUCTION KITS.

FOUR VARIATIONS TO THE BASIC SCHEDULE ARE ALSO UNDER CONSIDERATION. IN THOSE VARIATIONS THE PRODUCTION AND INSTALLATION PHASES ARE DELAYED BY VARYING AMOUNTS, THE LATEST OF WHICH CALLS FOR MODIFICATION OF THE FIRST PRODUCTION AIRCRAFT IN 1985.

COST ESTIMATES ARE NEARLY THE SAME FOR ALL PROPOSED SCHEDULES IN CONSTANT YEAR DOLLARS; HOWEVER, INFLATION IMPACTS LATER SCHEDULES IN VARYING AMOUNTS.

ALTERNATIVES AND COSTS

(FY 76 BILLIONS OF DOLLARS)

(AF ESTIMATES)

	R & D	PROCUREMENT	TOTAL
• MODIFY 77 C-5A AIRCRAFT	$.12	$.72	$.84
• PURCHASE 19 747-200F COMMERCIAL FREIGHTER AIRCRAFT	0	$.84	$.84
• PURCHASE 17 747-200Fs AND 8 C-5A SIMULATORS	0	$.84	$.84

NOTE:

AF(ICA/SPO) WING MOD ESTIMATE $.84 BILLION (FY 76); $1.09-1.26 (THEN YEAR $).
OSD(CAIG) ESTIMATE $.99 BILLION (FY 76 $); $1.34 BILLION (THEN YEAR $).

SLIDE 8 (ALTERNATIVES AND COSTS)

THIS CHART SHOWS THE ALTERNATIVES THAT WE CONSIDERED IN THIS ANALYSIS, INCLUDING A BREAKOUT OF THEIR COSTS. THE THREE ALTERNATIVES WERE: FIRST, MODIFY THE C-5As; SECOND, BUY 747-200F COMMERCIAL FREIGHTERS; OR, THIRD, BUY A SLIGHTLY LESSER NUMBER OF 747s AND SOME C-5A SIMULATORS. THE COST WOULD BE APPROXIMATELY THE SAME FOR ALL, WITH ONLY THE WING MOD INCURRING ANY R&D EXPENSE.

FOR THIS ANALYSIS WE USED THE CURRENT AIR FORCE (INDEPENDENT COST ANALYSIS) ESTIMATE OF $.84 BILLION FY 1976 DOLLARS. SHOWN AT THE BOTTOM OF THE SLIDE ARE THE CONSTANT AND INFLATED ESTIMATES THAT HAVE BEEN MADE BY THE AIR FORCE AND OSD.

AS THE NEXT SLIDE WILL SHOW, BOTH THE 747 AND C-5 WING MOD CAN PROVIDE INCREASED CAPABILITY.

CHARACTERISTICS OF C-5A AND BOEING 747-200F

	C-5A NO MOD	C-5A MODIFIED	747-200F
ALLOWABLE CABIN LOAD (THOUSANDS OF POUNDS)	209,000	235,000	253,000
CARGO CAPABILITY	OUTSIZE	OUTSIZE	OVERSIZE*
DOOR SIZE (HEIGHT x WIDTH IN INCHES)	162" x 228"	162" x 228"	98" x 140"
463L PALLETS	36	36	46
SPEED	440	440	490
SPECIAL LOADING EQUIPMENT REQUIRED	NO	NO	YES

* 747 DOOR OPENING IS 11" SHORTER THAN C-141.

SLIDE 9 (CHARACTERISTICS OF C-5A AND 747-200F)

THIS CHART SHOWS A COMPARISON OF CHARACTERISTICS OF THE TWO DIFFERENT AIRCRAFT. THE C-5 WITH A MODIFIED WING AND 747 FREIGHTER BOTH GIVE GREATER OVERSIZE CAPABILITY THAN OUR PRESENT FORCE. THIS IS BECAUSE THE WING MOD GIVES THE C-5 A 26,000 POUND INCREASE IN ALLOWABLE CABIN LOAD (ACL) OVER PRESENT LOAD LIMITATIONS, AND BECAUSE THE 747 ALTERNATIVE WOULD MEAN MORE AIRCRAFT IN THE AIRLIFT FORCE.

THE C-5A WOULD STILL RETAIN ITS OUTSIZE CAPABILITY BUT THE 747 WILL BE LIMITED TO OVERSIZE CARGO BECAUSE OF THE DOOR SIZE, WHICH IS SOMEWHAT SMALLER THAN THAT FOR A C-141, OUR PRIMARY OVERSIZE CARRIER.

THE 747 CAN CARRY MORE PALLETS AND IS FASTER THAN THE C-5, BUT WOULD REQUIRE ADDITIONAL LOADING EQUIPMENT BECAUSE OF ITS INCOMPATIBILITY WITH THE AIR FORCE 463L LOADING SYSTEM.

THE LOGISTICAL CONCEPT TO SUPPORT A 747 MAY BE DIFFERENT THAN FOR TRADITIONAL CARGO AIRCRAFT, AS SHOWN NEXT.

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POSSIBLE LOGISTICS CONCEPT FOR 747

- 747-200F LOGISTICS CONCEPT COULD FOLLOW THAT PROPOSED FOR ADVANCED TANKER/CARGO AIRCRAFT
  - MAXIMUM USE OF EXISTING WORLD-WIDE COMMERCIAL SERVICES AND FACILITIES
  - USAF FLIGHT LINE MAINTENANCE
  - CONTRACTOR SHOP MAINTENANCE (EXCEPT FOR USAF PECULIAR ITEMS)
    - DEPOT MAINTENANCE
    - SUPPLY SUPPORT WORLD-WIDE
    - DATA, SPECIFICATIONS, SUPPORT EQUIPMENT
    - LOGISTICS FACILITIES
    - TRAINING AND EQUIPMENT

SLIDE 10 (POSSIBLE LOGISTICS CONCEPT FOR 747)

A LOGISTICS SUPPORT CONCEPT FOR THE 747 COMMERCIAL FREIGHTER MIGHT FOLLOW THAT PROPOSED FOR THE ADVANCED TANKER CARGO AIRCRAFT (ATCA). THIS ENTAILS MAXIMUM USE OF THE IN-BEING WORLD-WIDE INFRASTRUCTURE OF 747 SUPPORT FACILITIES. AIR FORCE FLIGHTLINE MAINTENANCE, AUGMENTED BY CONTRACTOR SUPPORT IN MANY TRADITIONAL AREAS, AS SHOWN HERE, MIGHT MAKE LOGISTICS SUPPORT EASIER AND LESS EXPENSIVE THAN WITH A PURELY MILITARY CONCEPT.

THE NEXT SLIDE SHOWS THE TRAINING CONCEPTS EXAMINED FOR EACH ALTERNATIVE.

C-5 TRAINING CONCEPTS CONSIDERED FOR EACH ALTERNATIVE

ALTERNATIVE	TRAINING CONCEPTS	ANNUAL CREW FLIGHT HOURS IN C-5A	PEACETIME UTE RATE	MEAN WEAROUT DATE *
MODIFY C-5	ALL C-5 TRAINING - Present Concept ● Local and mission training in C-5A	143.2	C-5A 2.16	2000+
DO NOT MOD C-5 BUY 19 747 CF	C-5 LOCAL TRAINING CONCEPT ● Only local training in C-5; no cargo missions • Landings, instruments, local proficiency in C-5 • C-5 crews make up enroute training in 747	44.0	C-5A .79 747CF 7.78	1988 1999
DO NOT MOD C-5 BUY 17 747 CF + 8 C-5A SIMS	C-5 LANDING TRAINING CONCEPT ● Only landings in C-5 • Instruments, local proficiency, enroute training in simulator • No extra 747 flying to train C-5 crews	16.0	C-5A .43 747CF 2.16	1996 2000+

* WEAROUT IS: •8,000 HRS FOR NO MOD C-5 •30,000 HRS FOR MOD C-5 •30,000 HRS FOR 747 WARRANTY

SLIDE 11 (C-5 TRAINING CONCEPTS CONSIDERED FOR EACH ALTERNATIVE)

AS PREVIOUSLY SHOWN, THE C-5 WEAROUT DATE CAN BE EXTENDED EITHER BY MODIFYING THE WING OR LOWERING THE UTILIZATION RATE. THIS SLIDE SHOWS THE TRAINING CONCEPTS THAT WOULD BE REQUIRED TO PROVIDE EQUAL TRAINING TIME FOR EACH ALTERNATIVE, EITHER IN THE AIRCRAFT OR WITH FLIGHT SIMULATORS. THE FIRST ALTERNATIVE IS TO MODIFY THE C-5. IN THIS CASE, WE ASSUMED THE "ALL C-5 TRAINING" CONCEPT, WHICH WOULD ENTAIL TRAINING AS IT IS PRESENTLY DONE, WITH EACH CREW RECEIVING 143 HOURS PER YEAR IN THE AIRCRAFT IN ADDITION TO THE CURRENT SIMULATOR TRAINING. IT SHOULD BE NOTED THAT THE 143 HOURS PER YEAR IS THE LOWEST FLYING TIME REQUIREMENT OF ANY MAJCOM IN THE AIR FORCE. FIGHTER, TANKER, AND BOMBER PILOTS TYPICALLY RECEIVE 200-250 HOURS PER CREW PER YEAR. AIRLINE PILOTS NORMALLY FLY 600-900 HOURS PER YEAR. THE C-5 WEAROUT DATE WOULD OCCUR AFTER THE YEAR 2000.

THE SECOND ALTERNATIVE IS PURCHASE OF 747 AIRCRAFT AS SURROGATE TRAINERS INSTEAD OF DOING THE WING MOD. THIS INVOLVES USE OF A NEW, UNTESTED IDEA--THE "C-5 LOCAL TRAINING ONLY" CONCEPT. THIS WOULD PROVIDE THE SAME AMOUNT OF LOCAL TRAINING AS IN THE PRESENT CONCEPT, 44 HOURS PER CREW PER YEAR, BUT THERE WOULD BE NO CARGO MISSIONS. INSTRUMENT AND LOCAL PROFICIENCY FLYING WOULD BE DONE IN THE C-5 AS WELL AS INITIAL QUALIFICATION AND AERIAL REFUELING TRAINING; HOWEVER, THE LOST EN ROUTE TRAINING WOULD BE MADE UP IN THE 747 AIRCRAFT. THIS WOULD PROVIDE THE SAME TOTAL AIRCRAFT FLIGHT TIME AS IN THE PRESENT CASE: 44 HOURS IN THE C-5 AND 99 IN THE 747. THE DAILY C-5 UTE WOULD DROP TO .79 HOURS PER DAY, GIVING A WEAROUT DATE OF 1988. THE HIGH 747 UTE RATE INDICATED WOULD

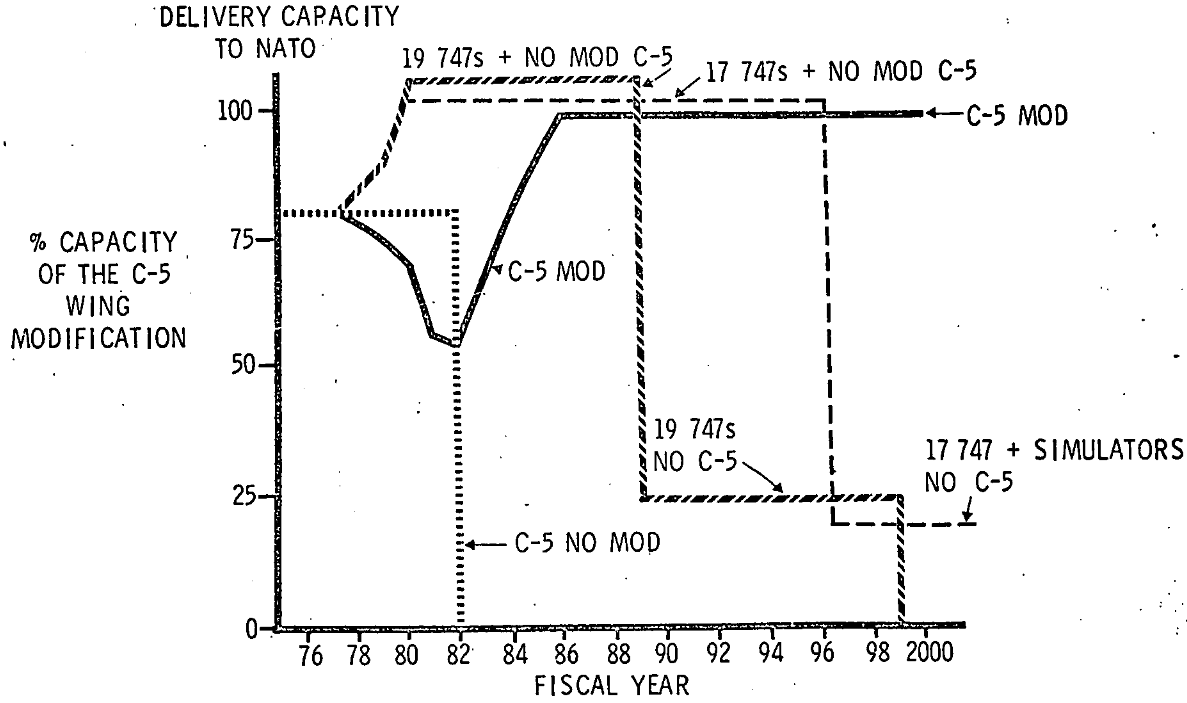
SLIDE 11 (C-5 TRAINING CONCEPTS CONSIDERED FOR EACH ALTERNATIVE)(CONT'D)

ACCOMMODATE THE C-5 EN ROUTE CREW TRAINING AS WELL AS TRAINING FOR CREWS ASSIGNED ONLY TO THE 747s. AT 7.78 HOURS PER DAY UNTIL C-5 WEAROUT, THE 747s WOULD REACH THEIR WARRANTED 30,000-HOUR LEVEL IN 1999.

THE THIRD ALTERNATIVE IS PURCAHSE OF SEVENTEEN 747s AND EIGHT C-5 FLIGHT SIMULATORS INSTEAD OF THE WING MOD. THIS IS ALSO AN UNTESTED IDEA--THE C-5 LANDING TRAINING CONCEPT--THAT WOULD HAVE THE C-5 CREWS RECEIVING ONLY TAKEOFF AND LANDING TRAINING IN THE C-5: TWO PER PILOT PER MONTH, AS IS PRESENTLY REQUIRED. THIS CONCEPT HAS NEVER BEEN TESTED AND IS GENERALLY CONSIDERED TO BE A MEASURE THAT IS OPERATIONALLY INFEASIBLE BY OPERATIONS PERSONNEL. THERE WOULD BE NO CARGO MISSIONS, AND ALL INSTRUMENT, PROFICIENCY, AND EN ROUTE TRAINING WOULD BE DONE IN THE SIMULATOR. INITIAL QUALIFICATION AND AIR REFUELING WOULD BE ACCOMPLISHED IN THE AIRCRAFT. THIS WOULD GIVE THE SAME TOTAL TRAINING HOURS AS CREWS PRESENTLY RECEIVE EXCEPT THAT ONLY 16 HOURS WOULD BE IN THE AIRCRAFT AND 127 ADDITIONAL HOURS IN THE SIMULATOR. THIS REPRESENTS AN 80% REDUCTION BELOW THE BASE CASE UTE RATE OF 2.16 HOURS PER DAY. THE C-5 DAILY UTE RATE COULD DROP TO .43 HOURS PER DAY WITH A WEAROUT DATE OF 1996. THE 747s WOULD ONLY BE FLOWN BY THEIR OWN CREWS UNDER THIS CONCEPT, AND THEIR 30,000-HOUR DATE WOULD BE PAST THE YEAR 2000.

ALL OF THE ALTERNATIVES, WHICH INCLUDE SOME NEW, UNTESTED CONCEPTS, AIM TO PROVIDE SUFFICIENT TRAINING TO MAINTAIN DEPLOYMENT CAPABILITY, WHICH IS SHOWN FOR EACH ALTERNATIVE ON THE NEXT CHART.

DEPLOYMENT CAPABILITY OF C-5 WING MOD FORCE AND 747 ALTERNATIVES



SLIDE 12 (DEPLOYMENT CAPABILITY OF C-5 WING MOD FORCE AND 747 ALTERNATIVES)

THIS CHART SHOWS CAPABILITY OF VARIOUS ALTERNATIVES COMPARED TO THE WING MODIFICATION IN TERMS OF DELIVERY CAPACITY TO NATO. NOTE THAT 100% ON THE VERTICAL AXIS REPRESENTS THE CAPABILITY OF THE FORCE WITH THE C-5 WING MODIFICATION. THE SMALL DASHED LINE BEGINNING AT THE 80% MARK REPRESENTS THE NO-MODIFICATION CASE AT 2.16 HOURS PER DAY WITH FORCE WEAROUT IN 1982. THE NO-MOD CASE PROVIDES ONLY 80% OF THE MODIFIED FORCE CAPACITY BECAUSE THE ACL OF THE WING MOD FORCE IS HIGHER. THE SOLID LINE REPRESENTS CAPABILITY WITH THE BASIC MOD SCHEDULE: THE DIP IS CAUSED AS AIRCRAFT ENTER THE MODIFICATION CYCLE, BUT TOTAL CAPABILITY ULTIMATELY INCREASES TO 100% AS THE MODIFICATION PROGRAM IS COMPLETED.

THE HATCHED LINE REPRESENTS PURCHASE OF 19 747s. THEY PROVIDE A TONNAGE CAPABILITY SLIGHTLY HIGHER THAN THE WING MOD, BUT IT IS ALL OVERSIZE CAPABILITY, NOT OUTSIZE. THE SHARP DROP IN 1988 REPRESENTS THE CAPABILITY LOST WHEN THE C-5 FORCE WEARS OUT. AFTER THIS POINT THERE WOULD BE NO OUTSIZE DEPLOYMENT CAPABILITY AT ALL UNLESS A DECISION WERE MADE TO MODIFY THE C-5 WING, OR POSSIBLY ACQUIRE A REPLACEMENT OUTSIZE CAPABLE AIRCRAFT. OTHERWISE THE ONLY CAPABILITY REMAINING WOULD BE THE OVERSIZE CAPACITY OF THE 747s UNTIL THEIR WEAROUT IN 1999.

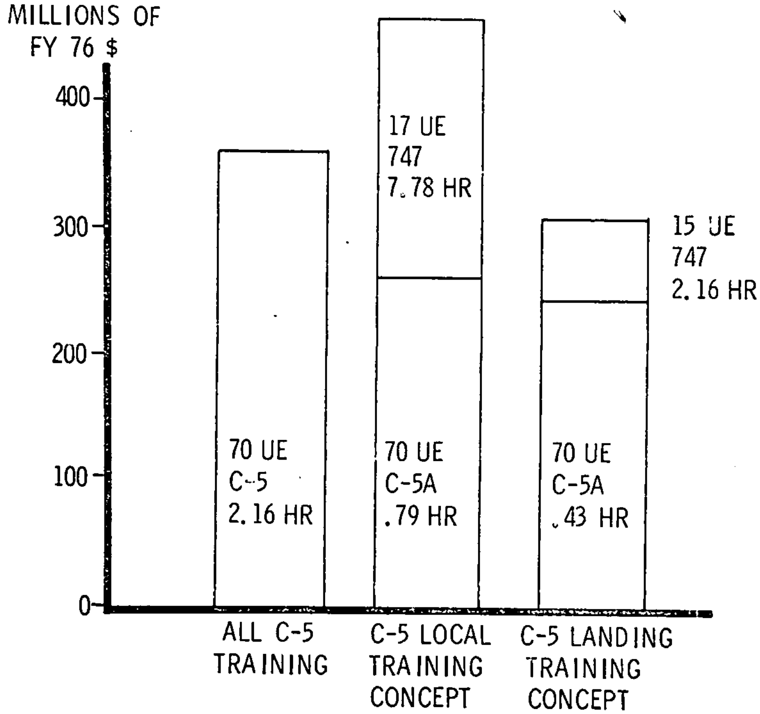
SLIDE 12 (DEPLOYMENT CAPABILITY OF C-5 WING MOD FORCE AND 747 ALTERNATIVES (CONT'D)

THE DASHED LINE REPRESENTS PURCHASE OF 17 747s AND C-5A SIMULATORS. AS BEFORE, THE INCREASE IN TONNAGE IS SLIGHTLY HIGHER THAN WITH THE WING MOD, BUT IT IS NOT OUTSIZE CAPABILITY, IT IS OVERSIZE IN THIS CASE. A TOTAL LOSS OF OUTSIZE CAPABILITY WOULD OCCUR IN 1996 UNLESS THE C-5 WING HAD BEEN MODIFIED BY THEN OR A NEW AIRCRAFT PROCURED. OTHERWISE ONLY OVERSIZE TONNAGE CAPABILITY OF THE REMAINING 747s WOULD BE LEFT.

IF OUR OUTSIZE CAPABILITY IS NOT MAINTAINED THROUGH EVENTUAL WING MODIFICATION OR WITH A NEW AIRCRAFT, WE WOULD BE UNABLE TO DEPLOY BY AIR THE MODERN HEAVY FIREPOWER EQUIPMENT OF OUR COMBAT FORCES DURING THE CRITICAL INITIAL PHASES OF A NATO CONTINGENCY.

THE NEXT CHART SHOWS OUR ANNUAL OPERATING AND SUPPORT COSTS FOR EACH OF THE ALTERNATIVES.

ANNUAL O&S COST COMPARISON
FY 76 $



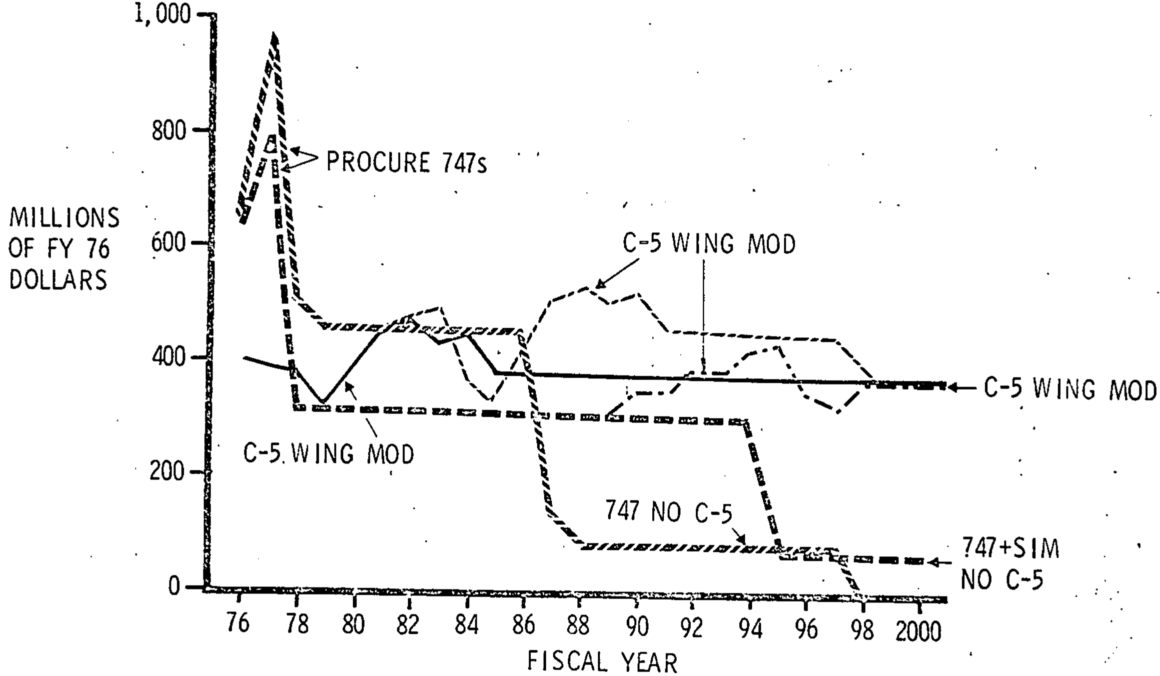
SLIDE 13 (ANNUAL O&S COMPARISON)

THIS SLIDE COMPARES NORMAL OPERATING AND SUPPORT COSTS OF THE THREE CONCEPTS. THESE REPRESENT COSTS AFTER THE WING MODIFICATION OR PURCHASE OF THE 747s, AND BEFORE WEAR-OUT OF EITHER AIRCRAFT. THE COLUMN ON THE LEFT REFLECTS TRAINING UNDER THE PRESENT CONCEPT, ALL IN THE C-5. THE MIDDLE COLUMN REFLECTS USE OF THE 747 AS A SURROGATE TRAINER FOR EN ROUTE C-5 CREW TRAINING. IT IS THE MOST EXPENSIVE OF THE THREE BECAUSE THERE ARE MORE AIRCRAFT AND MORE FLIGHT HOURS UNDER THIS OPTION THAN WITH EITHER OF THE OTHER TWO. THE THIRD COLUMN IS LOWEST BECAUSE IT HAS THE FEWEST ACTUAL AIRCRAFT FLIGHT HOURS, ALTHOUGH FIXED COSTS STILL KEEP THIS ALTERNATIVE ABOVE THE $300 MILLION LEVEL. 162

AN ADDITIONAL COST WHICH WOULD BE INCURRED WITH THE "LOCALS ONLY" AND "LANDING TRAINING" CONCEPTS IS THE LOSS OF PEACETIME ABILITY TO AIRLIFT OUTSIZE CARGO. WITH THESE TRAINING CONCEPTS, OUTSIZE CARGO WOULD HAVE TO BE MOVED BY OTHER MEANS INCURRING AN EXTRA EXPENSE NOT APPLICABLE TO THE "ALL C-5 TRAINING" CONCEPT.

THE NEXT SLIDE WILL DEPICT TOTAL FUNDING PROFILES FOR EACH ALTERNATIVE INCLUDING R&D, PROCUREMENT, AND O&S COSTS.

TOTAL FUNDING PROFILES FOR EACH ALTERNATIVE FORCE



SLIDE 14 (TOTAL FUNDING PROFILES FOR EACH ALTERNATIVE FORCE)

THIS CHART SHOWS THE TOTAL FUNDING PROFILE FOR EACH ALTERNATIVE. THE BASIC WING MOD SCHEDULE IS DEPICTED BY THE SOLID LINE. EACH OF THE 747 PROCUREMENT OPTIONS IS SHOWN BY THE HATCHED AND DASHED LINES. THE GENERAL SHAPE OF BOTH LINES IS THE SAME--A LARGE PEAK REPRESENTING PROCUREMENT OF 19 OR 17 747s. THE LEVEL OFF AFTERWARDS INDICATES THE STEADY STATE OPERATING EXPENSES OF THE FORCE UNTIL C-5 WEAROUT. IF NO MODIFICATION WERE ADOPTED AT THAT TIME, 1988 OR 96, THE DROP IN OPERATING COSTS WOULD REFLECT THE TOTAL LOSS OF OUTSIZE CAPABILITY WHEN THE C-5 SERVICE LIFE IS EXHAUSTED, WITH ONLY THE OVERSIZE CAPABLE 747s REMAINING.

THE THIN LINES REFLECT THE COSTS IF A DECISION WERE LATER MADE TO RETAIN OUTSIZE CAPABILITY BY MODIFYING THE C-5 WINGS PRIOR TO THEIR WEAROUT DATE. THE THIN HATCHED LINE REFLECTS INITIAL FUNDING REQUIREMENT FOR C-5 MODIFICATION IN THE CASE OF THE 19 747s AS SURROGATE TRAINERS. INITIAL FUNDING FOR R&D WOULD BEGIN IN THE EARLY 1980s SO THAT PRODUCTION COULD BEGIN IN ANTICIPATION OF C-5 WEAROUT IN 1988. THE MOD WOULD BE COMPLETED AND NORMAL FUNDING LEVELS RESUMED IN THE EARLY 1990s.

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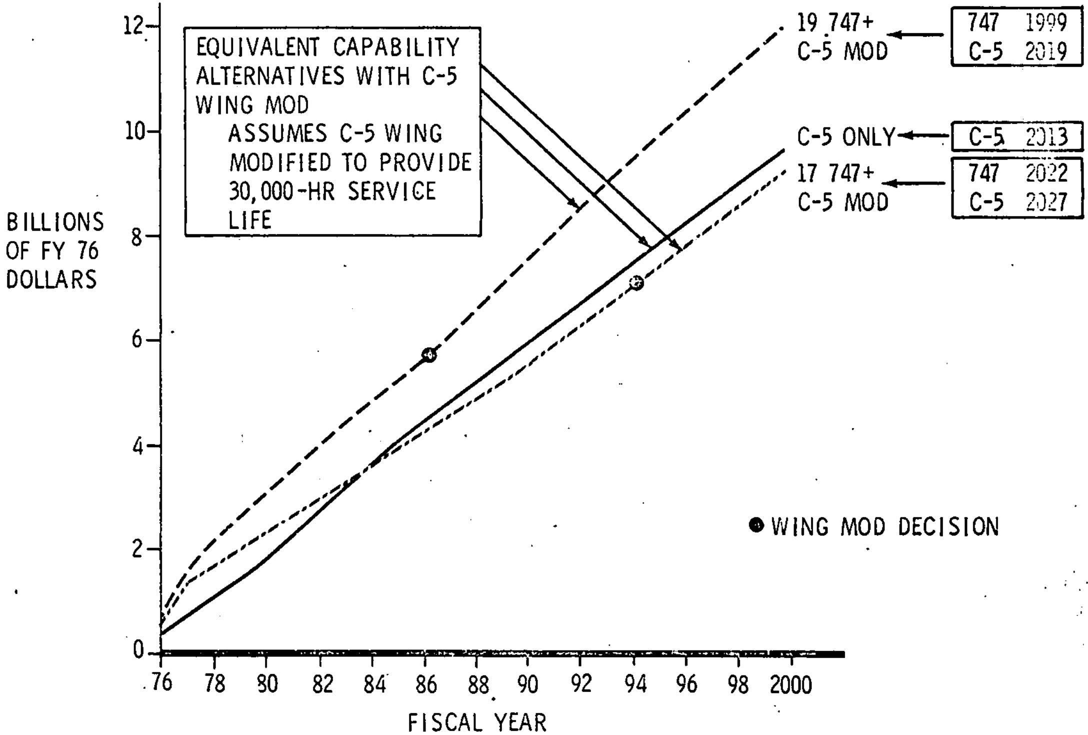
SLIDE 14 (TOTAL FUNDING PROFILES FOR EACH ALTERNATIVE FORCE)(CONT'D)

IN THE CASE OF THE 17 747s PLUS C-5 SIMULATORS PURCHASE, INITIAL FUNDING AS SHOWN BY THE THIN DASHED LINE, WOULD BEGIN IN THE LATE 1980s TO ALLOW PRODUCTION IN ANTICIPATION OF THE PROJECTED 1996 WEAROUT DATE. IF MODIFICATION WERE NOT ADOPTED, IT WOULD BE NECESSARY TO PROCURE NEW AIRCRAFT TO REPLACE THE LOST OUTSIZE CAPABILITY OF THE C-5. COSTS TO PROCURE AN EQUIVALENT CAPABILITY AIRCRAFT IN THE LATE 1980 OR 90s ARE DIFFICULT TO ASSESS. ALTHOUGH NOT DEPICTED ON THE CHART, PROCUREMENT OF ANY COMPARABLE NUMBER OF NEW OUTSIZE CAPABLE AIRCRAFT TO REPLACE THE C-5 WOULD LIKELY PRODUCE A FUNDING PROFILE WITH PEAKS AS HIGH AS THOSE SHOWN ON THE CHART FOR THE 747 PROCUREMENT, BUT LASTING FOR SEVERAL YEARS AND ENTAILING EXPENDITURE OF MUCH MORE MONEY. 165

ON THE NEXT SLIDE IS ANOTHER PERSPECTIVE, SHOWING CUMULATIVE COST OF EACH OF THE ALTERNATIVES THAT RETAIN AN OUTSIZE CAPABILITY--THAT IS, INTRODUCE WING MOD PRIOR TO C-5 WEAROUT.

CUMULATIVE COSTS FOR ALTERNATIVE FORCES WITH THE C-5 WING MOD



SLIDE 15 (CUMULATIVE COST FOR ALTERNATIVES WITH THE C-5 WING MOD)

HERE WE HAVE THE CUMULATIVE COSTS FOR EACH OF THREE ALTERNATIVE FORCES. ALL OF THESE OPTIONS INCLUDE THE WING MOD. THE SOLID LINE REPRESENTS THE COST OF THE PRESENTLY PLANNED C-5 WING MOD. THE DASHED LINE REPRESENTS THE COSTS IF WE BUY 19 747s AND DEFER THE WING MOD DECISION TO 1986. THE HATCHED LINE REPRESENTS THE CASE WHERE WE BUY 747s AND C-5A SIMULATORS, WHICH WOULD ALLOW US TO DEFER THE WING MOD DECISION TO 1994.

THE CUMULATE COST OF THE OPTION TO BUY 19 747s AND DEFERRING THE C-5 WING MOD TO 1986 IS ABOUT 25% HIGHER THAN THE OTHERS. THIS IS BECAUSE, AS PREVIOUSLY MENTIONED, THIS OPTION HAS THE MOST AIRCRAFT AND FLYING HOURS OF THE THREE ALTERNATIVES.

IF NO WING MOD IS ADOPTED AT THE DECISION POINT, THE COST LINE WOULD FLATTEN OUT, REFLECTING A COMPLETE LOSS OF OUTSIZE CAPABILITY UNLESS A NEW OUTSIZE-CAPABLE AIRCRAFT WERE PURCHASED. IT IS DIFFICULT TO SAY WHAT AIRCRAFT WOULD BE AN ACCEPTABLE SUBSTITUTE IN THE LATE 1980s OR 90s. ESTIMATES TO REPLACE THE C-5 FORCE NOW WITH LIKE CAPABILITY SUGGEST THAT THE ACQUISITION COSTS OF A NEW AIRCRAFT ARE ON THE ORDER OF FOUR TIMES AS EXPENSIVE AS MODIFYING THE C-5 WING.

SLIDE 15 (CUMULATIVE COST FOR ALTERNATIVE FORCES WITH THE C-5 WING MOD) (CONT'D)

IF THE FORCE USING 17 747s PLUS SIMULATORS IS ADOPTED, AS SHOWN BY THE HATCHED LINE, INITIAL COSTS ARE ABOVE THE C-5 LINE ONLY UNTIL 1984. AFTER THAT, THE REDUCED FLIGHT HOURS AND LOWER O&S COSTS OF THIS ALTERNATIVE BRING THE CUMULATIVE COST LINE SLIGHTLY BELOW THE "C-5 ONLY" FORCE EXPENDITURE LINE, EVEN IF THE WING MOD IS SUBSEQUENTLY ACCOMPLISHED. IT CAN BE SEEN THAT THE CUMULATIVE COST OF THIS OPTION, WHICH RELIES ON AN UNTESTED TRAINING CONCEPT THAT OPERATIONS PERSONNEL FEEL IS NOT FEASIBLE, IS NEARLY AS GREAT AS FOR THE BASIC "C-5 ONLY" OPTION. IF THERE IS NO MOD AT THE DECISION POINT, THE LINE WOULD FLATTEN OUT, AGAIN REFLECTING THE TOTAL LOSS OF OUTSIZE CAPABILITY UNLESS A REPLACEMENT AIRCRAFT WERE ACQUIRED, AT A POTENTIAL COST OF QUADRUPLE THE WING MOD FIGURE.

AS PREVIOUSLY MENTIONED, IF THE CAPABILITY TO MOVE OUTSIZE EQUIPMENT BY AIR IS NOT MAINTAINED, WE COULD NOT DEPLOY THE ESSENTIAL HEAVY FIREPOWER NEEDED BY OUR COMBAT FORCES IN THE VITAL, EARLY STAGES OF A CONTINGENCY IN NATO.

NEXT I WILL ADDRESS THE ELEMENTS OF RISK ASSOCIATED WITH THE PROPOSED ALTERNATIVES.

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TECHNICAL RISK

- 747-200F CURRENTLY OPERATIONAL WITH AIRLINES
- C-5 WING MOD IS BEEF-UP, NOT REDESIGN
  - TWO TEST KITS FOR PROOF OF STRUCTURAL INTEGRITY
  - SOME FATIGUE TESTING PLANNED BEFORE INSTALLATION
  - AFSC HAS VERY HIGH CONFIDENCE IN "H" WING

SLIDE 16 (TECHNICAL RISK)

BOTH AIRCRAFT ALTERNATIVES ARE CONSIDERED TO HAVE LOW TECHNICAL RISK. THE 747-200F IS CURRENTLY IN USE WITH CIVIL AIRLINES AROUND THE WORLD AND IS A PROVEN AIRCRAFT.

THE C-5 WING MODIFICATION IS PRIMARILY A BEEF-UP, NOT A REDESIGN. THE WING IS BEING MADE HEAVIER AND STRONGER THAN BEFORE, BUT WILL HAVE THE SAME BASIC AERODYNAMIC PROPERTIES AS THE OLD WING. IN ADDITION THE TWO TEST KITS WILL PROVIDE TEST DATA ON STRUCTURAL INTEGRITY BEFORE MODIFICATION OF THE ENTIRE FORCE. AIR FORCE SYSTEMS COMMAND HAS INDICATED A HIGH CONFIDENCE IN THE OPTION "H" WING MODIFICATION.

NEW TRAINING CONCEPTS AND FORCE POSTURES INTRODUCE OPERATIONAL RISKS THAT MUST BE CONSIDERED, AS SHOWN NEXT.

OPERATIONAL RISK

- C-5A AIRCREW PROFICIENCY
  - IMPACT OF RECEIVING MAJORITY OF TRAINING IN ANOTHER AIRCRAFT OR SIMULATOR UNKNOWN; WOULD REQUIRE OPERATIONAL TESTING.
  - LOWER OPERATIONAL EXPERIENCE LEVEL WITH SURROGATE TRAINERS
  - 747 SURROGATE TRAINER WOULD NOT DUPLICATE C-5A EN ROUTE MISSION TRAINING FOR CREWS OR MAINTENANCE .
  - C-5A SIMULATORS CAN DUPLICATE COCKPIT PROCEDURES
    - COULD LIMIT OPERATIONAL EXPERIENCE LEVEL
    - CREW MORALE AND RETENTION LIKELY PROBLEMS IN SIMULATOR-ORIENTED PROGRAM
- ABILITY TO ATTAIN WARTIME UTILIZATION RATES
  - MAINTENANCE PROFICIENCY
  - SUPPLY SUPPORT
  - EN ROUTE SUPPORT AND AERIAL PORT PROFICIENCY
  - ARMY READINESS

SLIDE 17 (OPERATIONAL RISK)

LARGE REDUCTIONS IN PEACETIME UTILIZATION RATES RAISE OPERATIONAL QUESTIONS OF WHETHER AN ACCEPTABLE PROFICIENCY LEVEL CAN BE MAINTAINED AND, EQUALLY IMPORTANT, WHETHER THE FORCE CAN SURGE TO ITS WARTIME UTILIZATION RATE AND FULFILL ITS WARTIME MISSION.

THE FIRST CONSIDERATION IS PROFICIENCY OF THE C-5 AIRCREWS AND THEIR ABILITY TO SAFELY OPERATE THE AIRCRAFT. WHETHER OR NOT A CREW CAN RECEIVE MOST OF THEIR TRAINING IN ANOTHER AIRCRAFT OR A SIMULATOR IS SOMETHING THAT HAS YET TO BE DETERMINED. THE LIMITED NUMBER OF C-5 AIRCRAFT IN THE INVENTORY AND THE EXPENSE TO REPLACE THEM MAKE PROFICIENCY AND FLYING SAFETY IMPORTANT CONSIDERATIONS UNDER ANY NEW TRAINING CONCEPT.

IN THE C-5 LOCAL ONLY CONCEPT, ALTHOUGH C-5 CREWS WOULD BE GETTING THE SAME LOCAL TRAINING AS PRESENTLY, THE 747 COULD NOT DUPLICATE THE EN ROUTE TRAINING FOR EITHER CREWS OR MAINTENANCE. THE OPERATIONAL EXPERIENCE LEVEL OF THE C-5 CREW FORCE WOULD SLOWLY DECLINE, POSSIBLY TO THE DETRIMENT OF THEIR ABILITY TO COMPLETE THEIR MISSION EFFECTIVELY.

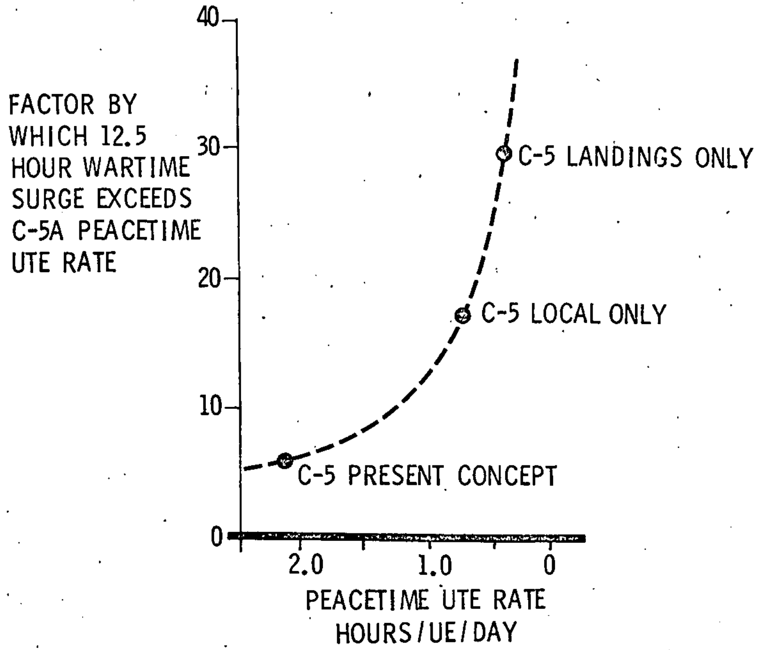
SLIDE 17 (OPERATIONAL RISK) (CONT'D)

IN THE LANDINGS-ONLY CONCEPT, C-5 CREWS COULD GET DUPLICATE PROCEDURAL TRAINING IN THE SIMULATOR. HOWEVER, THIS DENIES OPERATIONAL EXPERIENCE BY RELIANCE ON "BOOK ANSWERS" TO PROBLEMS. AS PREVIOUSLY MENTIONED, THIS CONCEPT, WHICH WOULD INVOLVE 80% REDUCTION IN CREW FLYING TIME, HAS NEVER BEEN TESTED AND IS CONSIDERED INFEASIBLE BY OPERATIONS PERSONNEL.

IN ADDITION, CREW MORALE AND RETENTION COULD BE A POTENTIAL PROBLEM IN A SIMULATOR-ORIENTED PROGRAM WHERE CREWS WILL FLY ONLY 16 HOURS PER YEAR IN THE AIRCRAFT.

THE PRIMARY WARTIME CONSIDERATION IS THE ABILITY TO GENERATE SUFFICIENT AIRCRAFT FOR THE AIRLIFT FORCE TO ATTAIN ITS WARTIME UTILIZATION RATES. WHETHER OR NOT IT CAN BE ACCOMPLISHED QUICKLY FROM A VERY LOW PEACETIME UTE RATE IS UNKNOWN FOR A NUMBER OF REASONS. MAINTENANCE PROFICIENCY, WHICH IS A KEY ELEMENT OF SURGE CAPABILITY, MAY BE DIFFICULT TO MAINTAIN. SUPPLY SOURCES COULD DRY UP WITH A VERY LOW UTE RATE BECAUSE OF A LOWER CONSUMPTION RATE. ELEMENTS OF EN ROUTE SUPPORT AND AERIAL PORT ACTIVITIES WILL HAVE REDUCED EXPERIENCE ON THE C-5, WHICH MAY IMPACT ON DEPLOYMENT CAPABILITY. WITH A LOWERED UTE RATE, JOINT TRAINING WITH THE ARMY MAY NOT BE ADEQUATE TO ASSURE EXPEDITIOUS LOADING DURING A DEPLOYMENT. THE NEXT CHART SHOWS THE MAGNITUDE OF THE EFFORT NEEDED TO ATTAIN THE WARTIME SURGE RATE.

COMPARISON OF C-5A PEACETIME UTE RATE OPTIONS AND FACTOR REQUIRED TO ATTAIN SURGE RATE



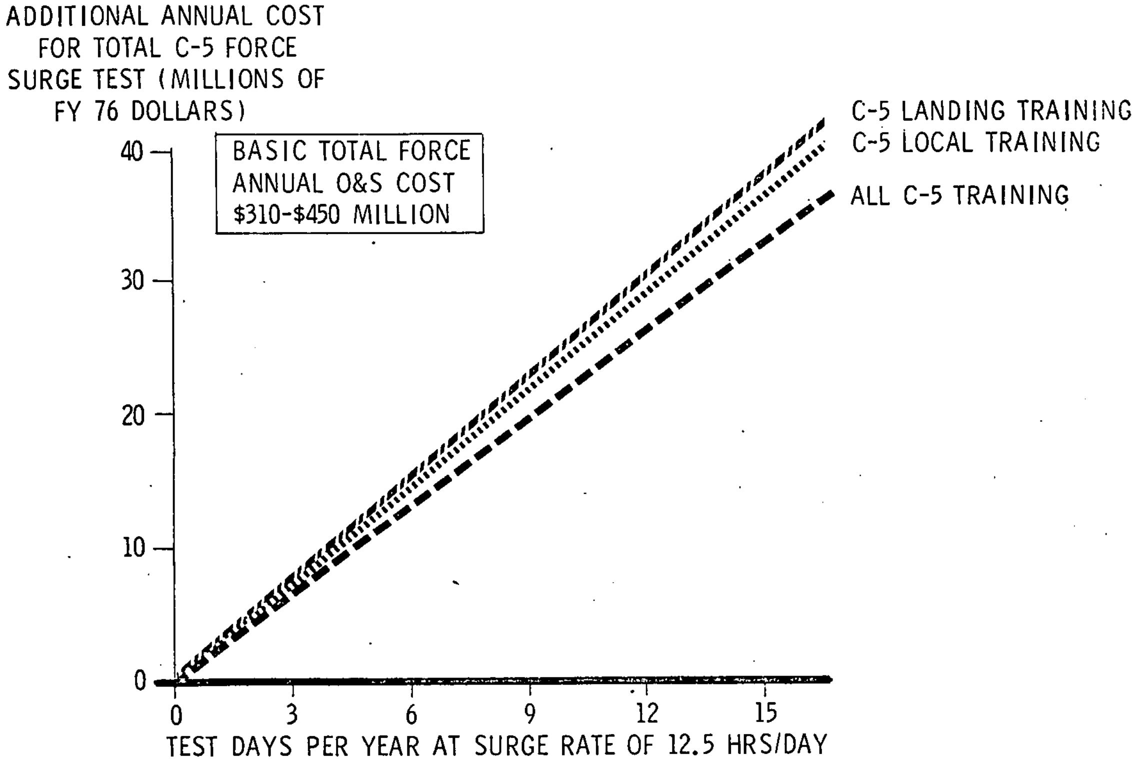
SLIDE 18 (COMPARISON OF C-5A PEACETIME UTE RATE OPTIONS AND FACTOR REQUIRED TO ATTAIN SURGE RATE)

THIS CHART HIGHLIGHTS THE POTENTIAL PROBLEM OF SURGING TO A 12.5-HOUR WARTIME RATE FROM VERY LOW PEACETIME RATES. FROM THE C-5 PRESENT TRAINING CONCEPT OF 2.16 HOURS PER DAY, IT REQUIRES AN INCREASE OF 5.8 TIMES ABOVE THE PEACETIME LEVEL TO ATTAIN THE WARTIME SURGE RATE.

FROM THE C-5 LOCALS ONLY POSTURE OF .79 HOURS PER DAY, THE FORCE MUST INCREASE 16 TIMES ABOVE PEACETIME FLYING TO ATTAIN WARTIME SURGE RATE.

FROM THE C-5 LANDINGS ONLY POSTURE OF .43 HOURS PER DAY, THE INCREASE IS NEARLY 30 TIMES MORE THAN THE PEACETIME RATE. IN THIS CASE, PEACETIME ACTIVITY WOULD BE LESS THAN 4% OF REQUIRED WARTIME UTE RATE. BECAUSE OF THE LARGE INCREASE NEEDED TO ATTAIN THE WARTIME SURGE RATE, TESTS MAY BE NEEDED TO ESTABLISH CONFIDENCE IN OUR CAPABILITY. COSTS TO CONDUCT AN ANNUAL TEST OF THE SURGE CAPABILITY WOULD ONLY REQUIRE A SMALL INCREASE IN TOTAL O&S COSTS, HOWEVER, AS IS SHOWN ON THE NEXT SLIDE.

ANNUAL COST TO TEST C-5A SURGE RATE CAPABILITY FROM VARIOUS PEACETIME UTE RATE LEVELS



SLIDE 19 (ANNUAL COST TO TEST C-5A SURGE RATE CAPABILITY FROM VARIOUS PEACETIME UTE RATES)

THIS CHART SHOWS THE ADDITIONAL COST TO SURGE THE ENTIRE C-5 FORCE TO 12.5 HOURS PER DAY FROM VARIOUS PEACETIME UTE RATES. FOR COMPARISON THE BASIC ANNUAL O&S COSTS ARE SHOWN IN THE BOX. THE COST OF THE TEST DEPENDS ON ITS LENGTH AND THE PEACETIME UTE RATE FROM WHICH THE SURGE IS INITIATED. THE LONGER THE TEST AND THE LOWER THE INITIAL PEACETIME UTE RATE, THE MORE EXPENSE IS INCURRED.

IMPACT IF 747 SELECTED IS AN ATCA

- C-5A CREW TRAINING CONCEPTS REMAIN THE SAME
- HIGHER ACQUISITION COSTS RESULT IN FEWER AIRCRAFT
  - 16 747 ATCAs AS TRAINING SURROGATES
  - 14 747 ATCAs PLUS 8 C-5A SIMULATORS
- DEPLOYMENT CAPABILITY LOWER WITH ATCAs THAN WITH FREIGHTERS DUE TO:
  - FEWER AIRCRAFT
  - LOWER ALLOWABLE CABIN LOAD DUE TO INCREASED OPERATING WEIGHT
  - NINE LOWER LOBE PALLET POSITIONS USED FOR FUEL TANKS
  - MAY NOT BE AVAILABLE FOR CARGO BECAUSE OF TANKER MISSION

SLIDE 20 (IMPACT IF 747 SELECTED IS AN ATCA)

IF THE 747 FREIGHTER SELECTED WERE AN ADVANCED TANKER/CARGO AIRCRAFT, THERE WOULD BE SOME IMPACT BECAUSE OF THE HIGHER COST OF PROCURING AN ATCA. WHILE THE C-5 CREW TRAINING CONCEPTS WOULD REMAIN THE SAME, FEWER AIRCRAFT COULD BE PURCHASED WITH THE SAME AMOUNT OF MONEY AS SHOWN ON THE SLIDE. AS A RESULT, THE ATCAs WOULD PROVIDE SOMEWHAT LESS DEPLOYMENT CAPABILITY THAN WITH FREIGHTERS. ALLOWABLE CABIN LOAD WOULD BE A LITTLE LESS AND CARGO COULD ONLY BE CARRIED ON THE MAIN CARGO DECK SINCE THE LOWER LOBE WOULD BE FILLED WITH REFUELING EQUIPMENT.

THERE IS THE POTENTIAL PROBLEM THAT ATCAs WOULD BE NEEDED MORE AS TANKERS FOR SOME OTHER MISSION THAN TO CARRY CARGO. IN THAT CASE THE CARGO DEPLOYMENT CAPABILITY OF THE 747s WOULD BE DENIED TO THE STRATEGIC AIRLIFT FORCES, AND TOTAL CAPABILITY WOULD DROP TO THAT PRESENTLY PROVIDED BY THE UNMODIFIED C-5 FORCE.

THE FINAL SLIDE WILL PRESENT THE OBSERVATIONS OF THE STUDY.

OBSERVATIONS

- C-5 WING MOD PROVIDES -
  - NEARLY 700 TONS PER DAY INCREASE IN CAPABILITY TO NATO PAST 2000
    - 24% INCREASE IN OUTSIZE CAPACITY
    - 13% INCREASE IN TOTAL CAPACITY
  - NO INCREASE IN O&S COSTS
  - LOW TECHNICAL RISK
  - NO INCREASE IN OPERATIONAL RISK
  - NO ADDITIONAL LOGISTICS SUPPORT REQUIREMENTS
- 747-200F COMMERCIAL FREIGHTER
  - OVER 850 TONS PER DAY INCREASE IN CAPABILITY TO NATO UNTIL 1988
    - NO INCREASE IN OUTSIZE CAPABILITY DUE TO DOOR SIZE
    - 36% INCREASE IN OVERSIZE CAPACITY
    - 17% INCREASE IN TOTAL CAPACITY
  - EXPECTED ANNUAL O&S COSTS INCREASE BY 80 MILLION DOLLARS
  - LOW TECHNICAL RISK
  - HIGHER OPERATIONAL RISKS TO TRAIN IN 747 FOR C-5A WARTIME MISSION
  - ADDITIONAL LOGISTICS SUPPORT REQUIRED
- 747-200F COMMERCIAL FREIGHTER AND SIMULATORS
  - OVER 750 TONS PER DAY INCREASE IN CAPABILITY TO NATO UNTIL 1996
    - NO INCREASE IN OUTSIZE CAPABILITY DUE TO DOOR SIZE
    - 32% INCREASE IN OVERSIZE CAPACITY
    - 15% INCREASE IN TOTAL CAPACITY
  - SIMULATORS MORE REALISTIC TRAINING SURROGATE THAN 747 AIRCRAFT
  - TOTAL O&S COSTS MAY DECREASE
  - LOW TECHNICAL RISK
  - HIGHER OPERATIONAL RISK - SAFETY AND SURGE
    - DUE TO PROFICIENCY OF CREWS AND MAINTENANCE
    - DUE TO ABILITY TO ATTAIN SURGE
  - ADDITIONAL LOGISTICS SUPPORT REQUIRED

SLIDE 21 (OBSERVATIONS)

THE OBSERVATIONS OF THE STUDY ARE SHOWN HERE.

Senator PROXMIRE. Mr. Secretary, when I asked whether the Joint Chiefs' study considered alternatives of rewinging the C–5, did it also consider pre-positioning——

Mr. WHITE. They are considered as various substitutes.

Senator PROXMIRE. Our cost comparisons show the use of commercial air carriers is the most economical way to enhance airlift capability. According to the Brookings' study, it costs $6,000 a ton of increased capability to modify commercial aircraft compared with $28,000 per ton to stretch the C–141 and $32,000 per ton to increase the utilization rate of C–5 and C–141 aircraft?

Did the Joint Chiefs' study consider the use of commercial aircraft?

Mr. WHITE. Yes, sir. As you know, we have had a proposal before the Congress to get increased civil reserve airfleet and modify portions of that airfleet in order to enhance our lift capability to Europe.

We have funds for one prototype this year, which is the first year we have been allowed to do this. We would like to do a good deal more of it.

Senator PROXMIRE. I would hope so. That cost comparison suggests it might be very advantageous to modify commercial planes.

Mr. WHITE. There is no question but that it is the most cost-effective method of enhancing our airlift to Europe.

Senator PROXMIRE. Has it been considered as a substitute?

Mr. WHITE. Yes. It has been considered in various mixes.

Senator PROXMIRE. General Gregg, here is what GAO told my staff, and what I expect Elmer Staats will say tomorrow, that the JCS study did not consider airlift, pre-positioning or commercial aircraft options or alternatives as substitutes to the current airlift proposals in case of a possible war in Europe.

Do you agree or disagree with that finding?

General GREGG. I disagree with that finding, sir, and as I read the GAO report, I think we have a difference——

Senator PROXMIRE. You mean the testimony, rather than the report?

General GREGG. Pardon?

Senator PROXMIRE. The testimony submitted to you for consideration.

General GREGG. No, sir. We also have a copy of the GAO report about our Stretch C–141 program, and in that report it addressed our treatment of alternatives. It also appears in the prepared testimony for the hearing, your hearing tomorrow. So it is in both those documents.

Senator PROXMIRE. Let me ask Mr. Kaufman to follow up on that.

Mr. KAUFMAN. Just a point of clarification, General.

The GAO report you are alluding to was issued last year, in June 1976. The JCS study was issued in February of 1977. It seems not possible that the GAO report of last year would have utilized the JCS study that wasn't issued until some 8 months later.

General GREGG. I can understand you point, Mr. Kaufman, but the General Accounting Office, as you probably know, has just completed a review of our C–141 Stretch program, and we have seen a copy of their report, and in that report it discusses in detail our analysis of the alternatives, and that is the report I made reference to.

Mr. KAUFMAN. And that report is still in draft form and has not been issued yet by GAO for transmittal to Congress.

General GREGG. Yes, that is correct.

Senator PROXMIRE. Here is what the General Accounting Office told my staff, and what I expect them to say.

Let me go on to that.

Isn't it a fact that pre-positioning and so forth were considered as additions to military aircraft?

General GREGG. We considered it in combination. We cannot meet our requirements in Europe, in our view, by pre-positioning, by sealift, or airlift as exclusive programs. What we need are combinations of these programs, and our analysis arrayed the advantages and disadvantages and the cost impact of these alternatives.

There are some strengths and weaknesses——

Senator PROXMIRE. Could you make the entire JCS study available to the staff of the committee so that they can reconcile that?

General GREGG. We have made the entire report available to the General Accounting Office, and I believe I am correct, to both Houses of Congress.

Yes, sir, we have.

Senator PROXMIRE. Well, we want the staff of this subcommittee to have it. You may have made it available to the Senate Armed Services Committee.

General GREGG. We will be happy to do so.[1]

Senator PROXMIRE. Mr. White, how many wide-bodied jets and other large cargo carriers and aircraft that can be converted for cargo are owned and operated for commercial use by our NATO allies?

Mr. WHITE. I will have to look that number up, Mr. Chairman. We have the number.

According to the information I have, there are 150 non-U.S./NATO-wide civil bodied aircraft, of which 10 are cargo capable.

Senator PROXMIRE. How many of those NATO aircraft are incorporated into present airlift plans for a European contingency?

Mr. WHITE. In the current analysis, they were not included. We have been discussing with NATO allies——

Senator PROXMIRE. They are not included?

Mr. WHITE. No, sir, they are not included.

Senator PROXMIRE. Are you aware of that in the 1973 Mideast war, Israel used eight of its commercial 707 and 747 aircraft to move 5,500 tons of cargo from the United States, compared with 22,500 tons moved by 51 C–5's and 177 C–141's?

Don't those figures show that allied assets should be included in plans for defense of our allies?

Mr. WHITE. We agree.

Senator PROXMIRE. You said it didn't include these cargo planes.

Mr. WHITE. They are not available to us as of now, sir.

Senator PROXMIRE. Don't you think that would be the first thing? I can understand about how the NATO allies complain about the burden of military costs, although they are carrying a far smaller share than we are in relation to their gross national products and capabili-

[1] The information is classified and was made available separately to the subcommittee staff.

ties, but it is their turf that is being defended, and it would seem to me that the least we should expect is that they would make their commercial cargo planes available to us without any questions to be included in our plans on a basis that we could really count on them.

Mr. WHITE. Sir, I think they will. There is a problem that we have, of modification. We have been slow in modifying our own craft.

Senator PROXMIRE. They ought to come first, although I think you are right. I think we ought to be consistent and move on ours. I would think that if we are defending Europe, the Europeans ought to be willing to come along, certainly in this area, which is a minimum cost area.

Mr. WHITE. I agree, Mr. Chairman, and we are working with them. I think they will be available.

Senator PROXMIRE. How many U.S. commercial craft are available on this basis now?

Mr. WHITE. Offered up to us, the number is 87, I believe, as of now. We have gone out with a request proposal and we have had responses on 87, and we anticipate that that number will go up.

Senator PROXMIRE. That is far greater than the Europeans. That is six times as much or more. They have none, zero; is that right?

Mr. WHITE. I am sorry.

Senator PROXMIRE. They have none available, and we have 87?

Mr. WHITE. They have none available. We have 87 from the airlines offered to us for modification. We have not done modification. We are just this year beginning the first prototype of that modification.

Congress provided funds in the 1978 budget for a prototype.

Senator PROXMIRE. Well, I hope you press that and let us know about that, because it seems here is an area where we can pick up airlift in this enormously expensive and burdensome operation at minimum cost.

Did the Joint Chiefs' study, Secretary White, consider the NATO-owned assets as substitutes for U.S. military aircraft?

Mr. WHITE. No, sir.

Senator PROXMIRE. Why not?

Mr. WHITE. Because they are not available to us, Mr. Chairman.

Senator PROXMIRE. Why wouldn't we study it as the basis for negotiation——

Mr. WHITE. We are negotiating with them. The question in the JCS study was in terms of what is available, what is programed and what is needed now. I think this is an important asset that we ought to examine.

Senator PROXMIRE. Well, you are studying what the United States has and what we can make available. It seems to me perfectly proper and desirable and sensible, and would be understandable on the part of the NATO allies if we studied theirs, too.

In your statement, General Gregg, you mention the need to provide for non-NATO contingencies as a limit on the usefulness of prepositioned equipment.

General GREGG. Yes, sir.

Senator PROXMIRE. Are the non-NATO contingencies considered in the JCS study, and are requirements for them analyzed to show how much airlift and other mobility forces need to be maintained for a war outside Europe?

General GREGG. No, sir, our study is based on a European scenario, but it is obvious that the capabilities that we have there in mobility forces would give us the capability of responding to contingencies in other parts of the world.

We look upon NATO as, No. 1, a priority contingency, and, No. 2, perhaps the most demanding contingency that we are likely to encounter.

Senator PROXMIRE. You say they would be helpful to us. We found they were helpful, to the limited extent that we were involved in the Arab-Israeli conflict.

General GREGG. Are you speaking now of pre-positioning, sir? I am sorry.

Senator PROXMIRE. Well, let me ask this: Isn't it correct that pre-positioned equipment can be used for wars outside Europe as they were in Vietnam and in the Mideast wars?

General GREGG. I am sorry, sir.

Senator PROXMIRE. Isn't it true that pre-positioned equipment can be used for wars outside Europe as they were in Vietnam and the Mideast wars?

General GREGG. Possibly, sir, but we have two problems I feel we must consider here. One is, you must move that equipment from where it is located in Europe to the contingency area.

Two, we must anticipate constraints which might be imposed on the movement of that equipment, and I think to go beyond that point, sir, would get into sensitive areas.

Senator PROXMIRE. I appreciate that. One of the reasons I raised that point is that that is what we did in the Vietnam and the Mideast wars. There were a lot of complaints about it, but we raided our equipment and reduced our capability in Europe in order to meet the need, something we can do if the President and Secretary of Defense and others decide it is the necessary course under the circumstances.

That means they should do it with their eyes open, I understand.

General GREGG. Sir, we have some views on that, but I think it would be more appropriate, if you would like, if we could submit something to you on that question. I think, though, that we must recognize that there could be limitations on our use of the equipment pre-positioned.

Senator PROXMIRE. We would like to have that if it is unclassified.

General GREGG. What, sir?

Senator PROXMIRE. We would like to have it if it is not classified.

General GREGG. Sir, it is my view that to give you the meaningful discussion on that subject, that we would be compelled to classify it.

Senator PROXMIRE. Now, Secretary White, what I am trying to get here is an understanding of how we might be able to do the job and do it effectively and vigorously, but do it at a lower cost, if possible, and one way of doing it is to rely on pre-positioning of units and this enormously expensive airlift.

You mentioned the vulnerability of pre-positioned units. Aren't airlifted units also vulnerable? Aren't airfields vulnerable? Isn't it easier to knock out an airfield—it is there, stationary and fixed—than to knock out pre-positioned equipment because it is, perhaps, hidden and you can move it around—dispersed?

Mr. WHITE. There is no question but that airfields are vulnerable. The pre-positioned stocks are vulnerable. If you have a number and maintain it, it is hard to keep secret. We are kidding outselves if we are thinking people don't know what is in those buildings. That is a fixed target, too. The airfields are a fixed target, too.

In the aircraft, though you have the capability of selecting airfields that are intact when you deliver your equipment, you have options on where you deliver it.

Senator PROXMIRE. Of course, the options are limited. A number of airfields can be knocked out. You can move it around to some extent, although I agree that you do have a very serious problem.

General Gregg, a study of mobility forces done by CBO at my request says——

General GREGG. Done by whom, sir?

Senator PROXMIRE. The Congressional Budget Office says, "Attrition rates would have a tremendous impact on U.S. ability to mobilize within a specified time period."

Now, do you agree, what does the JCS study consider attrition rates for airborne aircraft as well as those on the ground?

General GREGG. I think the attrition rate would obviously be impacted by the number of days of warning time. In our study, we did—will you pardon me 1 minute, sir?

Senator PROXMIRE. You bet.

General GREGG. Mr. Chairman, we did look at the attrition of our mobility forces, but in our analysis we did not find the attrition to inflict a crippling blow to our capability to move forces to Europe.

Senator PROXMIRE. Did you look at the attrition not only of grounded aircraft but aircraft in the air—airborne? Some of them are pretty vulnerable. All are vulnerable, in fact.

General GREGG. It is my understanding——

Senator PROXMIRE. You see, what I am getting at is that I get the feeling, and maybe it is unfair, but I get the feeling that somehow, the Pentagon didn't want to really consider pre-positioning as a substitute for airlift, and almost every argument that you can make against pre-positioning you can make with virtually equal force against the airlift.

Maybe not quite, and it varies somewhat but in the aggregate, it seems to me the arguments are almost as persuasive.

Mr. WHITE. Mr. Chairman, may I make a couple of responses?

First of all, we are getting into a lot of numbers; we have an enormous problem in my judgment in terms of support in the event of a NATO war.

Second, we have a problem with respect to deterrence, really, and it is first with respect to deterrence.

Third, we have been and are continuing to increase the amount of pre-positioning. Our desire is to increase the amount of pre-positioning. So I don't think there is any reluctance on our part not only to entertain, but to——

Senator PROXMIRE. Are you really considering pre-positioning as a tradeoff, or just as an add-on? You want to get as much as you can possibly get, so you will take pre-positioning, too?

Mr. WHITE. I don't think it is a question of getting all we can get. We have other requirements, too.

No, it is a question of a mix of forces in order to deliver what we need.

Senator PROXMIRE. Let me proceed.

The Congressional Budget Office report said, "What is the feasibility of increasing crew ratios for the KC–135's as an alternative to the ATCA?" A contractor for this new program, the advanced tanker-cargo aircraft, has just been chosen.

Was the question stated by CBO analyzed before the decision was made and, if so, will you provide a copy of the analysis to this subcommittee?

Mr. WHITE. I will ask General Kuyk for that.

General KUYK. Sir, we have reviewed the possibility of increasing those ratios. Certainly, the scenario that is normally visualized as a major requirement for the ATCA would be an indication of increased tensions in the world, and, at that time the KC–135's would be required for the alert rate of the strategic bomber force.

Certainly, the airplanes that would be allowed to be used for the general purpose force can be increased in their utilization rate, and we took that into consideration in our planning. We take them to higher rates of approximately 6 hours per day.

Certainly, in the case of the ATCA, in addition to the sheer numbers of airplanes that can do refueling, the requirement is also based on the capability to offload much larger quantities of fuel farther away from the United States.

The ATCA would allow us to refuel C–5's en route to the Middle East when based far away——

Senator PROXMIRE. Can you give us a copy of the study?

General KUYK. Yes, sir.

[The following information was subsequently supplied for the record:]

Tanker Requirement Studies are classified; therefore, I will provide an unclassified summary. If required, copies of the classified studies could be provided separately.

With respect to using the KC–135 for the long range ATCA mission, several observations can be made. The KC–135 is performance limited and can only offload significant amounts of fuel at short to intermediate ranges (1500–2000NM). It cannot support deployment operations at strategic ranges without being forward based in foreign host countries. At shorter ranges the KC–135 has about one-quarter the capability of the ATCA. Contingency surge operations are planned at a KC–135 utilization rate of six hours per day which compares to airline 707 operations of seven hours per day. The ATCA, on the other hand, is planned to sustain a surge rate of 10 to 12.5 hours per day, which compares with commercial DC–10 fleet averages of nine hours per day with some operators averaging up to fifteen hours per day. Consequently, at short to intermediate ranges the ATCA will carry four times the payload and fly nearly twice as many hours as the KC–135, and at long ranges will provide a capability that the performance limited KC–135 cannot achieve.

Senator PROXMIRE. Mr. White, the DC–10 was chosen to be used as the ACTA, as the advanced tank cargo aircraft. Can it be modified to carry outsize equipment, and do present plans call for such modification?

Also, it is correct that it is more feasible to modify the 747 for outsize equipment and by selecting the DC–10, the Air Force may have to build yet another cargo plane to replace the C–5?

General KUYK. Sir, the answer to the first question is no. The DC–10 cannot carry outsized cargo. It can carry approximately 64 percent of the oversized cargo. That would include such things as the 105 Howitzers, which can go on the DC–10. The 155 self-propelled gun cannot.

We currently have no plans to modify the DC–10 to make it an outsized carrier.

Senator PROXMIRE. Then it would be more feasible to modify the 747 for outsized equipment, and if you have no plans to modify it, the DC–10 for that purpose, I suppose you would respond that you are not building yet another cargo plane to replace the C–5, that the DC–10 is not designed for that purpose?

General KUYK. That is correct, sir, it is not.

Senator PROXMIRE. The question that Mr. Kaufman reminded me of is, why did you pick the DC–10 instead of the 747, since you are going to have to build another plane when the C–5 wears out?

General KUYK. Sir, the ATCA selection was based on six scenarios that showed a break in the scenarios between air refueling and support-type cargo missions. These six scenarios were evaluated against the capability provided by each airplane and the cost of the respective airplanes. On the basis of capability and the cost for the life cycle, the DC–10 was the winner.

It was not based on——

Senator PROXMIRE. The fact is that you will have to build a new plane to replace the C–5, and you have given up on——

General KUYK. I think we certainly have looked at the increased outsized requirement. Our current solution is to retain the C–5 in useful condition well passed the year 2000 with a wing modification.

That is the current Air Force position on the solution to that problem.

Senator PROXMIRE. Let me ask this: I understand ATCA was at one time considered for use as a cruise missile carrier, also.

Why has the cruise missile factor been eliminated, and isn't it true that the 747 would be more versatile?

General KUYK. I think in answer to the second question first, we do not see necessarily that the 747 would be more versatile. Certainly it could carry more cruise missiles than a DC–10.

Senator PROXMIRE. And more outsized equipment, too.

General KUYK. Yes; and more oversize equipment, but you get less airplanes for the dollar. That is certainly a key factor in the equation. We have not directly looked at carrying cruise missiles on the ACTA.

However, as we go ahead with the cruise missile studies, we are going to consider both of these airplanes for that use, both the DC–10 and the 747.

Senator PROXMIRE. General Gregg, I understand the advanced medium short takeoff and landing transport is being developed to transport items such as personnel carriers and tanks from one part of the battlefield to another. The 20-year life cycle cost is estimated at $16 billion.

Critics say it is not cost-effective because moving such items around Europe by rail or with the kinds of tank transports used by the Soviets is a more efficient and versatile means of tactical airlift.

How do you respond?

General GREGG. First of all, sir, source selection is not sufficient yet to identify what the cost will be. We know it is going to be an expensive program. What we are looking at here is a followon aircraft to replace our aging tactical airlift fleet.

The C–130 and the other aircraft which constitute now our tectical airlift fleet are aging, and we will be phasing them out in the 1980's. We must replace it with a suitable aircraft, and looking at what kind of aircraft we would like to see, we would like to see an aircraft that will give us some enhanced capability over the C–130, which we now have.

Two specific things we would like to see are an aircraft that would be able to take advantage of more of the airfields, that is, an aircraft with shorter landing and takeoff capability and the capability of moving all of the items currently in our Army inventory.

The AMST seems like a very attractive candidate to do all these things.

Senator PROXMIRE. I wonder if it is not cheaper and more practical to use the ground transport? That is really the fundamental question. The critics argue that it would be easier, once you are in Europe, to move this equipment around by rail or by the kind of tank transport the Soviet Union has, rather than by aircraft.

General GREGG. Sir, in order to give us the mobility we need in the European theater, we simply need the capability of moving combat formations by air. I think we would certainly use rail, we would road-march certain units.

We would use many means of transporting our combat forces from one location to the other, but in the judgment of our commanders, we must have the capability of rapidly relocating combat formations, and the only way to do that is by air.

I might say, sir, that the Soviet forces have a substantial capability in that regard as well.

Senator PROXMIRE. They have air transportation?

General GREGG. Pardon me, sir.

Senator PROXMIRE. Do they have air transport to move tanks?

General GREGG. The Soviets have a considerable cargo transport capability and I believe they can move tanks in them as well.

Senator PROXMIRE. Do you agree with that, General Kuyk?

General KUYK. I don't believe they have anything that will do that, sir. They have a very small number of large airplanes that might do it. We can get it for the record.

I prefer not to comment. I am not an expert.

Senator PROXMIRE. Submit that for the record, then, if you would.

[The following information was subsequently supplied for the record:]

The Soviets have the following miltary cargo transport aircraft:

[Security deletion] x An–12/CUB (similar to U.S. C–130).

[Security deletion] x Il–76/CANDID (similar to U.S. C–141).

[Security deletion] x An–22/COCK (roughly in the same size class as the C–5 except An–22 is a turboprop).

[Security deletion.]

Senator PROXMIRE. Will you provide the committee with the DOD estimates of the 20-year life estimate of ATCA and so forth?

Mr. WHITE. Yes.

[The following information was subsequently supplied for the record:]

The DC-10 ATCA 20-year life cycle cost estimate is $1,489.52 million. Included in the estimate are $762.55 million for the procurement of 20 aircraft; $266.27 million for logistics support; and $460.70 million for Air Force costs for fuel and personnel.

Senator PROXMIRE. It may be possible to pre-position equipment in ships such as the LHA which could be kept in European ports and made available for non-NATO contingencies.

Was this possibility considered as a substitute for military airlift in the JCS study?

Mr. WHITE. Pre-positioning, is that what you said, Mr. Chairman?

Senator PROXMIRE. Yes.

Mr. WHITE. No, it was not.

Senator PROXMIRE. General Gregg, the General Accounting Office criticized the proposal to increase C-141 and C-5 utilization rates as unrealistic on the grounds the Air Force cannot reasonably be expected to operate at a 12.5-hour surge rate for 40 days and a 10-hour rate after 45 days.

GAO says Air Force experts told them privately that the highest reasonable rates would be twice the peacetime rate of 2.5 hours for the C-5 and 3.5 hours for the C-141.

How do you respond to that?

General GREGG. First of all, sir, I feel we have a great responsibility to make the maximum use of the resources we already have. Increasing the utilization rate is one way of achieving this.

We see nothing inherent in our C-141 and C-5 fleets that suggests to us that we cannot achieve the increased flying hour rates which we have programed, given the necessary use and repair parts, that is.

Senator PROXMIRE. What was the surge rate in the Middle East war? It was only 11 days.

General GREGG. I cannot answer that, sir.

General KUYK. Sir, we took the airplanes to a little over 5 hours a day, but I think at the same time it would be fair to indicate that we did not have enough requirements during that period of time, and the availability of landing strips to cause us to use all of our airplanes.

Senator PROXMIRE. Have we ever, at any time, under any circumstances, reached 12½ hours or anything like it over a sustained period?

What is the best experience you ever had?

General KUYK. I think the best experience was the 141's during the war in Vietnam, and at that time we were in the area of 7 hours a day sustained.

Senator PROXMIRE. Then, the GAO criticism seems to be pretty sound, that it would be unrealistic to go to 12½ hours. That is almost twice the best rate you have ever had under the best circumstances in all our experience.

General KUYK. To speak as an operator, I think it is scenario dependent. It is possible if you run it from one base and back to the other. For example, the way Lufthansa is operating their 747 from Frankfurt to JFK 6 days a week.

If we went from Dover to Frankfurt, I think we could get very high utilization on the C–5, but it does take having the experienced people, the loading equipment able to handle it, and the parts at those bases. I think we have a goal that is optimistic, but I think it is a correct way for us to plan. Whether we can attain it, I think, will depend——

Senator PROXMIRE. You seem to be asking for a lot of money based on speculation not grounded on experience. I think it is nice to dream and to try. Maybe we could. In the past we found everybody seemed to proceed better than we expected.

The great experience we had was in World War II, when President Roosevelt talked about how we were going to build a few thousand planes and people said it was impossible, and, of course, we built far more.

We have a tendency to do more than expected, but I think we should try to be as realistic as we can, and maybe you are reaching a little too far.

General GREGG. Sir, we do see a little experience in this area from the civilian airlines carrying cargoe, and they are operating in the range of 14 to 16 hours per day.

Senator PROXMIRE. Well, GAO also pointed out in its report there might not be enough fuel in Europe to refuel aircraft for the return to the United States. And there might not be enough airfields in Europe to accommodate the planes in a European crisis.

What is your comment on that?

General KUYK. Sir, we have taken a look at that, and, certainly, that goes along with the lines of the attrition argument. It is difficult to clearly establish it.

The alternatives would be, one, to come out to England or Spain and go to those bases for ground refueling.

The other option would be to use an ATCA for refueling on the way over and the way back.

Senator PROXMIRE. Did you want to follow that up, General Gregg?

General GREGG. Sir, I want to correct myself on an earlier comment. In response to your question whether or not we looked at some scenario other than the European one in our strategic mobility study, I said that we did not. But, in fact, we did.

We did look at a Middle East scenario, but in a nonmobilization mode. So a Middle East scenario was looked at in our study, and I want to correct that.

Senator PROXMIRE. Gentlemen, I have considerable admiration for all three of you. I think you are responsive and intelligent and thoughtful. I think you are all very able officials, and what I am going to say in conclusion isn't meant to reflect in any way on you. But I must say that after studying the Pentagon's airlift and mobility proposals at some length I can only conclude that Presidents, Defense Secretaries, and Congresses come and go, but programs developed by bureaucrats live on.

All the airlift proposals described by the Armed Services Committee as a patchwork and low-priority programs are being pushed today with the same vigor as when they were patched together in 1973.

What is being presented today is even the same crazy quilt with just a few more patches.

The airlift proposals go forward despite the passage of 4 years during which, according to the Pentagon, the Soviet conventional threat to NATO has significantly increased.

Only two shifts in policy seem to have occurred since last year.

First, the Pentagon wants to add more pre-positioning not as a substitute but as an add-on to the old program.

Second, the stated requirement has been taken underground. The cloak of secrecy now surrounds airlift and mobility requirements, although they were discussed in public last year.

We also seem to have a conflict in interpretation of the February 1977 report. The Defense spokesman say alternatives to military airlift are considered. My undertsanding is that GAO concludes otherwise.

These and other issues will be taken up tomorrow when our witness will be Elmer Staats, Comptroller General of the United States.

Thank you very much.

The subcommittee will stand in recess until tomorrow at 10 o'clock.

[Whereupon, at 11:47 a.m., the subcommittee recessed, to reconvene at 10 a.m., Thursday, December 22, 1977.]

ECONOMICS OF DEFENSE PROCUREMENT: THE C–5A AND STRATEGIC MOBILITY

THURSDAY, DECEMBER 22, 1977

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON PRIORITIES AND
ECONOMY IN GOVERNMENT OF THE
JOINT ECONOMIC COMMITTEE,
Washington, D.C.

The subcommittee met, pursuant to recess, at 10:03 a.m., in room 5302, Dirksen Senate Office Building, Hon. William Proxmire (chairman of the subcommittee) presiding.

Present: Senator Proxmire.

Also present: Richard F. Kaufman, general counsel; and Mark Borchelt, administrative assistant.

OPENING STATEMENT OF SENATOR PROXMIRE, CHAIRMAN

Senator PROXMIRE. The subcommittee will come to order.

Yesterday, as the hearing opened, I named the rewinging of the C–5 as my candidate for biggest turkey among the airlift programs proposed by The Department of Defense. Perhaps I shouldn't have done that.

Now that I have heard the Penatgon's official explanation of how it plans to reinforce NATO in a European war, I cannot for the life of me make up my mind which of the proposals deserves to be first on the chopping block.

Current mobility proposals are estimated to cost from $10 to $12 billion. If experience is our guide, those estimates will go up once the programs are in full swing.

How, in good conscience, can the taxpayers be asked to foot this bill?

In the first place, the information needed to understand whether the requested programs will accomplish their intended mission is being withheld from the public on grounds of secrecy.

Second, there are many unanswered questions about the individual items in the Pentagon's mobility package. One question is whether it makes sense to spend $1.3 billion to fix the C–5 when a whole new fleet of planes could be purchased for that money.

Another is whether it makes sense to spend billions on a new type of plane intended to haul tanks and other large pieces of equipment from one part of the battlefield to another.

Another is whether it is realistic to expect the utilization rates of cargo planes to be raised to about twice the rates that have been achieved in the past. The list can go on and on.

A third reason for taxpayers to squawk back at the Pentagon's birds is that the United States so far has carried the entire burden of a European airlift program and present plans do not include our NATO allies.

Last year the Comptroller General reported that he was being denied access to information by the Pentagon needed to evaluate the strategic mobility requests. GAO was able to report its findings on individual components of the mobility requests and was quite critical.

Several committees directed the Pentagon to do the type of study requested by the Comptroller General and to give him access to it and other information so that it could be evaluated.

The Joint Chiefs of Staff completed a study, GAO has reviewed it, and we are here today to receive the results of that review. We will also listen to anything else GAO has found with respect to strategic mobility.

I am pleased to welcome Elmer Staats, Comptroller General of the United States, as today's witness.

Mr. Staats, your reports on mobility have been most helpful to this committee and others, and I hope you will continue your valuable efforts.

After you present your statement, I will have some questions, and I look forward to a fruitful discussion.

STATEMENT OF HON. ELMER B. STAATS, COMPTROLLER GENERAL OF THE UNITED STATES, ACCOMPANIED BY JEROME H. STOLAROW, DEPUTY DIRECTOR, PROCUREMENT AND SYSTEMS ACQUISITION DIVISION, AND FRANK P. CHEMERY, ASSOCIATE DIRECTOR, PROCUREMENT AND SYSTEMS ACQUISITION DIVISION

Mr. STAATS. Thank you very much, Mr. Chairman.

With me are Jerome H. Stolarow, Deputy Director of our Procurement and Systems Acquistion Division, and Mr. Frank Chemery, also in that division.

I would like to, with your permission, read my statement and, as you suggest, respond to your questions.

We are pleased to appear here this morning, at your request, Mr. Chairman, to discuss some of the economic issues involved in strategic mobility, and particularly new military airlift programs. As you know, GAO has issued several reports in the past, and we are currently preparing reports dealing with the recently completed Joint Chiefs of Staff's study on "Strategic Mobility Requirements and Programs"; and the justification for stretching the C–141 aircraft.

Because of the Department of Defense security restrictions, our statement today, of necessity, will have to omit references to specific details such as tonnages and kinds of equipment to be moved, need dates, warning times, readiness of forces, or assessment of threat. We will be happy to discuss these further in closed session if you desire.

I would like to address my first remarks to the JCS study. In several hearings on this subject last year concern was expressed about how the Defense Department determined the airlift requirements for a European contingency and the cost implications of the proposed airlift programs. Since then, as encouraged by several of the committees of Congress, the JCS completed a study and prepared a report on strategic mobility requirements and programs.

This report in our opinion is a good beginning and it represents the first comprehensive look at the strategic mobility mission. However, there are a lot of questions yet to be answered. This has been recognized by DOD, and followup studies on the matters covered in the initial effort are being initiated. In our opinion, because of the many unanswered questions, this study should not be relied on by the Congress as a justification for major airlifts programs.

Based on the judgment of senior military officials, there will be a need to move substantial quantities of equipment to Europe—to augment our forces that are currently in place—in the event of a possible attack by the Warsaw Pact forces. The augmentation of existing forces is planned through a combination of airlift, sealift, and pre-positioning of supplies and equipment in Europe for military units that will be moved there from the United States.

The problem that must be resolved by military planners is how to provide the needed forces in the period of time deemed critical to preclude a Warsaw Pact victory. The questions that require resolution deal primarily with the cost and effectiveness of various combinations of airlift, sealift, pre-positioning and possibly the forward deployment of additional forces.

Based on our work in this area, we believe there are a number of critical questions that should be addressed by the Congress—some necessarily in closed hearings because of the security implications—before approval is given for major new mobility programs. Those questions are:

First, there is growing concern by military officials that a short-warning period would precede a Warsaw Pact attack. What impact would there be on the strategic mobility planning if the currently anticipated warning time is changed?

Second, the Army has serious combat readiness problems. Why does the DOD continue to justify strategic mobility requirements based on a high state of Active Army and Reserve Force readiness? How will the readiness problem be resolved within current budget constraints?
the DOD continue to justify strategic mobility requirements based on

Third, how cost effective is the program to stretch the C–141 considering the minimal additional capability it offers in the period preceding a European conflict?

Fourth, in comparison with other alternatives, such as pre-positioning, is the C–5A wing modification program cost-effective in view of the limited amount of U.S. Army outsize equipment it would carry?

Fifth, what is being done to assure that United States and European logistics facilities, that is, ports, airports, transportation, have the capability required at the time of national emergency?

And, finally, in view of the increase in the availability of various types of containerships, what is being done to assess the strategic mobility potential these ships would offer at the time of a national emergency?

I cannot stress enough the importance of these questions to the Congress in its consideration of proposed mobility programs. A good understanding of the complete mobility mission is essential to a determination of airlift requirements and related program proposals.

HOW WERE PRESENT AIRLIFT REQUIREMENTS DETERMINED AND JUSTIFIED?

Our primary concern last year was that DOD had not justified new airlift programs in terms of a requirement to move certain tonnages to specific locations in a prescribed period of time. We are still not satisfied that this has been done in the JCS study—although a total strategic movement requirement has been identified.

In the event of a European conflict, DOD officials consider a rapid deployment capability critical in preventing initial Warsaw Pact advances, as well as being important in deterring the actual outbreak of hostilities. In case war does begin, the attack would be met with pre-positioned forces, supplemented in the early stages by deployment of forces first by air and later by sea. Airlift is, therefore, an important element of U.S. strategic mobility plans.

Airlift requirements must be considered, however, in relation to other deployment alternatives such as sealift and pre-positioning. The JCS study did not consider sealift, pre-positioning, or commercial aircraft options as alternatives to the current airlift proposals for the European contingency. Each alternative has certain advantages and disadvantages, but, until these alternatives are studied, it will not be known which would be the most desirable.

In prior hearings and in a 1976 report, we recommended that as a minimum the Department of Defense should identify the airlift requirement in terms of specific items and weights and required delivery dates. The response from Defense was the JCS study on strategic mobility requirements and programs.

As part of the study, total movement requirements for the period were determined based on a threat assessment. Then, the forces needed in battle and required order of delivery were determined after considering pre-positioned equipment and forward deployed forces. In the process, less essential or nonessential units and equipment were either deferred or deleted, and all items were arranged in the order of descending priority. This list of total movement requirements was then assigned to existing or projected quantities of either air or sealift assets. The fastest method of delivery, air or sea, was selected for given groups of units according to their relative priority.

The sequence followed in the study was to exploit the existing and projected airlift capability and then use other available and projected lift assets. Thus, the current and proposed airlift capability determined how much would be airlifted. This became the airlift requirement.

In other words, the study developed a total requirement based on specific items of equipment, weights, and delivery dates that need to be moved to Europe, but it did not develop a requirement limited to what must be airlifted. Without this information, Defense does not know what strategic airlift capability is needed or whether alternatives to airlift, such as pre-positioning or sealift, could meet the needs at a lower cost.

During our current reviews, we were denied certain detailed information concerning airlift requirements and capabilities. This data was considered by DOD to be part of the war plans. Recently, however, we were told we could have access to these plans and we plan to do a sample verification of airlift requirements in the near future.

WHAT IS THE STATUS OF THE PROPOSED AIRLIFT PROGRAMS?

As you requested, I will now discuss the status of the various airlift programs proposed or under consideration by the Air Force. There are a number of procurement, modification, and support programs that have either been proposed or are under consideration. The total cost is not clear at this time, but could very well exceed $10 to $12 billion.

THE C–141 MODIFICATION PROGRAM

The C–141 aircraft is being modified because the Air Force has found that it normally cannot be loaded to its weight capacity. As a result, the Air Force has a $677 million program to stretch the C–141 fuselage allowing the C–141 fleet to carry an additional 21,000 tons during the assumed warning period. This increase is relatively minor in terms of total requirements and current capabilities, especially in view of the estimated cost of $677 milllon. As I mentioned earlier, this program should be specifically justified by DOD in terms of overall priorities and requirements for airlift and the cost effectiveness of this particular modification.

In May 1975, the Air Force awarded a contract to Lockheed-Georgia Co. to develop a prototype stretch C–141. Lockheed recently completed this prototype ahead of schedule at a cost of $38 million. Structural and flight tests have indicated that stretching the aircraft is technically feasible.

INCREASED UTILIZATION RATES

The Air Force estimated it would cost $197 milllon for crew costs and $364 million for war reserve spare parts and other supplies in order to be able to increase the utillzation rates of the C–5 and C–141 aircraft in an emergency period.

To reach high utilization rates, the Air Force estimates that a total 280 C–5A and 936 C–141 flight crews will be required. As of October 31, 1977, there were only 176 C–5A and 656 C–141 flight crews.

The ability of the Air Force to attain significantly higher emergency use rates is questionable in our opinion. One of the problems is the additional demands placed on the maintenance support required by the increased utilization rates. This matter is dealt with in much greater depth in a separate report we issued on October 21, 1977. The report is classified, but, with your permission, I will provide a copy of the unclassified digest of that report for the record.

Senator PROXMIRE. We would appreciate that.

[The unclassified digest of the report follows:]

COMPTROLLER GENERAL'S REPORT TO THE CONGRESS ON "AIR FORCE MAINTENANCE DEPOTS—THE NEED FOR MORE RESPONSIVENESS TO MOBILIZATION AS WELL AS PEACETIME EFFICIENCY"*

The U.S. Air Force, like the other military services, maintains depot repair capability to assure a controlled source of competence to: keep aircraft and other equipment ready in peacetime; sustain this hardware in the initial surge of a contingency or war; and provide a base for rapid expansion.

*This is an unclassified digest furnished in lieu of a report containing classified security information.

Responsiveness, immediate and flexible, is considered to be of a higher priority than the need to obtain efficiency for peacetime operations.

How well has the Air Force alined its maintenance depot capability and capacity to respond to sudden need and expansion? How productively has it managed its resources in peacetime? GAO wanted to know and began by reviewing mobilization planning at Air Force Logistics Command, Headquarters, and by evaluating various productivity indicators and work processes at one of the five Air Force Logistics Centers. GAO also relied on previous work at two other centers.[1]

The Air Force spent about $7.7 billion in fiscal year 1976 to operate and maintain 8,450 aircraft, large numbers of missiles, and other equipment to keep them operational. Of this, about $2.8 billion was spent for operations and maintenance, primarily at the logistics centers.

PLANNING FOR MAINTENANCE DEPOTS: RESPONSIVENESS TO MOBILIZATION

The Air Force has made significant progress in measuring the depot maintenance capability and capacity it needs to meet mobilization requirements. Air Force planners have been concerned about the ability of depots to respond to high surges in maintenance during a war or contingency of intensity and short duration.

Maintenance depots, as currently configured, cannot support requirements which the Air Force anticipates in a "surge" period for most of its weapon systems. Under these conditions the Air Force had to determine which systems could and could not be supported. GAO questioned the Air Force plans because flying hour estimates for high surge transport aircraft exceeded the number possible under present conditions. (See pp. 8 to 14.)

Even if flying hour estimates were not questioned, the Air Force needs to consider subsidiary factors distorting its estimate of readiness such as not fully assessing the: ability of contractors to meet their share of the surge requirements (see p. 14); number and skill levels of people needed to meet surge requirements at the depots (see pp. 16 to 18); ability to hire and train people needed in each geographical location (see p. 18); estimates for repair parts (see pp. 20 to 21); and facilities and equipment bottlenecks in depot production processes (see pp. 21 to 23).

MEASURING PEACETIME PRODUCTIVITY

If depots are to respond in wartime then people, facilities, and supply support have to be effectively integrated and efficient in peacetime. The more productive depots are, the easier it should be to change to a war or contingency.

Industrial engineering techniques greatly affect the depots' ability to produce. GAO found much could be done. Problems include:

Analyzing job design/work methods, one of the first steps to successfully installing a work measurement system, has not been adequately emphasized. Savings of millions of dollars are possible. (See p. 26.)

Labor standards are of questionable accuracy and are not kept current. (See p. 27.)

Significant productivity is being lost because of chronic problems such as lack of repair parts. (See pp. 32 to 33.)

Subsequent to GAO's evaluation of the San Antonio Air Logistics Center in 1974, the Air Force indicated it was introducing a Depot Maintenance Programming, Budgeting and Costing System. The system as designed to implement actual hour, job order cost accounting in lieu of standard cost accounting and to correct the deficiencies of the current system. However, in September 1977 the Air Force canceled it. (See p. 33.)

PEOPLE

To achieve its mobilization objectives Air Force depots will have to realine vast numbers of personnel to match changes in weapon system support and absorb over 10,000 additional personnel quickly during the initial mobilization phase. GAO believes much work is needed to assure that in time of crises the Air Logistics Centers can perform their assigned tasks, including acquiring and training people.

Air Force Logistics Command has made significant efforts to motivate its personnel. One Center reported reduced sick leave, personnel turnover, overtime, and

[1] "An Industrial Management Review of the Maintenance Directorate San Antonio Air Materiel Areas, San Antonio, Texas," (B-159896, April 1974). "Assessment of the Air Force's Planning for the Technology Repair Center Concept" (LCD-76-429, July 1976).

production time as a result of a pilot job enrichment program. The Logistics Command has decided to do the same thing at all of its installations. A number of constraints may impair this because:

Performance appraisals do not meet the objectives set forth for them and do not have the confidence of most of the work force. (See pp. 36 to 38.)

Promotional and upward mobility opportunities are limited and people feel at a dead end. (See pp. 38 to 39.)

Awards, a motivational tool, could be used more effectively to offset the lack of promotional opportunities. (See pp. 39 to 40.)

Training opportunities and defined training objectives are limited. (See pp. 40 to 41.)

The above factors limit first-line supervisors' influence. (See p. 41.)

RECOMMENDATIONS

GAO recommends that the Secretary of Defense, along with the Secretary of the Air Force:

Establish more realistic surge data for each weapon system based upon what is achievable rather than what can be achieved under unlikely optimum conditions. Peacetime supportability, particularly bottlenecks, is a significant indicator to consider.

Define what and how much contractors can support in mobilization.

Evaluate its people, facilities and equipment, and repair parts, including production bottlenecks to achieve better alinement of its resources and more timely response.

The following recommendations are made in the context of the Air Force's continuing and aggressive efforts to improve the productivity of its maintenance facilities. The Secretary of the Air Force should require the Air Force Logistics Command to: increase methods work significantly; review, upgrade, update, and control labor standards; and make fuller use of various productivity measurement tools.

The Air Force Logistics Command efforts to motivate its people could be enhanced if the command were to: insure first-line supervisors understand and fully exploit the advantages of the appraisal system; develop better means to recognize degrees of individual performance; better recognize the impact of pay scales in motivating employees; increase the use of awards; and accurately monitor training efforts and evaluate the results.

AGENCY COMMENTS

In a May 18, 1977, letter, GAO asked the Secretary of Defense to comment on this report. As of the date of this report, Defense comments have not been received. GAO, however, met with Air Force officials and where appropriate has made changes in the report reflecting their comments.

THE CIVIL RESERVE AIR FLEET

Mr. STAATS. The estimated cost of the Civil Reserve Air Fleet program over a 5-year period is $592 million. The program is intended to modify commercially owned and operated wide-bodied passenger aircraft to permit them to carry mil tary cargo. Some commercial aircraft are already in the Civil Reserve Flee; Because of objections to an open ended arrangement which provided annual payments to the air carriers over the life of the modified aircraft, the Congress did not approve the program last year.

We have noted in previous reports that the CRAF program appears to be cost effective—providing a substantial reserve capacity at a relatively low cost.

THE ADVANCED MEDIUM SHORT TAKEOFF AND LANDING TRANSPORT PROGRAM

Currently, due to the considerable changes in the program for the advanced medium short takeoff and landing transport, AMST, the Air Force is unable to project the costs of the program. The aircraft now utilized for tactical airlift are nearing the end of their useful service. At one time, the AMST was viewed as a replacement for all the aging C–7, C–123, and C–130 aircraft, and the program was estimated at $6.3 billion for 277 aircraft. As of November 1977, both Boeing and McDonnell Douglas were flying prototype AMST aircraft and approximately $236 million had been spent for their development and testing. Selection of the winning design is scheduled for February 1978.

Although the AMST was not used in the JCS study as a strategic airlift asset, the AMST contractors believe it would offer some strategie airlift capability.

THE ADVANCED TANKER-CARGO AIRCRAFT PROGRAM

Because of changes in the advanced tanker-cargo aircraft program the Air Force was not able to project a current cost estimate for the program.

This program has been justified as an aerial tanker to support increased demands for inflight refueling and because of deficiencies in the existing tanker fleet of KC–135's. The AT–CA concept is to purchase standard off-the-shelf DC–10's and modify them for military use. The initial development contract was awarded to McDonnell Douglas this week.

We have been told that the Air Force initially requested 15 to 20 aircraft which was later increased to about 40 by the Office of Management and Budget. The requirement was later increased to about 90 aircraft on the basis of a perceived requirement to respond to worldwide emergencies. The actual number of aircraft that may be procured has not been determined by the DOD at this time. The price of a modified DC–10 is about $37 million.

As currently envisioned, the AT–CA could carry military cargo similar to that carried by the C–141 stretch aircraft. It would not have the capability the C–5A does for outsize cargo; that is, equipment that is too large to be moved in any other aircraft. The potential airlift capability of the AT–CA was not considered in the JCS study, although the DC–10 aircraft have the range and payload for strategic mobility missions.

THE C–5A WING MODIFICATION PROGRAM

The C–5A is the only aircraft that can move the relatively small amount of U.S. Army outsize equipment. As you know, the C–5A aircraft was originally expected to have a useful life of 30,000 flight hours. Because of technical problems the wings must be modified in order to achieve that goal. The estimated cost of the modification program is about $1.3 billion.

In 1977, there were two significant milestones in this program. In January, Lockheed-Georgia began building two wing kits for initial test and evaluation. In November the Air Force performed a critical design review of the proposed wing fix. Reportedly, the results were favorable.

No additional major milestones are expected until 1979 when, one, fatigue and flight testing are begun, and two, the production decision is scheduled. The plans are for the final modifications to be completed in mid-1987.

As mentioned earlier, we are of the opinion that Congress should review this program closely to ascertain if it is the most cost-effective solution to the problem of so-called outsize cargo.

WHAT ARE THE COSTS OF PRESENT PROPOSALS AND POSSIBLE SAVINGS OF ALTERNATIVE APPROACHES?

The DOD's fiscal year 1978 budget presentation showed a total program cost of $3.1 billion for four programs proposed to improve the current strategic airlift capability. The cost of the individual programs are: $1.3 billion for the C–5A wing modification program; $592 million for the civil reserve air fleet modification program; $677 million for the C–141 modification program; and $561 million for the spare parts and crew-training costs to increase the utilization of the C–5A and the C–141. The requested funds are for R. & D. and procurement for the first three programs, and spare parts and additional crew training for the increased utilization program.

Other alternatives, such as the contribution that the advanced tanker-cargo aircraft, AT–CA, could make to the movement of cargo, have not been considered by the DOD. The AMST, although considered to be a tactical transport, might also offer some strategic airlift capability. Costs for these programs have not been announced as yet.

We do not agree with the testimony presented yesterday which indicated that DOD has considered all althernatives in assessing the strategic mobility pro lem. The JCS study did not make tradeoff analyses between various combinations of airlift, sealift, pre-positioning, or forward deployment.

Thus, at this point in time, we do not know what the most cost-effective solution would be.

In summary, it is not clear what the current airlift proposals should be or what they should cost, given the postulated Warsaw Pact threat. Further study needs to be made on various alternatives to counter the threat to the European NATO countries.

Current Department of Defense guidance is based on a specified warning period before a Warsaw Pact attack. There is growing concern, however, that the Warsaw Pact could attack with less warning time. The warning period guidance to be used must be left to the judgment of military planners. This guidance, in our opinion, is the key to strategic mobility planning and should be discussed in great detail with the appropriate committees.

The Secretary of Defense is currently considering a change in the guidance to account for the increased capability of the Warsaw Pact. This would have a considerable effect on strategic mobility plans and related funding requirements.

That concludes my statement, Mr. Chairman. We will be glad to answer any questions you may have on military airlift.

Senator PROXMIRE. Thank you very much, Mr. Staats. That's an excellent statement, and you certainly come right to the point.

You point out in your statement in discussing the study by the Joint Chiefs, you say:

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The sequence followed in the study was to exploit the existing and projected airlift capability and then use other available and projected lift assets. Thus, the current and proposed airlift capability determined how much would be airlifted. This became the airlift requirement.

The capability then became the requirement, you are saying. You are saying the study developed a total requirement based on specific items of equipment, weights, and delivery dates that needed to be moved to Europe, but it did not develop a requirement limited to what must be airlifted.

You argue that without that information, Defense itself, not just the Congress or the public, Defense doesn't know what strategic airlift capability is needed or whether alternatives such as pre-positioning or sealift could meet these needs at lower costs.

Yesterday the Pentagon witnesses said that in the JCS study they did consider airlift, sealift, and pre-positioning as alternatives to the various proposals now pending.

In your statement, Mr. Staats, you flatly deny that these alternatives were considered. You say the tradeoff analyses were not made and that at this time we still do not know what the most cost-effective solution would be.

Can you shed any light on this conflict between the Defense Department and your interpretation of what the JCS study considered?

Mr. STAATS. I would like to respond and then ask Mr. Stolarow to add to my response.

What we are saying is that they have taken a good initial step, which is to determine their total requirements, but they have not taken the second step, which would be to determine what mix of capabilities would produce the result on the least cost basis.

In other words, they have looked at total requirements, but they have not decided what is the best mix of pre-positioning, of forward deployment, of sealift, and of airlift.

Until they do this, we don't quite know how they can make a judgment on the most cost-effective needs or most cost-effective way to go about making a determination of how much they need by way of airlift.

Senator PROXMIRE. I understand your viewpoint, but they didn't agree with that. They said, and I asked them explicitly about this, they said that they had considered various combinations, combinations of airlift, sealift, and pre-positioning as alternatives to the various proposals that have been pending.

Mr. Stolarow.

Mr. STOLAROW. In anticipation of this question, and knowing what the answer was yesterday, just this morning I again very carefully went through the JCS study, and I think we have a question of semantics here as to what are "alternatives."

I think in each segment of the mobility requirements they did look at various alternatives. In other words, they did look at alternative airlift programs as such. They looked at alternative sealift programs as such.

What we are saying is they did not make tradeoffs between quantities of airlift and possible pre-positioning; in other words, taking an equal cost approach and seeing what you could accomplish or what would be most effective by varying a quantity of airlift, or reducing that, and increasing pre-positioning, or using more sealift.

That we do not see in the study, and we stand by our claim.

Senator PROXMIRE. I am very strongly inclined to agree with you. In General Gregg's prepared statement he said, and I quote:

> We examined airlift, sealift, and pre-positioning programs and made cost-effective tradeoffs separately for each program and combined mobility options to meet the programed and prudent-risk requirements. In these tradeoffs we examined the costs of mobility programs and their contributions to risk reduction. The risk involved the amount of forces the Warsaw Pact has in relation to the NATO alliance.

You are saying they did not consider the various combinations that would give them the best results for the lowest cost.

Mr. STOLAROW. I think the key word is they considered them "separately" for each program. I think that is a true statement. That confirms, I think, what I am saying.

Senator PROXMIRE. I see. You think that separately they did that.

Mr. STOLAROW. Yes, with each segment of the program.

Mr. STAATS. Mr. Chairman, I would like to say this: I served as a member of the Procurement Commission, and I well recall the hearings held before this subcommittee which you chaired, and even prior to that, where we kept emphasizing the need to define "mission requirements" overall before you make a determination as to which specific weapons system you need to fulfill that requirement.

In other words, the tendency has been, in the executive branch and in the Congress, too frequently, to look at indiv dual proposals that have come forward without looking at what options you might have to accomplish the same mission.

And I think to some degree that is involved in this issue that you are holding these hearings on today.

We don t think that the tradeoff analyses really have been made here, at least to our satisfaction, in order to be able to make a judgment on the additional budget requirement that is being set forth here for congressional approval.

Senator PROXMIRE. Well, then, what you are saying is that the Pentagon has not presented the various options for Congress to consider nor have they given us the data, adequate information, so we can put together our own options. Is that fair?

Mr. STAATS. We think they can do it.

Senator PROXMIRE. But they have not done it?

Mr. STAATS. They have not done it.

Senator PROXMIRE. Just for the record, in your judgment, is it possible that there are other combinations of mobility forces that are more cost-effective than current proposals?

For example, is it possible that better use can be made of pre-positioning alternatives as a substitute for part of the airlift being proposed?

Mr. STAATS. Yes, and part of it has to be looked at in part in relationship to the assumed warning time. Pre-positioning may be the only option that you have, depending upon what warning time you assume.

Senator PROXMIRE. Let's consider another option.

I understand that fast cargo ships can cross the Atlantic in just a few days. Can you tell us how fast cargo can be sealifted for a European war, whether it's possible that greater use of sealift would make our mobility forces more cost-effective?

Mr. STAATS. I don't believe I can answer that question. Perhaps Mr. Stolarow can.

Mr. STOLAROW. Just yesterday, Mr. Chairman, GAO issued a report dealing with containership logistics, which in essence has criticized the DOD for not moving ahead faster with this technique of being able to move cargo.

Senator PROXMIRE. After all, they are talking about a 30-day scenario, and in a 30-day scenario obviously fast cargo ships could play a very important role, and expecially so over the latter part of the 30 days at least it would be more significant than the airlift.

Mr. STOLAROW. That is correct, sir.

Senator PROXMIRE. You say just yesterday there as a report issued on the containerships?

Mr. STOLAROW. Yes, sir.

Senator PROXMIRE. Can you give us the highlights of it?

Mr. STOLAROW. I would like to read you what is on the cover.

Senator PROXMIRE. All right.

Mr. STOLAROW [reading]:

Efficiency of container shipping has caused its growth in the industry and has produced a sharp decline in the number of conventional U.S.-flag ships. Because of this and the Department of Defense's reliance on U.S.-flag commercial shipping, the Department sought to improve its policies, procedures, and methods of shipping ocean cargoes. Recognizing that containerization would be essential in providing logistical support to military forces overseas, in 1970 the Joint Logistics Review Board ecommended early development of a container-oriented logistics system for Defense. Seven years later, critical elements of such a system still are lacking, and problems exist which would preclude effective use of the system in an emergency.

Senator PROXMIRE. How long does it take a fast containership to get across the Atlantic?

Mr. STOLAROW. My recollection is that is is about 4 to 5 days for a fast ship, maybe a little longer.

Senator PROXMIRE. Would you make that report available to us for the record? We would like to have it.

Mr. STOLAROW. Yes, sir.

[The report follows:]

REPORT TO THE CONGRESS

BY THE COMPTROLLER GENERAL
OF THE UNITED STATES

Container-Oriented Logistics System--Will It Be Ready When Needed By The Department Of Defense?

Efficiency of container shipping has caused its growth in the industry and has produced a sharp decline in the number of conventional U.S. flag ships. Because of this and the Department of Defense's reliance on U.S. flag commercial shipping, the Department sought to improve its policies, procedures, and methods of shipping ocean cargoes.

Recognizing that containerization would be essential in providing logistical support to military forces overseas, in 1970 the Joint Logistics Review Board recommended early development of a container-oriented logistics system for Defense. Seven years later, critical elements of such a system still are lacking, and problems exist which would preclude effective use of the system in an emergency.

LCD-77-234

DECEMBER 21, 1977

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

B-145455

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

This report discusses the progress made by the Department of Defense in developing a container-oriented logistics system and calls attention to needed improvements.

We made our review 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 Acting Director, Office of Management and Budget, and to the Secretary of Defense.

Elmer B. Staats

Comptroller General
of the United States

COMPTROLLER GENERAL'S REPORT TO THE CONGRESS

CONTAINER-ORIENTED LOGISTICS SYSTEM--WILL IT BE READY WHEN NEEDED BY THE DEPARTMENT OF DEFENSE?

D I G E S T

Containerization involves shipping cargo in truck-like bodies (containers) that can be detached from the wheels and chassis of a truck. When detached they can be

--loaded into specially constructed ships for ocean voyages,

--loaded onto rail flatcars, or

--attached to a prepositioned chassis and then trucked inland. (See p. 1.)

The efficiency of container shipping caused its acceptance within commercial industry and brought a sharp decline in conventional (break-bulk) ships operating under the U.S. flag. The Department of Defense's reliance on the U.S.-flag commercial shipping industry caused the Department to seek ways to improve its distribution policies and procedures. (See p. 1.)

Recognizing that containerization would be essential in providing logistical support to military forces overseas, Defense's Joint Logistics Review Board in 1970 recommended early development of a container-oriented logistics system. Some 7 years later, critical elements of such a system are still lacking, and problems exist which would preclude effective use of the system in an emergency. (See p. 6.)

For example:

--Slow acquiring of container handling equipment. (See p. 6.)

--Limited capability for handling outsized cargo. (See p. 7.)

--Limited over-the-shore discharge capability. (See p. 9.)

The complexity of container distribution system development requires intensive management, but the Department of Defense has never applied such management to this program. Neither the project management nor the present "lead service" approach provides the necessary control, coordination, and direction needed to effectively manage a multiservice system development. (See pp. 12 and 13.)

Under the present lead service approach, the central management body has difficulty in making policy decisions (see p. 14), resolving interservice disputes, and monitoring and coordinating development efforts of the services. (See p. 15.) Also, existing management provides inadequate influence over proposed funding of the services for specific tasks as related to entire system requirements. (See p. 16.)

The Department of Defense could achieve greater progress in container system development by strengthening its central management of the program. This would include

--improving the central management body's decisionmaking process (see p. 14),

--developing a comprehensive container system plan (see p. 15), and

--implementing a management procedure to assure accomplishing containerization objectives. (See p. 16.)

The Secretary of Defense could call for greater control, direction, coordination, and monitoring of the military services' containerization development efforts. Specifically, he should direct that:

--The central management body provide more timely guidance on policy matters and interservice development problems.

--A comprehensive container system development plan--including concept descriptions and task priorities--is developed to aid central management and the services in coordinating and controlling task development.

--A mechanism is established to identify and correct unnecessary and inadequate development and inappropriate funding allocations for specific tasks. (See p. 18.)

The Department of Defense agreed substantially with GAO's general conclusion that the central management body should become more active. The Department indicated that it has and will continue to seek greater progress in developing a container logistics system.

The Department of Defense added that GAO's recommendations will be beneficial in attaining these goals. (See p. 19.)

Contents

ABBREVIATIONS

DOD	Department of Defense
LOTS	Logistics over-the-shore
OSDOC	Over-the-shore discharge of containerships
RORO	roll-on/roll-off

CHAPTER 1

INTRODUCTION

Containerization involves shipping cargo in truck-like bodies (containers) that can be detached from the wheels and chassis of a truck. When the containers are detached from the chassis, they can be (1) loaded into specially constructed steamships for ocean transport, (2) loaded onto rail flatcars, or (3) attached to a prepositioned chassis and trucked inland. Containerization improves the distribution system by allowing the movement of materials from source to user without intermediate handlings.

Containerization is an extremely flexible operation and has many advantages over conventional (break-bulk) transportation. Time in transit is greatly reduced because preloaded containers enable the ocean carriers to achieve a 24-hour turnaround time--that is, to unload and reload vessels within 24 hours. Less loss and damage occurs in properly loaded containers than in conventional shipping. Containers can be loaded and sealed by shippers either at a port or some inland point and remain unopened until they reach overseas consignees.

The efficiency of container shipping caused its acceptance by commercial industry and brought a sharp decline in conventional (break-bulk) ships operating under the U.S. flag. The Department of Defense's (DOD's) reliance on U.S. flag commercial shipping industry for ocean lift caused it to seek ways to improve its distribution policy and procedures.

DOD peacetime use of the commercial container distribution system has been cost-effective for routine shipping requirements. In contingency and wartime situations many DOD shipping requirements are unique. For example DOD may be required to:

--Ship large volumes of cargo quickly.

--Move units with equipment to a "hot spot" quickly.

--Move cargo when ports are either nonexistent or their use denied.

--Ship large volumes of munitions.

DOD must determine inadequacies in the commercial system and provide solutions to these problems. In addition, DOD must provide alternatives to the commercial system when that system cannot meet military requirements.

Nevertheless, the commercial system will always provide the basic capacity to meet DOD logistics requirements. Consequently, DOD's procedures and equipment must interact with the commercial system.

However, before effective integration can be achieved with the commercial containerized system, the services (Army, Navy, and Air Force) must first integrate their container support equipment, facilities, and procedures. An effectively functioning DOD container distribution system, completely integrated and entirely compatible with the commercial system, is essential for the logistics support of U.S. Forces overseas during contingency mobilization or war.

CHAPTER 2

HOW THE CURRENT MANAGEMENT STRUCTURE EVOLVED

By recommendation of the Secretary of Defense, and the approval of President Nixon, the Joint Logistics Review Board was established on March 1, 1969. The Board was to review worldwide logistics support during the Vietnam era, to identify strengths and weaknesses, and to analyze logistics knowledge gained which might affect future military operations. The Board was composed of eight members representing the Army, Navy, Air Force, Marine Corps, Defense Supply Agency, and the Joint Chiefs of Staff.

In 1969-70 the Board extensively analyzed the logistics operations of the military services. It recommended establishing a DOD-wide container-oriented distribution system. The Board's recommendation was influenced by the economic benefits of containerization and the trend toward replacing commercial break-bulk ships with container ships. Since the Board's study, break-bulk shipping has continued to decline. The growth of container shipping capability in the commercial system accompanied by the decline in break-bulk shipping capability increases the necessity for timely development of a DOD containerized distribution system.

A DOD project to develop a container distribution system was initiated in 1971, with the Army and Air Force as executive services for developing separate but coordinated surface and air container-supported distribution systems. The Deputy Secretary of Defense directed that the surface and air development efforts be conducted under the broad guidance of the Logistic Systems Policy Committee to be assisted by a Joint Container Steering Group.

This report discusses efforts to develop a surface container distribution system for other than ammunition items. Because of the peculiar handling characteristics of ammunition items, ammunition transportation was excluded from this review.

Also, since surface transportation accounts for about 98 percent of DOD's cargo and since most of DOD's resources are directed to developing a surface system, we concentrated our effort on the development of a surface system.

PROJECT MANAGER ASSIGNED

In 1971 the Army, as executive service for developing a surface container system, assigned a project manager to plan, direct, and control the developing and implementing of the system. Initially, the project manager had responsibility for preparing and implementing a project master plan for system development and for coordinating and directing the military services and transportation operating agencies in developing and implementing these tasks. Specifically, the project manager's responsibilities included:

--Identifying specific tasks to be accomplished, agencies responsible for their accomplishment, and target dates for completion.

--Planning, directing, and controlling resources authorized for executing approved projects.

--Coordinating with interfacing agencies.

--Executing tasks to conform to the master plan, including implementation by agencies responsible for tasks.

--Developing, testing, and obtaining approval of hardware, software, procedures and concepts relating to all aspects of container-supported distribution systems.

MASTER PLAN APPROVED

A project master plan was prepared which outlined 22 tasks for developing equipment, policies, and procedures which were considered essential for a surface container system. (App. I lists the 22 original tasks established under the project manager.) These tasks included a variety of activities within each military service and DOD transportation operating agency.

In August 1973 the project master plan was approved. In January 1974 after receiving a status report on the tasks assigned to the project manager, the Assistant Secretary of Defense (Installations and Logistics) concluded that the project had progressed sufficiently to allow the services and operating agencies to assume management responsibility for the tasks. Accordingly, all but two tasks were reassigned to individual services and operating agencies, with the project manager retaining responsibility for ammunition restraint and logistics over-the-shore operations (LOTS). Overall coordination of development efforts was shared by the project manager and the Steering Group.

PROJECT MANAGER TERMINATED

In July 1975 the project manager's charter expired. The two remaining development tasks were assigned to the responsible military services and overall coordination responsibility to the Steering Group, which retained its original responsibility for coordinating surface and air development programs to insure mutual compatibility of procedures and equipment.

A Container Systems Standardization/Coordination Group was established under the Steering Group to provide technical assistance. The former Group monitors all ongoing efforts relating to container systems in the services and operating agencies. This responsibility includes maintaining contact with the many military components involved, identifying problems, such as duplication and conflicting requirements, and recommending solutions to the Steering Group. The coordinating group also updates and implements the project master plan.

In eliminating the project manager's office and tranferring development responsibilities to the services and transportation operating agencies, DOD, in effect, shifted from centralized management approach to one involving a more decentralized "lead service." Under this latter approach, the services and operating agencies have direct responsibility for developing and implementing specific surface containerization tasks related to their individual missions. Overall monitoring and coordination of efforts rests with the Steering Group. The services and the transportation operating agencies also have a major role in coordinating their container development tasks with those of other military components to assure common interface.

When the project master plan was revised in August 1976, 8 of the original 22 tasks had been completed. Four tasks had either been discontinued or development had reached an impasse, and the remaining 10 tasks had yet to be completed.

Most uncompleted tasks related to three major development areas:

--Special purpose containers for handling outsized cargo and equipment for stuffing and handling containers.

--Methods, procedures, and equipment for offloading containers where no port exists or the port is unimproved.

--Methods for containerizing ammunition.

CHAPTER 3

CRITICAL ELEMENTS OF CONTAINER SYSTEM LACKING

In 1970 the Joint Logistics Review Board recommended early development of a DOD container-oriented logistics system. Some 7 years later, critical elements of such a system are still lacking, and problems exist which would preclude effective use of the system in an emergency or war situation.

Military equipment used to handle break-bulk cargo is unsuited for container operations, and commercial handling equipment will not operate in the demanding environments (unsurfaced areas and rough terrain) of military operations. Also, much military cargo will not fit in closed containers, and insufficient open-sided containers (flatracks) exist in the commercial inventory to satisfy military needs.

In addition, the commercial container system depends on sophisticated port facilities which may be destroyed or denied during military operations. It is questionable whether DOD has adequate over-the-shore container landing capability where container ports do not exist.

ACQUIRING CONTAINER HANDLING EQUIPMENT HAS BEEN SLOW

The Army in 1970 recognized a need for specialized forklifts to stuff and unstuff containers. However, enough forklifts will not be available until 1979. Without the specialized equipment, containers cannot be efficiently handled in the field in peacetime. In an emergency or war, container loading and unloading would become even more critical.

Beginning in October 1971 the Army's "Field Materials Handling Equipment Family" study recommended a low mast, 2,500-pound capability, rough-terrain forklift to move cargo in and out of containers since most pallet loads would not exceed 2,500 pounds. In July 1973 the Department of the Army approved developing this forklift because current methods of stuffing and unstuffing containers (forklifts without rough-terrain capability, manual loading and unloading, or winching methods) were inefficient and caused operation delays and damage to cargo or containers. However, until the required forklift could be developed, the Army Materiel Command's only alternative was to continue sending inadequate substitute forklifts to the Army in the field.

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In December 1974 the Army revised the requirement for rough-terrain forklifts from a 2,500-pound capacity to a 4,000-pound model which could handle both regular cargo and heavier ammunition pallet loads. This change in forklift capacity requirements was a primary reason for the delay in providing necessary forklifts to Army users.

In early 1976 the Army's Tank Automotive Command stated that the 4,000-pound rough-terrain forklift would be unavailable until the third quarter of fiscal year 1979. Again, another substitute item had to be sent to the Army in the field until the 4,000-pound forklift was available.

In May 1976 the Army ordered 970 rough-terrain forklifts for container stuffing and unstuffing and other uses. Delivery of these forklifts should be completed as planned by 1982 at a cost of about $39 million.

Delays in providing adequate equipment to Army users were discussed in a June 13, 1975, message to Headquarters, Army Materiel Command, from the Commander-in-Chief of the U.S. Army in Europe. This letter described the critical nature of the container unstuffing situation. The commander-in-chief emphasized the Army's reliance on containers, the need for rough-terrain forklifts, the inadequacies and maintenance problems of existing equipment, and Army Materiel Command's unresponsiveness to the existing need for Army field units.

CAPABILITY FOR HANDLING OUTSIZED CARGO LIMITED

In an emergency, commercial industry must make a large number of containerships available for DOD use. To use these ships effectively, DOD would have to containerize a substantial part of its cargo, including some outsize cargo which cannot be loaded into a regular container. As a result, open-sided containers (flatracks) would have to be employed.

Open-sided containers are primarily used to carry vehicles and oddly shaped break-bulk cargo--such as pipes, lumber, etc.--that either require little protection from the weather or cannot fit in regular dry cargo containers. Flatracks can accommodate loads up to 12 inches wider than regular container loads. Appendix II is a photograph showing a vehicle being transported on a flatrack.

Flatracks would provide the loading flexibility necessary to use the modern containership, which is estimated to be the mainstay of the future merchant fleet available for DOD use.

Cargo can be selectively unloaded from flatracks, even when container support equipment is unavailable in forward areas. However, commercial industry does not have enough flatracks to support projected military operations. Flatracks comprise less than 1 percent of all U.S. commercial containers, an insufficient quantity for meeting military requirements, especially in the larger sizes needed for vehicle transport.

At the time of our review, one manufacturer estimated that a simple 20-foot commercial flatrack would cost approximately $3,500 to $4,000 and a 40-foot flatrack between $5,000 to $5,500. Flatracks with other desirable features, such as ends that form ramps, would be more costly. However, we were told that flatracks designed for one-way deployment/contingency use may be less expensive than stronger flatracks designed for repeated use.

In a briefing to the Joint Container Steering Group in early 1976, the Container Systems Standardization/Coordination Group concluded that if commercial flatracks are unavailable in sufficient quantities, and if the United States does not have sufficient shipping other than containerships to support deployment plans, then three viable alternatives remain:

--Procure flatracks.

--Subsidize commercial industry to support the military need.

--Increase other shipping capabilities.

Regarding these alternatives, a considerable investment would be required to procure enough flatracks for DOD's needs. For example, one 1971 Army study on flatrack use estimated a need for between 20,000 and 30,000 flatracks to deploy a 5-division force. According to one Army official, however, this study did not consider alternatives to flatracks--such as roll-on/roll-off (RORO) ships--which would significantly reduce the flatracks needed.

DOD officials have informally contacted several commercial firms concerning these firms' willingness to acquire and maintain flatrack inventories under Government subsidization. DOD would then lease the flatracks from these businesses as needed. Although some firms appeared interested, we were told that commercial industry might be reluctant to participate if large quantities of flatracks were required in the near future since the commercial firms would bear the costs of adding a new item to their inventories which had little commercial use.

At its February 1976 meeting, the Joint Container Steering Group discussed the need for flatracks and later asked the Joint Chiefs of Staff to determine DOD's requirements, if any, for flatracks. The Joint Chiefs indicated that flatracks had been considered in its joint strategic capabilities plan for fiscal year 1976 but did not provide specific requirements. Because requirements were not known, the Steering Group was unable to provide guidance on deploying outsize cargo if suitable commercial ships, other than containerships, are unavailable to support deployment plans.

OVER-THE-SHORE DISCHARGE CAPABILITY LIMITED

The commercial container distribution system which DOD uses depends on a sophisticated port environment. In wartime, port facilities may be destroyed, denied, or tactically desirable to bypass. Therefore, to adequately support combat operations, a capability must exist to move cargo over unimproved shorelines or through inoperable ports (over-the-shore container capability).

Over-the-shore discharge of container ships (OSDOC) involves

--unloading cargo from ships at sea (ship unloading subsystem),

--transporting the cargo from ship to shore (lighterage subsystem), and

--moving the cargo to a designated beach area to await further distribution (shoreside subsystem).

The OSDOC system would be used in two basic military operations--amphibious operations and LOTS operations. The Navy and Marine Corps are primarily responsible for amphibious operations, and the Army for LOTS. Although these missions have similarities, each is unique.

The amphibious operation consists of a launched attack in which combat forces land on a hostile shore. An amphibious operation is carried out in three phases--initial assault, immediate follow-on, and resupply. The initial assault is supported by naval amphibious ships. During the immediate follow-on, supplies and equipment are also landed from naval ships and commercial ships as necessary. Because of shortages in amphibious ships, the immediate follow-on often depends on commercial ships (that is, containerships, breakbulk ships, bargeships, RORO ships) provided the ships can be offloaded in the desired area. Commercial ships are used for resupply, and containers are used as early as possible in this resupply phase.

LOTS operations involve loading and unloading ships without fixed port facilities in nonhostile territory. In wartime LOTS operations involve phases of theater development in which no enemy opposition exists. For successful LOTS operations, the service must be able to deploy LOTS system equipment to the objective area, discharge cargo without fixed port facilities, and interface with cargo distribution operations ashore. A LOTS operation may either follow an amphibious operation or be conducted separately.

The basic difference between LOTS and amphibious assault missions centers around the projected length of operation and the tactical environment. The Navy's amphibious operation is relatively short and is conducted under threat of hostile action. The Army's LOTS operation is generally longer and is operated in a relatively secure, nonhostile environment.

One Army proposal for an OSDOC operation involves using a large crane to offload containerships and an air cushion vehicle to transport containers from ship to beach. The large crane and air cushion vehicle would also be used in Army coastal, harbor, and inland waterway missions.

To support its amphibious operations, the Navy currently has sectionalized causeways which can be used to ferry supplies and equipment. The Navy is developing an improved causeway system for use in both amphibious and LOTS operations. Part of this improved system would be the potential to form elevated piers to support container cranes.

The Joint Logistics Review Board in 1970 recognized that containers would be required in over-the-shore logistics operations because of the commercial fleet's transition from break-bulk ships to containerships. Both the Joint Logistics Review Board and the project master plan for a surface container distribution system reported that LOTS operations probably would be required during the early stages of a major conflict when ports are overloaded, destroyed, or denied. The Board also recommended that the services jointly develop and test the capabilities and procedures necessary for LOTS container operations and procure the required quantities of equipment needed to support contingency operations in underdeveloped areas. The 1973 project master plan outlined seven projects which would be required to develop an adequate LOTS container capability. These seven projects are described in appendix III. In November 1977 only one of the seven major projects had been completed.

A Joint Army-Navy LOTS operational test of currently developed equipment and techniques was completed in the summer of 1977. DOD officials expect that a realistic assessment of capabilities and limitations should be possible based on these test data.

In December 1971, all LOTS components were expected to be developed and tested by December 1978. The military departments now plan to complete their over-the-shore system development by 1980. We found, however, that funding and developmental uncertainties may cause further delays.

No adequate capability for sustained over-the-shore container operations currently exists according to DOD officials. However, a very limited capability can be employed by using test equipment and existing organizations. In our opinion, much must be done to complete OSDOC development to enable the services to conduct satisfactory over-the-shore container operations.

CHAPTER 4

MANAGEMENT OVER CONTAINER SYSTEM DEVELOPMENT SHOULD BE STRENGTHENED

In establishing the surface container-oriented distribution system, DOD recognized the need for intensive management of the development program. Intensified management, as described in DOD Directive 5010-14, "System/Project Management," requires a central management authority responsible for planning, directing, and controlling the definition, development, and production of a system.

In designating a project manager to head the surface container system development program, the Army attempted to apply intensive management procedures, as directed by the Deputy Secretary of Defense. However, for various reasons, the project manager was either unable to or chose not to exercise intensive management responsibility.

Our discussions with past project managers and other DOD officials and our review of project records and correspondence showed both accomplishments and inadequacies. The project manager successfully developed a project master plan which identified specific surface containerization tasks to be accomplished and assigned responsibilities for those tasks. To a limited extent, the project manager also coordinated the task development efforts of responsible DOD components. However, the project manager did not exercise his authority to direct and control development and production of system components. Also, he did not control resource allocations for specific tasks.

The lack of funding control over container system development tasks probably most hindered the project manager's timely managing system development. Without funding control, the project manager could only try to persuade the services and transportation operating agencies to move toward specific tasks and to conform to the objectives stated in the master plan. Although intensive management procedures called for a central authority for planning, directing, and controlling the definition, development, and production of a system, the office of the project manager functioned primarily as a planning and coordinating body, while the direction and control of the development remained with the services and the transportation operating agencies.

PROJECT MANAGER PHASED OUT--
DECENTRALIZED APPROACH ADOPTED

In July 1975 the project manager's charter expired. Remaining development tasks were assigned to the responsible military services, and overall coordination responsibility was assigned to the Steering Group, which retained its original responsibility for coordinating surface and air development programs for insuring compatibility of procedures and equipment.

In eliminating the project manager's office and transferring development responsibilities to the services and transportation operating agencies, DOD, in effect, shifted from an attempted centralized management approach to one involving a more decentralized lead service.

The rationale of the Assistant Secretary of Defense (Installations and Logistics) for the reassignment of management responsibility was that container development had progressed to a point where management responsibility could be assigned to the various operating services and agencies. Officials in the Assistant Secretary's Office also told us that project management had served its intended purpose with the development of a surface containerization master plan.

The decision to deactivate the project manager position followed an executive session of the Steering Group. Prior to the decision, individuals associated with the Logistics Systems Policy Committee, Army, Marine Corps, and Air Force officials working with containerization, and a number of other top level logisticians expressed strong opposition to deactivation. They considered the phaseout of the project manager premature, arguing that many critical tasks had not been sufficiently developed to insure their completion and implementation by the functional elements of the services and transportation operating agencies. Opponents of the phaseout also believed that accomplishing the remaining tasks required the intensive, centralized management that the project management concept provided.

RESPONSIBILITIES DISPERSED UNDER
PRESENT MANAGEMENT APPROACH

Under the present decentralized, lead service approach, management responsibilities were officially dispersed to the various services and transportation operating agencies. Recognizing that overall responsibility for developing, managing, and implementing a container system still represented a complex management and coordination problem, the Steering Group was retained to provide a centrally monitored overview of container system development. This responsibility includes

--meeting with services and agencies to evaluate the status of subsystem development,

--insuring development problems are identified and required action taken,

--insuring satisfactory progress is made, and

--evaluating the development funding plans of the services and agencies.

A chart showing the present management structure and the responsibilities assigned to the services and transportation operating agencies is included as appendix IV.

NEED TO STRENGTHEN JOINT STEERING GROUP DECISIONMAKING PROCESS

The Steering Group, as now composed, has not provided the timely guidance for attaining satisfactory progress in achieving a container-oriented distribution system. The Steering Group, which is chaired by an official of the Office of the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics) is composed of general and flag officers from each of the services, the Defense Logistics Agency, and the Joint Chiefs of Staff. The group seeks agreement of all members before making a decision. However, DOD officials told us that when members disagree this desire for consensus within the Group may hinder decisionmaking.

Upon termination of the DOD project manager, the Steering Group was expected to guide and expedite DOD efforts in producing effective solutions for container distribution system development problems. However, Steering Group meetings do not appear directed toward decisionmaking. A review of the minutes of Steering Group meetings from July 1975 to June 1976 showed that the meetings largely consisted of informational and status briefings concerning container system development. Our review revealed only one Steering Group policy decision during this period--to ship ammunition in 20-foot containers when containerization is appropriate. While this decision constitutes a significant commitment to containerization for munition distribution, a more fundamental question concerning the extent that ammunition would be shipped by containers in contrast to break-bulk was discussed by the Steering Group for 7 months without a decision. The extended discussions on this issue illustrate the delays that occur when Group consensus is sought.

NEED FOR COMPREHENSIVE CONTAINER SYSTEM DEVELOPMENT PLAN

Developing a coordinated DOD container distribution system requires establishing overall objectives, a system concept, and specific tasks for accomplishing objectives. Since the DOD container distribution system involves all military services and transportation operating agencies, a comprehensive system concept description and delineation of developmental responsibilities as applicable to each DOD activity are necessary to insure standard equipment, policies, and procedures.

The project master plan set up project tasks for developing equipment, policies, and procedures which were considered essential for developing a surface container distribution system. The plan also assigned responsibility and target dates for task development.

The master plan had several weaknesses, however, which limited its effectiveness as a management tool. The plan was primarily hardware-oriented and did not describe how various system components would be integrated into a total surface system. In our opinion, such a description is necessary to insure that the services' attention and efforts are directed toward the specific areas chosen by the Steering Group. However, before development of an overall system concept, each service must develop its own detailed system concepts to meet their own logistics needs. These system concepts should describe the source-to-user movement of containerized material in the logistics system during peacetime, wartime, and emergency situations.

The plan also failed to assign development priorities for the tasks. Establishing priorities is important to insure systematic development and appropriate allocation of resources. Finally, the plan did not provide a system for responsible DOD components to report task progress and developmental problems to DOD management for monitoring and coordination.

DOD officials recognized that the old plan was no longer operational. Consequently, in August 1976, the Steering Group approved a revised project master plan which updated the status of development tasks. This plan assigned milestones for each task, projected dollar requirements, and provided for periodic task status reports. Although these changes are an improvement over the old plan, the revised plan still contains no concept description and fails to assign priorities for task accomplishment. In our opinion, the lack of an overall system concept description hinders the services in formulating total system containerization tasks which will be compatible within the services and with the efforts of commercial industry. Similarly, without a concept description, the Steering Group may have difficulty in assessing the services' development efforts in achieving a DOD-wide container distribution system.

Failure to assign priorities for task accomplishment may block the Steering Group in exercising control over the services' allocation of their resources for specific tasks. Also, the likelihood increases that the services may not fully use their resources allocation because they are unaware of the priority requirements of the entire DOD system.

MEANS TO ASSURE ACCOMPLISHMENT OF CONTAINERIZATION OBJECTIVES IS NEEDED

To effectively control and coordinate development of a DOD-wide surface container distribution system, the Steering Group needs some means to insure that the services follow the development tasks in the master plan. To accomplish this, the Steering Group should be periodically informed about ongoing development efforts, problems encountered, and new projects undertaken. The old master plan required no periodic status reports by the services. Consequently, the Steering Group received no systemized information on which to monitor and coordinate the services' efforts. The new master plan, by requiring semiannual reports to the Steering Group, should provide more information to the Group on the services' development efforts.

An improved reporting system is not enough, however. The Steering Group must be able to assure that the services are directing task development efforts in accordance with overall DOD containerization objectives. To do this the Steering Group needs authority to (1) redirect the services' efforts when the group identifies deviations from the master plan, (2) approve new projects, and (3) make sure the services allocate resources to priority tasks.

The Steering Group could strengthen control over service-directed task development by exercising greater influence over service funding allocations. Although the Assistant Secretary (Manpower, Reserve Affairs, and Logistics) has approval authority over the services' budget requests for containerization development, officials from the Assistant Secretary's Office told us they are not actively involved in services' allocations for specific container system resource tasks.

Under current procedures, each participating service budgets its portion of the surface system development effort. Funds for the containerization program, along with all other budget items, are subject to numerous budget reviews. If adequate funds from each participating service are unavailable, the containerization program can be delayed, and the plans of other services can be upset. To prevent this situation, management must improve identification of the program funds.

Greater central influence over funding would assure that the services are applying their resources to overall system needs and would allow DOD to prevent unnecessary development or deviation by a service from its assigned responsibilities. It would also aid DOD in monitoring, coordinating, and controlling system development efforts.

CHAPTER 5

CONCLUSIONS, RECOMMENDATIONS, AND AGENCY COMMENTS

CONCLUSIONS

Growth in commercial industry reliance on container ships, rather than break-bulk ships, has caused DOD to examine all components of the commercial system for compatibility with DOD requirements. Although 7 years have elapsed since the Joint Logistics Review Board first recommended developing a container-oriented logistics system, critical elements of such a system are still lacking. Container handling equipment is inadequate, insufficient open-sided containers exist, and DOD's over-the-shore capability is limited.

As a result, full container capability cannot be used effectively, and no adequate capability for sustained over-the-shore operations exists, particulary in underdeveloped areas.

The complexity of container distribution system development requires intensive management, but DOD has never applied such management to this program. Neither the project management nor the present lead service approach provides the necessary control, coordination, and direction needed to effectively manage a multiservice system development.

Under the present lead service approach, the central management body has difficulty in making policy decisions, resolving interservice disputes, and monitoring and coordinating the services' development efforts. Also, existing management provides inadequate influence over the services' proposed funding for specific tasks as these tasks relate to entire system requirements.

We believe that DOD could progress further in container system development by strengthening central management of the program. In implementing management changes, DOD should be aware of the need for program development continuity. Any changes, therefore, should be instituted with minimal disruption of the ongoing program.

RECOMMENDATIONS

The Secretary of Defense should direct that the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics) provide greater control, direction, coordination, and monitoring of the military services' containerization development efforts. Specifically, the Assistant Secretary should take action to assure that:

--The Steering Group provides more timely guidance on policy matters and interservice development problems.

--A comprehensive container system development plan--including concept descriptions and task priorities--is developed to aid central management and the services in coordinating and controlling task development.

--A mechanism is established whereby corrective action can be taken when the Assistant Secretary identifies unnecessary and inadequate development, and inappropriate funding allocations for specific tasks.

AGENCY COMMENTS

DOD substantially agreed with our general conclusion that the central management body should be more active in policy guidance, resolving interservice disputes, and monitoring and coordinating the services' development efforts. Defense indicated that central management efforts involved in developing a highly complex container logistics system have been and will continue to be reviewed to strengthen these efforts and to achieve greater progress. DOD added that our recommendations will be beneficial in further attainment of these goals.

A copy of DOD's response is included as appendix V.

CHAPTER 6

SCOPE OF REVIEW

Our examination included a review of pertinent studies, correspondence, and other records relating to container system development. We also analyzed the practices and procedures of containerization.

We interviewed officials of (1) each service involved in container systems management and development, (2) transportation operating agencies, and (3) the Office of the Assistant Secretary of Defense for Installations and Logistics (now Manpower, Reserve Affairs, and Logistics). We visited various locations, including

--U.S. Army Logistics Center and Quartermaster School, Fort Lee, Virginia,

--U.S. Army Transportation School, Fort Eustis, Virginia,

--U.S. Army Armament Command, Rock Island, Illinois, and

--Sea-Land Service, Inc., Elizabeth, New Jersey.

In addition we observed the following demonstrations:

--Joint Balloon Transport System Test,

--Joint LOTS LASH ship pretest,

--container handling equipment for use over the beach.

ORIGINAL TASKS ESTABLISHED UNDER THE PROJECT MANAGER

Task	
1	Establish a surface container-supported distribution concept
2	Determine services' peacetime tonnage requirements
3	Determine services' wartime tonnage projection for deployment/resupply flows
4	Establish a system providing for control of military-owned/leased containers and monitorship over movement of commercial containers carrying military cargo
5	Develop concept and prototype hardware for evaluating automatic sensing and reporting of container movement
6	Develop system providing containerized cargo movement compatibility with system objectives for visibility of supplies in transit
7	1. Publish joint operating procedures for surface container general cargo and ammunition operations 2. Prepare documentation procedures for container contents/shipments
8	1. Determine requirements for acquisition of commercial container equipment & facilities to support war plans 2. Establish procedures/plans to acquire and allocate intermodal container system to meet national priorities
9	Prepare change to DOD Instruction 4500.37 requiring that shelters and special purpose vans will conform to ANSI/ISO standards
10	Test "The Electronic Label Logistics System" (TELLS) for future system application
11	Coordinate requirements for plans to develop marshalling areas, container handling facilities, revetments, ramps, platforms at depots, ammunition plants and ports

<u>Task</u>

12 1. Coordinate requirements to develop marshalling areas, container facilities, revetments, ramps, platforms as required at ammunition ports
2. Coordinate the requirements for plans to develop additional berths, piers, gantries, road/rail access and related facilities required at general cargo ports in CONUS and other facilities as required overseas

13 Determine standards for packaging, packing and preservation (PP&P) of supplies in surface containers

14 Coordinate movement requirements for pilot operations covering both general cargo and ammunition movements

15 Develop, test, and obtain approval for procurement of initial increment of cargo handling equipment suitable for container operations

16 Develop, test, and obtain approval for procurement of initial increment of surface cargo container handling equipment

17 1. Develop container offshore discharge methods/ equipment
2. Convert non-self-sustaining ships (NSS) to self-sustaining ships (SS)
3. Develop elevated pontoon causeway capability/system
4. Develop, test, and procure lighterage
5. Develop pendulation and vertical motion control devices to be installed on cranes for offshore discharge
6. Conduct offshore discharge of containership (OSDOC)
7. LOTS/port containership discharge handling equipment

18 1. Determine requirements, obtain approval, and procure initial increment of:
a. general-purpose containers
b. special-purpose containers
2. Develop, test, obtain approval of an ammunition dunnage system to convert commercial containers into certified ammunition carrying containers
3. Develop/recommend ammunition stowage criteria for containers

28-003 O - 81 - 16

Task

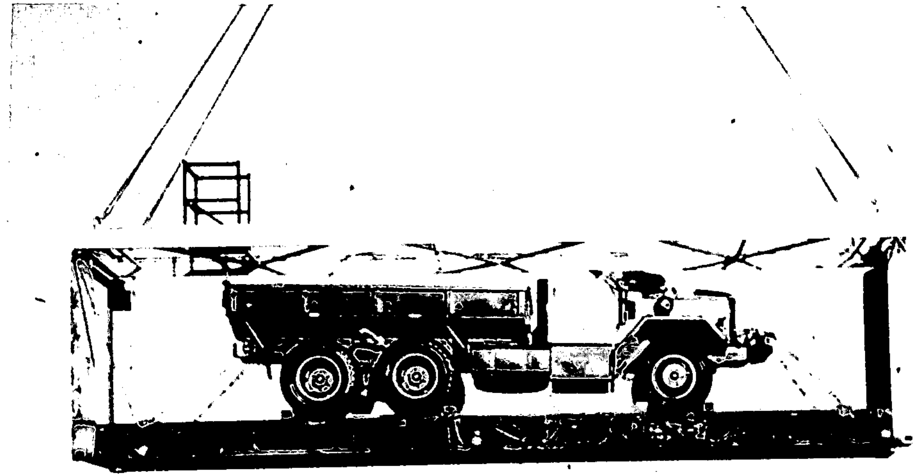
19 1. Establish qualitative/quantitative requirements and prepare procurement specifications for a family of chassis dual purpose break-bulk/container transporters (semitrailers)
2. Establish qualitative/quantitative requirements and prepare procurements specifications for a commercial type linehaul truck tractor
3. Develop, test, obtain approval, and procure initial increment of 463L adapter for MILVAN chassis

20 Conduct general cargo and ammunition pilot operations using MILVANS and available equipment, facilities, and techniques

21 Publish Revised Joint Operating Procedures covering use of containerized cargo distribution equipment and techniques in:
a. logistic support
b. research, development, and engineering
c. configuration management
d. procurement
e. test and deployment
f. reporting

22 Orderly transference of responsibilities

APPENDIX II



FIVE-TON TRUCK ON FLATRACK CONTAINER.

SEVEN PROJECTS IN 1973--PROJECT MASTER PLAN

Project description

SHIP UNLOADING SUBSYSTEM

1. Develop container offshore discharge methods/equipment

   The major project for the ship unloading subsystem. Hardware includes platforms, cranes, mooring devices, wavelessening devices, fenders. Other considerations include training, maintenance, transportability.

2. Convert nonself-sustaining ships to self-sustaining ships

   Ten elements to this project. Includes identifying candidate containerships, determining quantity and types of cranes required, determining time required to convert ships, preparing a crane storage plan, procuring necessary cranes, etc.

3. Develop pendulation and vertical motion control devices to be installed on cranes for offshore discharge

   By reducing container motion during offshore discharge, less containers will be damaged, and container lift cycle times will be shortened. Technical risks are associated with these motion control devices.

4. Develop, test, and procure lighterage

   Includes surface or aerial equipment such as barges, amphibian, landing craft, causeway ferries, air cushion vehicles, and helicopters. New craft must be container-capable.

5. Develop elevated pontoon causeway capability/system

   To be used as a ferry, floating platform, or elevated platform.

APPENDIX III

6. <u>Develop LOTS/Port containership discharge handling equipment</u>

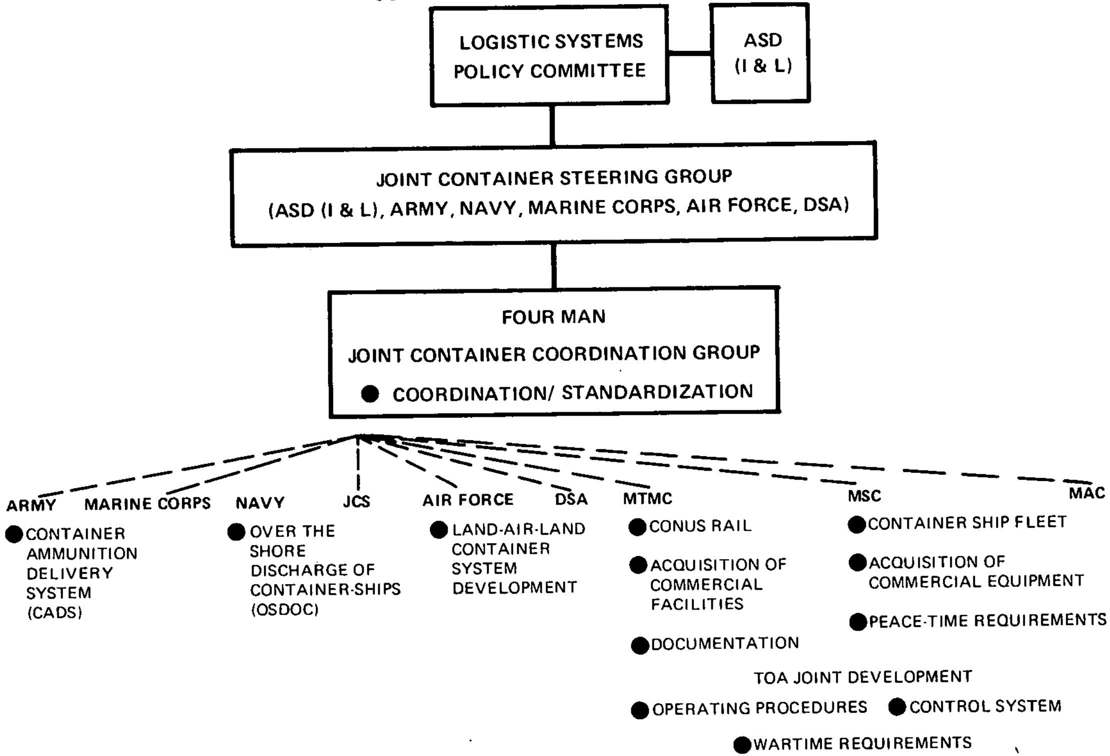
   Includes large cranes for use on Army self-elevating barge piers. Also includes handling equipment to move containers off lighterage and across the beach to a transfer area for inland movement.

7. <u>Conduct offshore discharge of containership tests (OSDOC)</u>

   Joint tests of current capability.

In November 1977 only the last project (conduct offshore discharge of containership tests) of the seven major projects had been completed.

MANAGEMENT STRUCTURE
CONTAINER SYSTEM DEVELOPMENT



APPENDIX IV

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301

MANPOWER,
RESERVE AFFAIRS
AND LOGISTICS

7 OCT 1977

Mr. F. J. Shafer
Dir, Logistics and Communications
  Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Shafer:

This is in response to your letter to the Secretary of Defense transmitting copies of your draft Report dated July 26, 1977 on the "Container-Oriented Logistics System - Will It Be Ready When Needed?" (OSD Case #4676).

In reviewing this draft Report, as revised, we substantially agree with the general conclusion that the central management body should become more active in policy guidance, resolving interservice disputes and monitoring and coordinating the Services' development efforts. Under the lead Service approach, the Joint Container Steering Group has exercised the coordination of container and logistics systems development while recognizing the Services' unique mission requirements and prerogatives.

The central management efforts involved in developing this highly complex system have been and will continue to be reviewed to determine means by which it can be strengthened to achieve greater progress. The recommendations included in the draft Report will be beneficial in further attaining those goals.

Sincerely,

ROBERT B. PIRIE, JR.
Principal Deputy Assistant Secretary
of Defense (MRA&L)

PRINCIPAL OFFICIALS

RESPONSIBLE FOR ADMINISTERING

ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office From	To
DEPARTMENT OF DEFENSE		
SECRETARY OF DEFENSE:		
Dr. Harold Brown	Jan. 1977	Present
Donald H. Rumsfeld	Nov. 1975	Jan. 1977
James R. Schlesinger	July 1973	Nov. 1975
William P. Clements, Jr. (acting)	Apr. 1973	July 1973
Elliott L. Richardson	Jan. 1973	Apr. 1973
Melvin R. Laird	Jan. 1969	Jan. 1973
DEPUTY SECRETARY OF DEFENSE:		
Charles W. Duncan, Jr.	Jan. 1977	Present
William P. Clements, Jr.	Feb. 1973	Jan. 1977
Kenneth Rush	Feb. 1972	Jan. 1973
Vacant	Jan. 1972	Feb. 1972
David Packard	Jan. 1969	Dec. 1971
ASSISTANT SECRETARY OF DEFENSE (MANPOWER, RESERVE AFFAIRS AND LOGISTICS):		
Dr. John P. White	May 1977	Present
Carl W. Clewlow (acting)	Apr. 1977	May 1977
ASSISTANT SECRETARY OF DEFENSE (INSTALLATIONS AND LOGISTICS) (note a):		
Dale R. Babione (acting)	Jan. 1977	Apr. 1977
Frank A. Shrontz	Feb. 1976	Jan. 1977
John J. Bennett (acting)	Apr. 1975	Feb. 1976
Arthur I. Mendolia	Apr. 1973	Mar. 1975
Hugh McCullough (acting)	Jan. 1973	Apr. 1973
Barry Shillito	Feb. 1969	Jan. 1973

	Tenure of office	
	From	To
DEPARTMENT OF THE AIR FORCE		
SECRETARY OF THE AIR FORCE:		
John C. Stetson	Apr. 1977	Present
Thomas C. Reed	Jan. 1976	Apr. 1977
James W. Plummer (acting)	Nov. 1975	Jan. 1976
John L. McLucas	July 1973	Nov. 1975
John L. McLucas (acting)	May 1973	July 1973
Robert C. Seamans, Jr.	Feb. 1969	May 1973
UNDER SECRETARY OF THE AIR FORCE:		
John J. Martin (acting)	Apr. 1977	Present
Vacant	Nov. 1976	Apr. 1977
James W. Plummer	Dec. 1973	Nov. 1976
Vacant	July 1973	Dec. 1973
John L. McLucas	Mar. 1969	July 1973
ASSISTANT SECRETARY OF THE AIR FORCE (MANPOWER, RESERVE AFFAIRS, AND INSTALLATIONS):		
Joe Meis (acting)	July 1977	Present
James P. Goode (acting)	Jan. 1977	July 1977
ASSISTANT SECRETARY OF THE AIR FORCE (ACQUISITION AND LOGISTICS):		
John J. Martin	July 1977	Present
ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS AND LOGISTICS) (note b):		
Vacant	May 1977	July 1977
Richard J. Keegan (acting)	Jan. 1977	May 1977
J. Gordon Knapp	Mar. 1976	Jan. 1977
Richard J. Keegan (acting)	Feb. 1976	Mar. 1976
Frank A. Shrontz	Oct. 1973	Feb. 1976
Richard J. Keegan (acting)	Aug. 1973	Oct. 1973
Lewis E. Turner (acting)	Oct. 1972	Aug. 1973
Philip N. Whittaker	May 1969	Sept. 1972

	Tenure of office From	To

DEPARTMENT OF THE NAVY

	From	To
SECRETARY OF THE NAVY:		
W. Graham Claytor, Jr.	Feb. 1977	Present
Gary D. Penisten (acting)	Feb. 1977	Feb. 1977
Joseph T. McCullum	Feb. 1977	Feb. 1977
David R. MacDonald	Jan. 1977	Jan. 1977
J. William Middendorf	June 1974	Jan. 1977
J. William Middendorf (acting)	Apr. 1974	June 1974
John R. Warner (acting)	May 1972	Apr. 1974
John H. Chafee	Jan. 1969	May 1972
UNDER SECRETARY OF THE NAVY:		
R. James Woolsey	Mar. 1977	Present
Vacant	Feb. 1977	Mar. 1977
David R. MacDonald	Sept. 1976	Feb. 1977
John Bowers (acting)	July 1976	Aug. 1976
Vacant	Mar. 1976	June 1976
David S. Potter	Aug. 1974	Mar. 1976
Vacant	June 1974	Aug. 1974
J. William Middendorf	June 1973	June 1974
Frank Sanders	May 1972	June 1973
John W. Warner	Feb. 1969	May 1972
ASSISTANT SECRETARY OF THE NAVY (MANPOWER, RESERVE AFFAIRS, AND LOGISTICS):		
Edward Hidalgo	Apr. 1977	Present
ASSISTANT SECRETARY OF THE NAVY (INSTALLATIONS AND LOGISTICS) (note c):		
Dr. John J. Bennett	Sept. 1976	Apr. 1977
Jack L. Bowers	June 1973	Sept. 1976
Charles L. Ill	July 1971	May 1973

	Tenure of office From	To
DEPARTMENT OF THE ARMY		
SECRETARY OF THE ARMY:		
Clifford Alexander	Feb. 1977	Present
Martin R. Hoffman	Aug. 1975	Jan. 1977
Howard H. Callaway	July 1973	Aug. 1975
UNDER SECRETARY OF THE ARMY:		
Walter B. Laberge	July 1977	Present
Vacant	Jan. 1977	July 1977
Norman R. Augustine	May 1975	Jan. 1977
Vacant	Apr. 1975	May 1975
Herman R. Staudt	Oct. 1973	Apr. 1975
ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS, LOGISTICS, AND FINANCIAL MANAGEMENT)		
Alan J. Gibbs	June 1977	Present
ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS AND LOGISTICS) (note d):		
Alan J. Gibbs	Apr. 1977	June 1977
Edwin Greiner (acting)	Jan. 1977	Apr. 1977
Harold L. Brownman	Oct. 1974	Dec. 1976
Vacant	Aug. 1974	Oct. 1974
Eugene E. Berg	Nov. 1973	July 1974
Vincent P. Huggard	Apr. 1973	Nov. 1973

a/The Assistant Secretary of Defense (Installations and Logistics) has been changed to the Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics).

b/The Assistant Secretary of the Air Force (Installations and Logistics) has been changed to the Assistant Secretary of the Air Force (Acquisition and Logistics).

c/The Assistant Secretary of the Navy (Installations) has been changed to the Assistant Secretary of the Navy (Manpower, Reserve Affairs and Logistics).

d/The Assistant Secretary of the Army (Installations and Logistics) has been changed to the Assistant Secretary of the Army (Installations, Logistics, and Financial Management).

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Senator PROXMIRE. You mentioned the fact that forward deployment was not considered as an alternative in the JCS study, Joint Chiefs' study. That subject was not discussed yesterday. Can you explain what you mean by forward deployment?

Mr. STOLAROW. That would be positioning of additional troop units over and above what are now in Europe.

Mr. STAATS. When we referred to pre-positioning, we were speaking of equipment and supplies, and forward deployment would be adding to that, the forces required.

Senator PROXMIRE. Personnel?

Mr. STAATS. Personnel.

Senator PROXMIRE. It was brought out yesterday a draft of your statement was submitted to the Defense Department for security review. I understand that the statement was censored for security reasons.

I wonder if you would explain why the statement was submitted for review and whether this is a common practice.

As I recall testimony yesterday, it was indicated that last year your statement was not submitted for censorship, and there were no deviations made.

Why the change in policy, to your understanding?

Mr. STAATS. There is no change in policy involved here, Mr. Chairman. I think the situation is that last year we were relying on unclassified data and there was no need to send it to the Defense Department for a security classification review.

This year we were using classified data, and in line with our normal practice throughout the Government, if we are using classified data in developing a report, we will ask the agencies that originated the data to review it as to what can be classified and what can be unclassified in the public report that we make.

This has been a standard practice that we have followed throughout the years.

If we question their judgment on whether a particular set of data needs to be classified, we can argue with them about it. But it would seem to us that it would not be proper for us to make a determination as to what is classified and what is not classified if the agency is strongly of the view that it should be classified for security reasons.

Senator PROXMIRE. Let me follow up on that by asking you this: Is it correct to say that some of the kinds of information that were available from public sources last year were deleted from your statement on grounds of secrecy?

For example, your statement does not discuss tonnage or the number of days it would take to deliver cargo or assumptions about warning time. Were such facts taken out of your statement, or similar facts, discussed publicly a year ago?

Mr. STOLAROW. Yes; that's true.

Senator PROXMIRE. They were. You see that's my problem.

Last year you discussed—even though I do see the distinction that last year you were not using classified data—nevertheless, you were able to use specific information with respect to warning time, tonnage, and so forth. This year you cannot.

I get the feeling that we are retrogressing in making information available to the Congress and to the public.

Would you discuss that, Mr. Stolarow?

Mr. STOLAROW. The only possible justification for the classification of some figures and data this year as opposed to what was released last year was in the context that it was being used.

Last year we spoke in very general terms of gross tonnages, airlift requirements and capabilities, and a projected warning time.

This year, when you put that together with threat assessments and more specifics, I would assume that that is why the Department of Defense felt they should be classified. In other words, in the way in which you discuss them, although I think you would have to ask them specifically why that step was taken.

Senator PROXMIRE. Would you agree that in order to make an informed judgment about the mobility proposals, more facts would have to be made available to the average Congressman or Senator, who does not have access to secret information, than is now available?

Would you also agree that for useful public debate or discussion of present mobility plans to take place more information would have to be disclosed?

Mr. STOLAROW. I think this is a very complex subject, and all of the facts and specifics must be understood and discussed before rational judgments can be made.

Senator PROXMIRE. Then how do we reconcile that, Mr. Stolarow? I think all of us agree that there must be some classification in this area. At the same time I think you are right, we should get as specific information as possible so we all have a notion of what we are doing, and we all know that, although the Pentagon has some very able people, they do make some serious blunders and mistakes, and discussion often helps correct that.

What's the solution?

Mr. STOLAROW. I don't know that I have the solution.

This is a dilemma that is facing the Congress and the press over many programs that deal with national security. The compromise, of course, in the past has been for the committees to take testimony in executive session, and as you point out, this is not entirely satisfactory to Members of the Congress.

But certainly there are certain facts and data that for reasons of national security should not be made public.

Senator PROXMIRE. Well, let me proceed on that then.

This brings us to the information being withheld and whether it is so sensitive that it should not be disclosed.

Under present procedures the Pentagon is the one who makes these decisions.

My staff has been told privately that much, if not all, of the information in the JCS report could be made public without endangering national security.

I wonder if you or your staff could comment on this and also whether in your opinion some or all of the facts deleted from your statement by the Pentagon could be unclassified without endangering national security.

How do you feel about that?

Mr. STAATS. I don't know of any way we can respond to that, Mr. Chairman, except to go back to Defense and on an item-by-item basis see whether or not they would reconsider their judgment.

This is not an unusual procedure. We do this quite frequently in fact. If we have some doubts as to whether or not the document is overclassified——

Senator PROXMIRE. What puzzles me and troubles me a lot about this is that, while I am sure that the people in the Defense Department are people of high integrity, nevertheless, there is a great temptation when you've got a program you can't really justify and that is very vulnerable to criticism and costs far more than it should, and you don't know quite what you are doing and you know you will be critized, to just cover it up, argue that it shouldn't be disclosed.

I think this is something that we have to look at.

Mr. STAATS. I think there is that danger, and there is certainly widespread feeling that we have overdone the security classification, not just by Defense, but by various agencies.

But in the final analysis, I guess the dilemma that we face in GAO, and I think it is the same dilemma that the committees of Congress face, if the authorities responsible for national security say that this information should not be made public, then what basis do we have for overriding that judgment, if they have thoroughly considered it and are still of that viewpoint?

Senator PROXMIRE. I have two suggestions for you.

One, I would hope that you would take another look at the JCS study and make the best judgment you can of where you think it might be proper or helpful to declassify and where you think it could be done properly. Then ask the Defense Department to reconsider this to see if they could go along.

That is suggestion No. 1.

Mr. STAATS. That would be my suggestion, too, Mr. Chairman.

Senator PROXMIRE. Suggestion No. 2: It occurs to me that both you and I have been wrestling with these problems for many years, and I wonder if it may be appropriate and would improve the process as to classified or declassified material that is made available to GAO and Congress for review, not only by the Pentagon, but by other agencies if you would undertake a comprehensive review of these problems and make a report together with recommendations for Congress to consider overall.

I am not asking for a deadline on it, but would you consider that?

Mr. STAATS. I would certainly be prepared to respond. We will take a look at it and see if there is something that we can do that would be useful here. I know that this has been a matter of congressional hearings over the past 4 or 5 years. I know that it's been a matter of some concern to the White House lest there be overclassification. But there might still be something that we can do that would be useful in this area.

Senator PROXMIRE. We were also told yesterday that GAO's problem of access to data, aside from the questions, I am not talking about disputes of what is classified and what is not, but access to data had been solved. We were told that by the witnesses yesterday.

Have you been given complete access to the information you need to evaluate the mobility proposals?

Mr. STAATS. Mr. Stolarow has had these conversations. It has been oral, but I prefer to have him give you the specifics of it.

Mr. STOLAROW. The only specific data we did not have access to in our work on this JCS study were the contingency plans, the war plans, which would be the basic source documents for determining which units would be moved and where they would be moved to and in what time frames.

Over the years we have consistently been denied access to those plans in our work.

Senator PROXMIRE. How important is that to making a sensible and efficient judgment?

Mr. STOLAROW. For purposes of verifying the data that goes into the study, it becomes an important part of the input to studies such as this; those are important.

Senator PROXMIRE. Do you feel you should be given access to that?

Mr. STOLAROW. Yes; we have felt that for a long time.

About 10 days ago, for purposes of this work, I received a phone call from a gentleman in the Office of the Secretary of Defense, saying that we would be given access to the contingency plans if we wanted to make a sample test or verification of the airlift requirements.

I told them as soon as these hearings were over and our staff was free, that we would do that.

Senator PROXMIRE. So the situation is you have been promised access, but you don't have it as yet?

Mr. STOLAROW. That is correct.

Senator PROXMIRE. You are assured you would get the information to evaluate these programs and assured that the information would be made available, but such information was not made available, and delays and failures to give you access have interfered with your work?

Mr. STOLAROW. That's been true for many years, yes, sir.

Senator PROXMIRE. So you get the indication that you would get it, and then you don't get the information.

Getting down to the substance of the mobility proposals, you make what must be considered a call for Congress to reconsider approval of the current programs. You say the JCS study should not be relied on by Congress as justification for major programs. The Defense Department has not justified its new airlift programs in terms of a requirement, and you conclude that it is still not clear what the current airlift programs should be or what they should cost.

Are you saying that the Pentagon still can't adequately justify its mobility proposals?

Mr. STOLAROW. I think right now we are far ahead of where we were last year. In other words, I think they can reasonably justify a requirement to move large tonnages to Eurpoe in the event of potential hostilities.

So that this is something we have never had before. In other words, it's a list of units, weights, pieces of equipment, that must be moved in the judgment of the military planners in order to protect against the Warsaw Pact attack.

Senator PROXMIRE. So you are saying they justify moving a great deal of equipment and personnel and so forth; but we don't have any kind of satisfactory explanation of how they would do that most efficiently at the lowest cost?

Mr. STOLAROW. That is correct. In other words, if they wanted to—I don't think that they attempted to—they could say that that whole requirement could be a justification for airlift.

In other words, certainly the faster you can get something there the more effective it is going to be.

So the entire tremendous quantity could be airlifted, somebody could very easily say that.

Senator PROXMIRE. I don't know about that, considering the fact that the container ships could make it in 4 or 5 days when you might have a 30-day, 15-day, or even a 10-day requirement.

Container ships obviously have a big role to play here.

Mr. STOLAROW. That is right.

Senator PROXMIRE. Even if the requirement is much quicker than that, 3 days, pre-positioning would have a big role to play.

Mr. STAATS. I guess what we are looking for is the most effective method to get the equipment and the forces there in the time that you have to have them there. We don't think those tradeoff analyses have been made as yet.

Senator PROXMIRE. I am not sure if you have answered this, Let me ask it for the record anyway; you criticized mobility proposals in your 1976 report. Since that report was issued, have you had any reason to reconsider or withdraw any of your criticisms or do you stand by what you said in that report?

You just said there has been some modification.

Mr. STOLAROW. As I said, I think there is a big improvement in the knowledge that is available since the time of that previous report.

Last year we said there was no information at all as to specific weights and tonnages and units that would have to be moved.

That has been the big step forward in my opinion that has been done this year at the behest of the Congress, at least we have identified a total strategic mobility requirement.

Senator PROXMIRE. Do you stand by your criticisms of the individual proposals for modifying aircraft, and of the proposals concerning new aircraft?

Mr. STOLAROW. Yes, sir.

Senator PROXMIRE. You mentioned the Army's readiness program. Last year, Senator Humphrey released two GAO reports and we will put those in the record.

[The reports referred to follow:]

UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

LOGISTICS AND COMMUNICATIONS DIVISION

B-146896

July 23, 1976

The Honorable Hubert H. Humphrey
Chairman, Joint Economic Committee
Congress of the United States

Dear Mr. Chairman:

Pursuant to your request of July 8, 1976, enclosed is an unclassified version of our full report on the readiness of first-line U.S. combat armored units in Europe.

Sincerely yours,

Fred J. Shafer

Fred J. Shafer
Director

Enclosure

28-003 O - 81 - 17

UNITED STATES
GENERAL ACCOUNTING OFFICE

Readiness Of First Line U.S. Combat Armored Units In Europe

Department of Defense

This report is an unclassified version of GAO's report LCD-76-412 (Revised), dated June 30, 1976. This report points out that limitations in personnel, equipment, and ammunition exist but units report they are substantially ready with minor deficiencies.

LCD-76-452

UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

LOGISTICS AND COMMUNICATIONS DIVISION

B-146896

The Honorable
The Secretary of Defense

Dear Mr. Secretary:

This report discusses the readiness of key armored and mechanized units in Europe and the problems concerning these high priority units. We offer recommendations which could improve their readiness and which could provide better information to higher headquarters about their combat capabilities.

This report was reviewed by Headquarters, United States Army, Europe (USAREUR), and Headquarters, Seventh Army. We have revised the report, where appropriate, according to their comments and proposed revisions. Several actions have been taken or were being taken by USAREUR to correct some of the problems discussed in this report, but additional actions are necessary at Headquarters, Department of the Army.

Please note that this report supersedes our June 3, 1976, report of the same title. This report was reissued because of changes required in the security classification applied by USAREUR. Twelve copies (control numbers 1-12)and 40 copies (control numbers 13-52) of the June 3, 1976, report were distributed to your office and to the Office of the Secretary of the Army, respectively. With the exception of copy number 28, which was returned to the General Accounting Office, all copies of the June 3, 1976, report should be destroyed upon receipt of this report.

In accordance with approval from your office, we are sending copies of this report to the House and Senate Committees on Government Operations, Appropriations, Armed Services and to the Joint Economic Committee.

This report contains recommendations which are set forth on pages 24, 36, 43, and 47. 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 and Senate Committees on Government Operations not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with agency's first request for appropriations made more than 60 days after the date of the report.

B-146896

If you or your representatives wish to obtain further details concerning any of the matters contained in this report, please contact Mr. Werner Grosshans, Associate Director, at 275-5897.

Sincerely yours,

R. S. Rothwell

for F. J. Shafer
Director

Contents

ABBREVIATIONS

ALO	authorized level of organization
APDS-T	Armor-Piercing, Discarding Sabot-Tracer
ASP	ammunition stock point
ESC	equipment serviceability criteria
GAO	General Accounting Office
HEAT	High Explosive Anti-Tank
MOS	military occupational specialty
MTOE	Modified Table of Organization and Equipment
NATO	North Atlantic Treaty Organization
OJT	on-the-job training
USAREUR	U.S. Army, Europe

GENERAL ACCOUNTING OFFICE
REPORT TO THE SECRETARY
OF DEFENSE

READINESS OF FIRST LINE U.S.
COMBAT ARMORED UNITS IN EUROPE
Department of the Army

D I G E S T

The U.S. Army in Europe is expected to maintain a combat ready force to assist NATO allies in the defense of Europe should it be necessary. Tracked vehicles provide the mobility and much of the firepower for these Army units. GAO wanted to find out whether the tracked vehicles assigned to these units together with the people who operate them and the ammunition they use are ready to perform assigned missions. Units of one mechanized regiment and one armored division were selected for study.

READINESS

Personnel, equipment, and ammunition problems existed but units continued to report they were substantially ready with minor deficiencies. Some of these conditions, such as equipment deficiencies, could have been remedied in a matter of days, possibly hours, through intensive maintenance actions, but many other conditions could not have been improved. (See pp. 11, 26, 31, and 37.)

REPORTING PROBLEMS

Units are not required to report on the readiness condition of their ammunition. (See p. 37.)

The standards for computing and reporting personnel readiness in Army Regulation 220-1 have been relaxed to the point where units could almost always be reported as combat ready. (See p. 22.)

The Army reporting system provides for combining key combat personnel and equipment with other less critical, more numerous, and more ready unit resources and for applying judgmental factors by various levels of command. As a result, readiness ratings

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LCD-76-452

at the regimental or divisional level are not always a reliable indicator of combat readiness. (See p. 44.)

RECOMMENDATIONS TO THE SECRETARY OF DEFENSE

Recognizing that the Army is striving continuously to improve the management of equipment and logistics support for U.S. Forces in Europe, GAO recommends that the Army:

--Insure that combat units have full crews assigned for all tracked combat vehicles.

--Review, in conjunction with the Training and Doctrine Command and the U.S. Army in Europe, training programs conducted in the United States for crew members to assure that needed basic skills are acquired before assignment to Europe. This is especially important in view of general shortages of combat qualified E-5 to E-8 noncommissioned officers.

--Have the the U.S. Army in Europe aggressively follow up its training program as defined in its Training Directive, USAREUR Regulation 350-1. Training should be geared individually to those crew members that need it to make them fully combat qualified.

--Have the U.S. Army in Europe weigh unit access priorities to training areas according to identified needs and the units' importance to the general defense plans. Units should have the opportunity to continue the training until an acceptable number of crews meet minimum requirements.

--Pursue vigorously, with input from field units, the development and use of simplified equipment checklists to determine and report the serviceability and combat readiness of equipment. Areas should be identified where maintenance personnel would be better qualified than crewmen to conduct tests and checks, and maintenance personnel should be directed to conduct these tests periodically.

--Have the U.S. Army in Europe identify unserviceable basic load ammunition at storage points in Europe and take the necessary action to rehabilitate or replace the defective ammunition.

--Have the U.S. Army in Europe, in conjunction with field commanders, develop procedures to insure that combat units have all their basic load ammunition readily available at all times.

--Have the U.S. Army in Europe and subordinate commands identify the need for materiel handling equipment as well as position this equipment where needed to speed the uploading of ammunition.

In view of problems not shown by the unit readiness reporting system, GAO recommends that the Army:

--Require that European divisions forward battalion level readiness reports to the U.S. Army in Europe along with the divisional consolidated report. This would give managers at higher levels more specific information on critical situations which are not now shown because of the averaging provision.

--Redesign the readiness reporting format so combat and support assets (personnel and equipment) are rated separately.

--Permit regimental and divisional commanders to make narrative comments on the ratings, as is done now, but require that overall ratings be strictly a compilation of those submitted by subordinate units.

--Require units to report the number of tracked combat vehicles which cannot be fully crewed to the U.S. Army in Europe level that can best deal with the problem.

--Incorporate basic load ammunition in unit readiness reporting. Readiness should measure or consider factors, such as:

1. Serviceable quantities on hand versus those required for initial combat operations.

2. Accessibility of ammunition areas measured in terms of (a) materiel handling and transportation resources available to meet mission uploading time frame and (b) success in achieving uploading exercises within mission time frames. Such exercises should be conducted periodically and be designed to create the minimum disruption of materiel and other resources. Where several units are to have access to the storage facilities, joint uploading exercises should be conducted to test coordination of unit planning.

We also recommend that the Secretary of Defense aggessively pursue the opportunities for geater use of cost effective simulators for combat tracked vehicle crews.

AGENCY ACTIONS AND COMMENTS

Discussions were held in January 1976 at U.S. Army in Europe headquarters with the Chief of Staff and various representatives regarding the contents of this report. Army officials indicated the following actions had been or were being taken for readiness and readiness reporting.

--The Commander in Chief of the U.S. Army in Europe sent a notice to field units indicating concern about proper assignments and full crews. He gave instructions emphasizing the need for full crews on all combat vehicles. Personnel from the Military Personnel Center, Europe, have been to field units reviewing personnel problems and indications are that the situation noted in this report is improving.

--Command has also emphasized (1) maintenance and operability of equipment, (2) capability to move, shoot, and communicate, (3) ability to upload basic load ammunition, and (4) cross-training of the individual soldier.

--Command has continually increased the amount of readiness information available to the Commander in Chief. Currently,.battalion unit readiness is reported directly to U.S. Army in Europe headquarters and is used to more effectively control readiness problems.

--The U.S. Army in Europe's major goal for 1976 is to sustain and improve combat readiness. Emphasis is to be on system discipline and dealing with personnel and equipment problems.

--A U.S. Army in Europe Training Directive has been published outlining training goals. New training aids have been received in theater which should aid the program. Formalized on-the-job training is being emphasized.

--The Department of Army is developing a "hands-on" testing program for combat arms to supplement other testing programs.

--The U.S. Army in Europe will incorporate actual uploading of basic load ammunition as part of its readiness testing program.

--Access to training areas is improving at both major training areas. For the first time there will be a brigade level training exercise this year.

--The U.S. Army in Europe is emphasizing budgeting of funds and materiel management to get the most value from each training dollar spent.

--The U.S. Army in Europe is actively pursuing the construction of new ammunition storage areas to meet recognized needs. Land constraints and NATO funding are the biggest problems.

--Followup work done at the units in November 1975 showed significant improvement towards attaining manning requirements.

Discussions with these officials convinced GAO that the U.S. Army in Europe is actively and positively pursuing many of the problems highlighted in this review.

CHAPTER 1

INTRODUCTION

The U.S. Army, Europe (USAREUR), is expected to maintain a combat ready force to carry out operational tasks as assigned by higher headquarters and as warranted under our commitment to the North Atlantic Treaty Organization (NATO). To accomplish this mission the Army recognizes it must have trained personnel, equipment in top condition, fuel, ammunition, spare parts, and constant vigilance.

About 183,000 U.S. Army troops are assigned to the U.S. Army in Europe, with an annual operating budget of around $1.3 billion. The troops are assigned under the Seventh Army in two Army corps--V and VII--and to various other smaller commands. The corps are made up of four and two-thirds divisions and two armored cavalry regiments.

The Seventh Army is essentially an armored, mechanized, nuclear-supported force which relies extensively on mobility through the use of tracked vehicles for reconnaissance, armor, and troop transportation. In case of war these units would be deployed across rivers and rolling hills and forested terrain toward the West German eastern border. They would provide the first line of defense in assigned sectors until reinforcements from other nations or from the United States are available.

As of December 1974 the fleet of Seventh Army mechanized tracked vehicles included:

	Number of vehicles on hand
Main battle tank M-60	DELETED
Sheridan M-551	
Armored personnel carrier M-113	
Reconnaissance vehicles M-114	
Self-propelled artillery M-107, M-109, M-110	
Total	

Tracked combat vehicles, such as the M-60 battle tank, M-551 armored reconnaissance vehicle, M-106A1 and M-125A1 self-propelled mortar carriers, M-109A1 and M-110 self-propelled howitzers, and M-113A1 TOWs (antitank weapon mounted on an armored personnel carrier chassis) provide the heavy ground firepower. Trucks generally transport spare parts, food, petroleum, lubricants, and ammunition necessary to support combat operations.

WARSAW PACT THREAT

The communist forces in Central and East Europe are organized under the Warsaw Pact. In addition to air and sea forces, the ground forces of the Warsaw Pact members total over 200 divisions, of which about 160 are Soviet. The Soviet Union has 31 divisions, armored and mechanized, permanently stationed in East Europe, with nearly 300,000 troops in East Germany and contingents of lesser size in Poland, Hungary, and Czechoslovakia. The U.S. Army believes Soviet ground forces are well trained and well equipped and are maintained in an advanced state of readiness. DELETED Under the latter, hostilities could begin in a matter of hours.

Facing the sector currently held by the U.S. Forces, the ground threat is estimated by USAREUR at DELETED

Warsaw Pact member	Number of divisions	Type
Soviet Union	DELETED	
East Germany		
Czechoslovakia		
Total		

USAREUR believes that at the start of hostilities its units could be attacked by about DELETED tanks, many of which are Soviet T-62 tanks supported by infantry and self-propelled artillery. In the sector to be defended by U.S. ground forces, the ratio of main battle tanks of the Warsaw Pact to U.S. tanks is about DELETED.

The Commander, U.S. Army Training and Doctrine Command, indicated in October 1974 that tank units can successfully engage the enemy against these odds by:

1. Recognizing the significance of increased firepower lethality.

2. Maximizing protective use of terrain.

3. Utilizing fire suppression.

4. Greatly improving combined arms teamwork.

Also the Army has drawn on facts obtained from recent battles in the deserts of the Middle East. Currently, the Army believes that:

--Long-range, high-velocity tank cannon and long-range, antiarmor missile systems dominate the modern battlefield. Anything they can see can be taken under fire and hit. Anything they can hit can be killed.

--Long-range, air defense cannon and missile systems dominate the air above the battlefield. They can effectively prevent forward fighting elements from receiving close air support; they severely limit operations of Army aircraft.

--The U.S. Army must learn to fight outnumbered and win. The tank ratios on the Golan Heights in October 1973 were not at all unlike those to be expected in a war in Central Europe.

MOVE, SHOOT, AND COMMUNICATE

Armored combat vehicles must be able to move, shoot, and communicate to perform their assigned missions.

Today's battlefields require extensive movement and maneuvering by combined armed forces. Such forces consist of tanks, armored personnel carriers, and supporting mobile artillery, mortars, antitank, and air defense weapons.

These forces must operate over wide areas in varying terrain. Movements of over 100 miles in short periods of time are not considered excessive. Once into an operating area, movement does not cease but becomes critical to the maneuvering of forces to enable them to engage the enemy under the best possible conditions. This is essential for successful operations and for team survival.

Combat teams must be able to shoot fast first in a tank-antitank battle, particularly at antiarmor capable targets. Control and distribution of fire to destroy targets rapidly and save ammunition for the next engagement is essential.

Teams must communicate in controlling and reporting the battle as well as in maneuvering forces with precision, discipline, speed, and security if they are to defeat opposing forces in modern environments. Communications are done by hand and arm signals when possible, but teams rely heavily on radio communications when unit personnel are not in visual contact and when movement, fire control, and coordination are essential.

Armored forces are expected to capitalize on their mobility and firepower to force the enemy to fight at a time and place not of his choice. Enemy weapons which the force may encounter are not only present in larger numbers but are also highly effective. To overcome this disadvantage as much as possible, armored forces must utilize all natural cover and concealment afforded by the terrain. The team must make every effort to operate unseen.

While proper use of terrain affords protection from enemy weapons, the team must also actively counter them if it is to accomplish its mission. Due to the density, range, and effectiveness of present antiarmor weapons, operations cannot be effective unless these fires are suppressed. To do so when contact is expected, a team commander must insure that moving unit personnel are covered by other team personnel and that reinforcing fire from mortars, artillery, attack helicopters, and tactical air is provided as necessary and as available.

Each of the basic elements of the armored force should be assigned the job it does best. For example, tanks are best used to destroy enemy armored vehicles and other hard targets. Also, in support of mechanized infantry maneuvers, tanks suppress enemy fires. The mechanized infantry suppresses antiarmor fire for maneuvering tanks or may dismount to clear antiarmor defenses or to secure areas where they may be located. Tanks and armored personnel carriers can move together close to supporting fires and under carefully planned mortar and artillery fire to gain an objective.

Communications become increasingly important as contact with an enemy becomes more likely. Contact should be by the smallest unit element possible. This element must report the contact concisely and rapidly to give the force commander the best information possible. In turn, the commander must be able to communicate his plan for defeating the enemy force and to coordinate the operation until the objective is secured.

UNIT READINESS REPORTING SYSTEM

The U.S. Army constantly monitors the ability of its combat and other field units to perform the mission they are assigned.

This ability is measured quantitatively by comparing personnel, equipment and supplies, operational equipment, and training against standards assigned to various categories of units. Additionally, unit commanders are required to provide judgmental appraisals of the overall quality of these resources.

Data for each type of resource is submitted monthly by field units into a unit readiness reporting system. Differences between actual conditions and Army standards are noted by percentage of standards achieved and reported in terms of

--C-1: fully combat ready;

--C-2: substantially combat ready with minor deficiencies;

--C-3: marginally combat ready with major deficiencies severely limiting combat performance; and

--C-4: not combat ready, incapable of performing assigned mission.

Unit commanders compile this information into an overall unit readiness rating and can increase or decrease it somewhat as a result of their judgmental appraisal of unit quality; however, reasons for such change must be documented in the remarks section of their report. Divisions and armored cavalry regiments consolidate readiness ratings prepared at battalions or squadrons into one readiness rating for each of the elements and assign an overall readiness rating. Units not assigned to divisions or regiments generally report directly to higher headquarters. The divisions, regiments, and nondivisional units submit their readiness reports

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to USAREUR which in turn submits them to the Department of the Army and the Joint Chiefs of Staff. The commanders use the readiness report data to monitor Army and command readiness, to identify readiness problems, and to analyze trends which may require a shifting of or additional resources.

Field units also submit equipment readiness data quarterly to the U.S. Army Materiel Development and Readiness Command. The data is used to evaluate trends in equipment condition and related maintenance programs.

CHAPTER 2

MISSION

The readiness of Army units closest to a potential enemy is imperative because these units must delay or prevent a successful attack until other units or reinforcements can be brought in.

USAREUR has assigned the mission of delaying an enemy ground attack in the U.S. sector to DELETED DELETED located about 1 hour from the international borders of Czechoslovakia and East Germany. The mission of DELETED These units, based upon their relative geographical positions, have to be ready for combat deployment anywhere from DELETED As warning time increases, so does the deployment time available to these units.

To evaluate the readiness of tracked vehicles, we selected units of the 2nd Armored Cavalry Regiment and the 1st Armored Division in the VII Corps. We evaluated personnel, equipment serviceability, and ammunition. These items are crucial to immediate deployment capability and combat performance.

DELETED The regiment has three squadrons which have DELETED tracked combat vehicles, including M-551 Sheridans and M-60 series main battle tanks.

The squadron visited during the review is located about 35 miles from the Czechoslovakian border and is responsible DELETED This unit also has a peacetime mission of patrolling part of the Czechoslovakian border. DELETED

DELETED in the event of hostilities. This includes time to gather crews, issue rations, and other implements. If there is DELETED

DELETED

DELETED to its wartime position. From this position combat crews are to maintain sight of the enemy and radio information about the enemy and his location to the rear area. Besides keeping command channels apprised of the advance, combat crews in the unit are to delay the advance of enemy tracked vehicles.

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CHAPTER 3

OBSERVATIONS

The units reviewed could have deployed for combat within the time frame allotted under the current USAREUR mission

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Some of the conditions, such as inoperational equipment, could have been remedied in a matter of days, possibly hours, through intensive maintenance action. While it may have been possible to obtain personnel working in other jobs to crew some of the equipment in an emergency, they would lack desired proficiency because they would not have practiced their skills.

DELETED would have to be filled from other storage facilities. How long this would have taken is difficult to evaluate

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Commanders of these units plan to go into combat with the resources available at the time. Also, they believe that by coupling high morale and expediency to solve the above problems the units will give a good account of themselves. We believe these comments are creditable. However, we believe that any identifiable limitation which could be corrected would lessen the burden on the units in a crisis and thereby greatly improve their chances of achieving assigned missions.

The unit readiness reporting system which could best attract the attention of higher headquarters to these limitations failed to do it adequately.

CHAPTER 4

PERSONNEL

The unit's Modified Table of Organization and Equipment (MTOE) specifies the number of personnel authorized for each job and the skills each person should have to perform the job. Units are instructed to report their personnel readiness monthly by comparing numbers and skills of personnel in the unit to those stipulated in the MTOE.

Units within the 2nd Armored Cavalry Regiment and the 2nd Brigade of the 1st Armored Division did not have all the personnel they were authorized, and many of these shortages were in skills (Military Occupational Specialty (MOS)) stipulated for tracked combat vehicles.

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as stipulated in the MTOE and necessary for these vehicles to be effective fighting systems. These shortages also adversely affected the crewing of other tracked vehicles, such as the M-109A1, M-113A1, M-106A1, and M-125A1 because they did not have the correct number of personnel assigned to the crews. To make up for lack of experienced personnel, commanders said they were conducting extensive training. However, some of the training has been constrained by lack of funds and insufficient training grounds. Despite significant personnel shortages, unit commanders did not have available at that time established programs to train personnel who were available for making the transition from peacetime jobs to crewing a tracked vehicle for combat.

In addition to personnel shortages, DELETED DELETED of those personnel actually assigned to crews lacked the experience and skill levels stipulated by the MTOE for their crew positions. This was due to the Army-wide shortage of noncommissioned officers with combat MOSs. While some of the young, less experienced crew members may be more aggressive and perhaps capable of performing effectively in these crew positions, it is important that they receive training necessary so that they can handle these responsibilities. However, many of the crews failed to demonstrate an adequate level of proficiency during training tests, and these frontline crews did not have an opportunity to retake training tests because of the lack of training areas.

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COMBAT UNITS NOT ASSIGNED AUTHORIZED CREWMEN

Units visited had an authorized level of organization (ALO) of 2, which indicated that they should have about 90 percent of all personnel required under the full MTOE. The level of organization was being increased to ALO 1, or the full MTOE during our review.

At ALO 2, the MTOE authorizes full crews (four men) to be assigned to each M-60A1 tank and each M-551 Sheridan. Personnel spaces not authorized at ALO 2 usually are support position or less important combat positions. For example, less than full crews are authorized for other tracked combat vehicles, such as M-125A1 mortar carriers, M-109A1 howitzers, and M-113A1 armored personnel carriers. Shortages of one or two crew members generally would not keep these vehicles from combat, but these shortages could affect performance. The degree to which effectiveness would be degraded would depend on the mission and the capability of available crew members.

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While less than full crews were authorized for other tracked combat vehicles, these were not crewed to the authorized level. The extent of authorized members of personnel assigned to crews is shown in the chart on page 14 for each type of vehicle reviewed at each organization.

Tracked vehicles were not crewed to authorized levels for several reasons. First, units had not received the total number of personnel authorized. Second, units were not provided sufficient numbers of personnel with the proper MOSs; therefore, units were not able to assign sufficient numbers of personnel to tracked vehicles on a full-time basis and at the same time perform other unit tasks requiring the same basic skills or knowledge.

Third, although units were confronted with overall personnel shortages and shortages of personnel with tracked vehicle MOSs, unit commanders did not have available at that time established programs to provide essential training on tracked vehicles to personnel filling other positions deemed to be less essential in time of combat.

At ALO 2, the 2nd Armored Cavalry Regiment's squadrons were authorized DELETED personnel assigned in February 1975.

Units of both the 2nd Armored Cavalry Regiment and the 2nd Brigade were experiencing shortages of personnel with MOS skills for operating many of their vehicles.

The chart below illustrates the personnel situation with MOSs required for M-551s and M-60A1s by one unit within the regiment.

Basic MOS	Personnel authorized for the entire unit at ALO2	Personnel authorized for M-551 and M-60A1 crews	Personnel assigned to unit	Personnel under(-) or over total unit needs (note a)
Armor crewman	DELETED			
Armored reconnaissance specialist				
Total				

a/Personnel assigned to unit less personnel authorized for the entire unit at ALO2.

Units within the 2nd Brigade also had shortages in the same MOSs. Throughout the entire 1st Armored Division they had DELETED percent of their armor crewmen and DELETED percent of their armored reconnaissance specialists.

Recognizing that units may be faced with personnel shortages, the Department of the Army suggests the use of available personnel to fill key positions in Department

Unit and type of vehicle	Personnel authorized at AL02	Personnel assigned to crews regardless of MOS	Percent of authorized personnel assigned to crews (note a)
	DELETED		

of the Army Pamphlet 525-10 entitled "Combat Readiness." This can be achieved through dual qualification and cross-training where personnel or skill shortages exist. Futhermore, commanders are encouraged to always have a designated understudy for each key position. Crewmen for tracked combat vehicles hold key positions.

At the time of our visit unit commanders did not have established programs to provide this training so that all vacant crew positions could be filled. Units generally treated each position in the organization as a full-time assignment and generally had not taken action suggested in the pamphlet.

Unit commanders should have identified personnel filling positions deemed less essential in time of combat so that they can be used as additional crews. These personnel should have been assigned to a crew position within a tracked vehicle for training and combat. It may be necessary for these personnel to perform their normal administrative or support duties in peacetime, but they would participate in combat-related training with fellow crew members. This approach may place an additional burden on unit personnel, but in view of personnel shortages and the critical combat missions of these units there are few other options except to cross-train their personnel to insure mission performance.

The units were revisited in November 1975. The Army had provided these units additional personnel. These additional personnel have made it possible for units to assign full crews to tracked combat vehicles on a full-time basis. However, because of the Army-wide shortage of personnel with the armored reconnaissance specialist MOS, units have received personnel with other MOSs, primarily infantry MOSs. Units have been instructed to provide on-the-job training to these personnel.

Additionally, USAREUR has developed and is implementing an improved training program for all combat units. The program is built around USAREUR Regulation 350-1 and for fiscal year 1976 is to sustain current levels and to improve and perfect what has already been accomplished.

The shortage of armored reconnaissance specialists is not expected to be rectified during fiscal year 1976. As of November 11, 1975, the Army expected to train only 3,268 of the 3,511 required armored reconnaissance specialists during fiscal year 1976. At the same time, the Army is overtraining in other skills as discussed in our report to the Secretary of the Army (FPCD-76-28, February 10, 1976). In our opinion, the Army should continue to strive to balance its training program with its manpower requirements.

ASSIGNED CREWMEN DO NOT HAVE ARMY-DESIRED SKILL LEVELS

The MTOE stipulates the skill--military occupational specialty--and the skill level, which is indicative of a soldier's rank and his years of experience, desired for each crew member of a tracked vehicle. For example, the MTOE states that M-551 and M-60A1 crew members are to have ranks ranging from 1st lieutenant to private first class. A typical M-551 or M-60 crew would be manned as follows.

	Rank 1/
Commander	Staff sergeant, E-6
Gunner	Sergeant, E-5
Loader	Private 1st Class, E-3
Driver	Sergeant, E-5

All crew members in M-60 tanks are to have an armor MOS while only the gunner and driver are to have an armor MOS in M-551 Sheridans. Sheridan tank commanders and loaders are to have an armor reconnaissance specialist MOS. The MTOE requires greater MOS proficiency for the commander, gunner, and driver and a lower level for the loader.

Analysis of assigned combat crews within the 2nd Armored Cavalry Regiment and the 2nd Brigade and one field artillery battalion of the 1st Armored Division

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The following graph shows the number of vehicles of those included in our analysis which would not be fully crewed according to MTOE standards. The

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1/Since the time of our review, MTOE requirements have been changed Army-wide to:

Commander	Staff Sergeant, E-6
Gunner	Sergeant, E-5
Loader	Specialist, Fourth Class, E-4
Driver	Private First Class, E-3

277.

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predominant reason for the number of crews not meeting MTOE standard was that crew members were lower in rank and thereby lacked the experience stipulated by the MTOE. The Army has recognized a major shortage of noncommissioned officers, especially in the E-5 to E-8 categories.

Lack of experience does not necessarily mean the soldier cannot do the job, and furthermore it can be overcome through training. DELETED

During annual tank gunnery training in the spring of 1975, DELETED M-551 and M-60A1 crews attempting qualification successfully met mininum requirements as shown below.

Tracked vehicle	Vehicles in regiment	Vehicles fully crewed (note a)	Vehicles completing firing run	Crews meeting minimum scores	Percent of crews demonstrating qualifications (note b)
M-551	DELETED				
M-60A1					
Total					

a/One additional M-551 and four M-60A1 combat crews were assigned to these vehicles after our visit and before the 2nd Armored Cavalry Regiment's tank gunnery training.

b/Number of crews meeting minimum scores divided by number of vehicles fully crewed.

An analysis of the experience of participating crew members indicated that DELETED Information was not available to explain the reason for the DELETED M-551 crewmen had the same MOS as crewmen for the M-114A1E1, command and reconnaissance tracked vehicle, and have received their training in this vehicle. These vehicles are compleltly different, especially the armament systems. This situation has placed unit commanders in the predicament of teaching new arrivals fundamentals necessary for operating the M-551 before they can take their crews to tank gunnery. Currently, the Army is providing training on the M-551 to selected personnel as part of advanced individual training for armored reconnaissance specialists.

Although tank gunnery is only one portion of training, it is one of the most important. Getting first round hits in minimum time after target indentification is a key to survival. Tank gunnery training is designed with this in mind. Yet these crews did not get a chance to rerun the qualification course until acceptable scores were attained because other units had been granted access to the training area.

The Army is adversely affecting the readiness of its front line units by sending replacements to Europe that have not been adequately trained as M-551 crewmen. This places unit commanders in the position of attempting to train crewmen to use their equipment, perform their peacetime surveillance missions, and be ready to enter combat at a moment's notice. Crewmen should be taught fundamentals before assignment to Europe. This should increase readiness. Part of the problem seems to be matching Sheridan-trained personnel with experience. Recently, an additional skill indicator has been awarded to Sheridan qualified crewmen which is intended to identify Sheridan-trained personnel for reassignment purposes. This should help provide additional Sheridan-qualified crewmen to Europe.

Another factor affecting readiness is

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In a letter to the Secretary of Defense dated February 26, 1976, we suggested that the Department of Defense investigate opportunities for greater use of simulator for tracked vehicles, including a crew simulator for tanks which could be used to qualify crew members. A cost effective simulator could be put to good use in Europe.

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on the ranges to develop their proficiency. These opportunities should be available immediately after qualification runs until an acceptable number of crews meet minimum requirements.

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USAREUR officials said that the skill levels of combat crews have improved considerably in recent months due to increased management emphasis. However, fund constraints still have an impact on what units can and cannot do to provide needed training and practice.

IMPORTANCE OF WELL-TRAINED CREWS

Long-range, high-velocity tank cannons and long-range, antiarmor missile systems dominate the modern battlefield. Today, anything that can be hit can be destroyed.

The 2nd Armored Cavalry Regiment has

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More specifically, a typical troop 1/ within the 2nd Armored Cavalry Regiment has the wartime mission of providing

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The troop's sector is a

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This

1/Generally a troop is equivalent to a company.

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troop, which is authorized DELETED M-551 Sheridans and 4 crew members for each, would have had the necessary 4-man crews for DELETED crews had the desired MOS, skill level, and rank. The remaining crew members had the basic MOS but lacked the desired skill level and rank.

To perform this mission successfully, crews are expected to possess basic skills, such as

--thorough knowledge of vehicle;

--ability to perform routine maintenance;

--ability to transmit messages within and between tanks, aircraft, command posts, and artillery support;

--knowledge of enemy equipment for identification purposes;

--camouflage techniques;

--demolition techniques;

--ability to fire armament systems successfully; and

--knowledge of terrain.

Crews are expected to use these skills in conducting delay operations.

Squadron artillery, located behind the M-551 Sheridan, is to fire on the approaching enemy at maximum range. As the enemy approaches, Sheridan crews, located on the tops of wooded hills for good visibility but with avenues of escape, engage him with all available direct fire. Artillery fire is to continue during the bombardment. Intensity of the firing is to increase until the enemy is forced to deploy from his approach formation and defend or prepare a deliberate assault. When the enemy concentrates superior forces and threatens to close, Sheridan crews are to begin delaying to new positions in the rear. Crews are to maintain contact with the enemy and to move by bounds. Usually, contact with the enemy is maintained by crews covering the withdrawal of other crews. When new positions are established, the enemy is to be stalled and delayed again by forcing him to deploy and plan a deliberate

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attack.

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As can be seen by the above, it is extremely important today for crews to possess skills essential to performing missions, surviving combat, and winning. We were unable to assess the ability of crews to perform most of the above skills because records of the these skills did not exist for assigned crew members. Detailed records such as these are not required to be kept on each crewman or on the entire crew for a vehicle. We were able to obtain the results of tank gunnery, as discussed earlier.

WHY PERSONNEL READINESS PROBLEMS WERE NOT SHOWN IN UNIT READINESS REPORTS

Various Army echelons monitor and evaluate the readiness of subordinate units to determine which are fully combat ready and what is needed to improve the readiness of units below the desired state of preparedness. The desired state of preparedness is the authorized level of organization. Thus, units reviewed were expected to attain a C-2 readiness state. As long as units reported that they were meeting their level of organization, there seems to be little incentive for managers at headquarters level to look at the comment section of reports.

The fact that units did not have full combat crews for all tracked vehicles and had many crewmen who could not demonstrate minimum tank gunnery skills was not shown in the personnel readiness portion of readiness reports. This was due to the instructions in Army Regulation 220-1 which do not specifically require unit commanders to consider the above facts in determining personnel readiness ratings or to report these facts to higher headquarters.

We believe these problems should be indicated in readiness reports so managers at all levels can take corrective action or at least know of the relative risks they are forced to take by not providing the resources. These problems have a direct bearing on the units' ability to perform important missions, if needed. If a unit cannot perform planned tasks, units behind them must change or alter their war planning until such problems are corrected.

Units report personnel readiness to higher headquarters through readiness rating codes which range from C-1 to C-4, with C-1 representing the highest state of readiness. For example, according to Army Regulation 220-1, a personnel readiness condition of C-1 indicates that the reporting unit has at least 95 percent of its required people and that at least 86 percent of these people are qualified to perform the duties of the position to which assigned. According to this regulation, personnel are to be considered qualified if the first three characters of any of their MOSs match the first three characters of the position in the MTOE. Further, individuals are to be considered qualified if they possess a substitutable MOS as outlined in Army Regulation 611-201. For individuals in an on-the-job training (OJT) status, unit commanders are required to judge the individuals' capability to perform satisfactorily. If the judgment is positive, the individual is considered qualified for the readiness computation. When unit readiness is affected by personnel shortages, units are to report these shortages by grade/skill level within MOS in the comment section of the report.

If units were instructed to compute the percentage of qualified personnel assigned to those vehicles reviewed by us (see p. 14) by comparing ranks and skills (MOS) possessed by crewmen to those stipulated in the MTOE, the 2nd Armored Cavalry Regiment would have derived about

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personnel in crews possess the desired rank and skills to perform the duties to which assigned. Shortages of non-commissioned officers was the prime cause for these low percentages as well as shortages of personnel trained on the M-551 Sheridan.

If the 2nd Armored Cavalry Regiment would have computed the personnel readiness of their M-551 and M-60 combat crewmen on the basis of their qualifications as demonstrated at tank gunnery, they would have

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The personnel readiness condition is computed by considering all the personnel in the unit. While this may indicate that personnel readiness is a problem, the readiness rating does not indicate whether the problem is related to combat or support personnel. Both combat personnel and support personnel are necessary for accomplishing the mission, but without combat personnel there is little or no chance of mission accomplishment.

For these reasons we believe personnel readiness should be computed and reported separately for combat and support personnel. Furthermore, to highlight major combat readiness problems, provisions should be made for reporting the number of tracked combat vehicles that can be fully crewed by units. Proficiency of assigned crew members should be recorded and maintained so efforts can be concentrated on those who need training. Crew member proficiency also should be considered in readiness reporting.

Because of the massive forces facing European units, their readiness is essential for mission accomplishment. Tracked combat vehicles should be available to thwart the enemy. Crew members should be proficient to fight, although outnumbered, and win. If crews lack proficiency, they should be given an opportunity to improve their abilities through further practice on gunnery ranges depending on their relative importance in the general defense plan.

We believe the number of tracked combat vehicles that can be fully crewed along with crew member proficiency should be reported on readiness reports. This would enable Army planners to obtain a more accurate picture of the readiness state so corrective action can be taken or planned during peacetime.

RECOMMENDATIONS TO THE SECRETARY OF DEFENSE

We recommend that the Army:

--Insure that combat units have full crews assigned for all tracked combat vehicles.

--Review, in conjunction with the Training and Doctrine Command and USAREUR, training programs in the United States for crew members to insure that needed basic skills are acquired before assignment to Europe. This is especially important in view of general shortages of E-5 to E-8 noncommissioned officers with combat MOSs.

--Have USAREUR aggressively follow up its training program as defined in its Training Directive, USAREUR Regulation 350-1. Training should be geared individually to those crew members that need to become fully combat qualified.

--Have USAREUR weigh unit access priorities to training areas according to identified needs and the units' importance to the general defense plans. Units should have the opportunity to continue the training until an acceptable number of crews meet minimum requirements.

--Require units to report the number of tracked combat vehicles which cannot be fully crewed to the USAREUR level that can best deal with the problem.

We also recommend that the Secretary of Defense aggressively pursue the opportunities for greater use of cost effective simulators for combat tracked vehicle crews.

CHAPTER 5

EQUIPMENT

Units are required to report the readiness condition of tracked vehicles, trucks, and communication and other types of equipment. Generally, unit readiness reports indicated to USAREUR and higher command levels that

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Most tracked vehicles inspected were

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We also noticed during our inspections of tracked vehicles that Army personnel at all levels were critical of the standards for checking vehicles. The Department of the Army has established equipment serviceability criteria (ESC) for each type of vehicle. This was established to measure the vehicles capability to operate for 90 days. Field personnel were displeased because some of the items included in the ESC do not affect the combat performance of the tracked vehicle. As discussed later in this chapter, these checklists were modified for our inspections to insure that critical items, which would affect vehicles' ability to move, shoot, and communicate, would be evaluated.

SERVICEABILITY AND REPORTING

At each unit, vehicles were selected that were considered combat ready by the unit. Vehicles which were deemed not combat ready by the unit were not inspected. Furthermore, we included in our selection platoon sergeants, platoon leaders, and company commanders' vehicles if they were operational. These vehicles are important to the unit, because combat operations are generally directed from them. These vehicles have additional communications equipment which enable command personnel to monitor two frequencies simultaneously and to transmit on different frequencies at the flick of a switch. This equipment is used mostly for command and control of battlefield operations.

Because of the past problems Army personnel had with the ESC standards, we discussed each item listed with senior level personnel, especially those in charge of maintenance, at each unit visited. We wanted to determine what they considered to be critical checks to uncover deficiencies which would directly affect combat operations.

The Command Maintenance and Evaluation Team, 1st Armored Division, inspected the vehicles. The team is staffed with specialized senior maintenance personnel who periodically evaluate combat equipment and counsel unit personnel. The inspection team used the established ESC for each vehicle. We observed the inspections and recorded and tabulated the results. We also measured the results using those items which were considered by Army personnel as directly affecting combat operations.

At the time of review, the 2nd Armored Cavalry Regiment, composed of 3 squadrons, was authorized DELETED tracked combat vehicles. Each squadron was authorized 17 DELETED M-60 series main battle tanks, DELETED M-551 Sheridans, DELETED M-113A1 armored personnel carriers, DELETED M-106A1 mortar carriers, and DELETED M-109A1 medium self-propelled howitzers.

To test the readiness of the 2nd Armored Cavalry Regiment, we selected one of the three squadrons.

The following table shows the number of tracked combat vehicles available to the unit to perform the mission and the number which we found were combat ready after checking the readiness of those mechanical, hydraulic, and electric items which could directly affect combat operations.

	Vehicles available at unit	Vehicles combat ready	Percent combat ready
M-60			
M-551		DELETED	
M-113A1			
M-106A1			
M-109A1			
Total			

The Army's ESC would rate a much lower percentage of tracked combat vehicles as combat ready. For example, only DELETED of the M-551s would be rated combat ready as opposed to DELETED (Problems with ESC are discussed in detail on pp. 33 to 35.)

The communications problem was the greatest reason for vehicles being classified as not combat ready. We do not know whether the high percentage of communication problems are indicative of chronic equipment problems or of a lack of proper testing. We found that, in many cases, the problems were not known and hence were not being reported.

To work effectively, radios should be able to transmit from specific distances, usually several miles, depending upon the radio's capabilities and specifications. The unit had adequate resources to check the required distance. The checks require positioning a vehicle or a remote station several miles away with communication gear to test other systems against it. We suspect this was not always done. The unit commander indicated that he would reemphasize communications testing and maintenance in the future.

The 1st Armored Division has DELETED tracked combat vehicles distributed throughout its 3 brigades, a divisional artillery element, an armored cavalry squadron, and an air defense artillery element.

Inspection results are shown below for the brigade which will defend the terrain behind the unit visited in the 2nd Armored Cavalry Regiment.

Again, we checked the readiness of only those items on the vehicles which could directly impair combat operations.

	Vehicles availabe within brigade	Vehicles combat ready	Percent combat ready
M-60			
M-113A1			
M-113A1 (TOW)		DELETED	
M-114A1E1			
M-106A1			
M-125A1			
Total			

Defective communication systems again accounted for the greatest percentage of problems noted.

EXAMPLE OF CONDITIONS WHICH LIMIT COMBAT PERFORMANCE

On March 21, 1975, we inspected DELETED assigned M-60 series tanks at a tank company of the 2nd Brigade. These DELETED were considered to be combat ready by the company commander. DELETED of these vehicles could not meet ESC standards. Of these, DELETED were considered not combat ready for the following reasons.

Vehicle number	Type	Problem(s)
	DELETED	

Vehicle number	Type	Problem(s)
	DELETED	

a/Vehicle not combat ready.

b/Item which directly affects combat performance.

c/Platoon sergeant's vehicle.

d/Platoon leader's vehicle.

Of the DELETED found not combat ready, all had defective communication systems. One tank commander could not communicate with the driver of the tank because the intercom was inoperative. The intercom was used by commanders to give instrucions to the tank driver and other crew members.

DELETED vehicles had radios that could not transmit as required. DELETED vehicles could not receive instructions from company and battalion commanders on the auxiliary receiver especially provided for that purpose. These receivers are in addition to the standard receiver-transmitter (radio) on a tank. They are mounted in company commander, executive officer, platoon leader, and platoon sergeant tanks to enable them to monitor two radio networks simultaneously.

The importance of the auxiliary receiver was demonstrated when we observed company tests conducted by the brigade. One of the tests was to assault and destroy a simulated enemy position. A tank platoon leader's auxiliary receiver was not functioning. He could not monitor the company network and simultaneously use his communication equipment to maneuver his platoon. The company commander ordered the platoon not to leave a wooded area where it was positioned at the time. The platoon leader did not receive the order because he was on the other network. The platoon leader moved his unit from the woods into an open area in accordance with a prearranged line of advance, while other platoons held their positions.

We were told that if this had been a real situation, the platoon which advanced would have been destroyed. "Aggressor" tank forces were in the area and had a clear shot at the platoon from concealed positions less than 1,000 meters away.

Some problems would take several days to correct

While some of the problems uncovered during our inspections could have been corrected immediately or within a day or two, others would have required longer. Using the units' daily deadline reports, we estimated the work days to repair; that is, how quickly vehicles could be made combat ready.

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As shown, within DELETED of M-60s on hand would be operational, barring any new failures and assuming available spare parts.

A similar study for the M-551 showed that about DELETED

We recognize that in an emergency the unit would attempt to repair all vehicles by shifting maximum effort to maintenance.

PROBLEMS WITH ARMY SERVICEABILITY CHECKLISTS

Checklists are used to determine equipment serviceability and the results are put into the readiness reports. Even if the crew members followed required testing and checking, the combat readiness of these vehicles still would not be reported accurately. Army checklists include items that can result in vehicles being reported not combat ready which, although of importance, do not immediately affect combat readiness. DELETED tanks in the 1st Armored Division's Brigade were not combat ready. Only 35 items directly related to immediate combat performance are considered combat ready. The Army checklists are complicated, difficult to understand, and can cause the readiness condition of these vehicles to be reported improperly, as discussed below.

Department of the Army Technical Manual TM 9-2350 215-ESC, March 15, 1973, lists the items to be checked for automotive, armament, and fire control of the M-60 and M-60A1 tanks. Other technical manuals are used for the communication checks, depending upon the type of radio installed. There are 49 checks to be made by crew members for automative, armament, and fire control items. Of these 23 are critical checks which directly relate to the vehicle's ability to move and shoot.

Some checks could result in an M-60 tank being reported not ready when in fact it is combat ready. For example, a vehicle is rated not ready if the engine oil temperature or pressure gauge or transmission oil temperature or presure gauge are missing or not functioning properly as shown by DELETED on page 30. Army officials recognize the importance of gauges to monitor various functions; however, they believe the fact that these gauges are inoperative or missing would not hinder their ability to take the vehicle into combat.

Some required checks are complicated; for example, the serviceability of the track on the tanks. A tank is to be judged not ready if there are three or more dead shoes (sections of track out of normal position) or any broken shoe or pin, 25 percent chunking on one-half of the vehicle track, one or more shoes worn to the point where the metal tube is showing, one or more missing wedges, or missing center guide or end connector. While these checks may be proper from a maintenance viewpoint, they require the ability to relate a number of conditions and from them derive a conclusion. Army personnel believed that a criterion to report a tank not combat ready if it had three dead shoes in a row or any broken shoe or pin would be much simpler and more realistic.

Department of the Army Technical Manual TM 9-2350-230-ESC, May 23, 1969, contained 57 items to be checked on the M-551 Sheridan. Like the checklist for the M-60 and other tracked vehicles, the checklist excludes communications. Twenty-five of the 57 items to be checked in the automotive and armament-fire control areas were considered critical to combat readiness.

Army officials pointed out that several of the required checks in the manual are not critical but can cause a vehicle to be reported not ready. For example, a vehicle is to be rated not ready if one item is missing or if there is evidence of leaking or deterioration in the exhaust system. Again unit officials recognize the importance of this check. However, they point out that in a decision to deploy, this would have no bearing. While these items may be good guides for maintenance purposes, their impact on readiness is questionable.

Commanders generally do not rely on the results of ESC reports. Instead the commanding officers at the units we visited carried a notebook listing the number of vehicles that were combat ready and not combat ready, generally based on "deadlined" vehicles in shop for maintenance.

We understand that field units have been dissatisfied with the ESC for many years, and this is shown in a U.S. Army Armor School Study on Army Maintenance System Simplification conducted between August 1971 and August 1972. The study recommended eliminating the ESC and replacing it with a more simple and meaningful system keyed to the operator's manual for the particular piece of equipment. At the time of our field work, the study's recommendations were still under review by the Department of the Army.

In our opinion adoption of the recommendations in the study would alleviate many of the problems in equipment reporting, assuming field personnel would perform required tests and checks. These recommended actions would also make it easier for the crew members to understand what they are supposed to do when checking the readiness of their vehicles. That the ESC is not currently doing the job is in part illustrated by the fact that commanders in the field do not rely on it.

IMPACT ON READINESS REPORTING

Because of the problems noted with the ESC checklists, we believe the probability of an error in reporting combat readiness is considerably increased. As a result, maintenance problems may go unreported or may be understated. Should a crisis arise, this may result in a large demand for maintenance services.

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WAR RESERVE MATERIEL

War reserve tracked vehicles in Europe were reduced substantially from 1973 through 1975 to meet foreign military sales commitments. Below is the status of tracked vehicles in reserve as of March 31, 1975.

Type	Required	Theater on hand	Percent filled
Theater reserves			

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As shown, DELETED These organizations have DELETED M-60s and DELETED M-551s. This shortage in war reserves is in addition to the unit readiness problems discussed earlier.

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We recognize that the U.S. Army and the Congress are aware of the shortages of theater reserves. We do not know the extent to which the impact of these shortages on unit readiness has been evaluated and what solutions have been proposed.

In any event, these shortages place an ever greater premium on the adequate and full use of those resources available to active units in peacetime and on quality of personnel, equipment, and training these units should have if they are to minimize potential losses.

<u>RECOMMENDATIONS TO THE SECRETARY OF DEFENSE</u>

We recommend that the Army pursue vigorously, with input from field units, the development and use of simplified equipment checklists to determine and report serviceability and combat readiness of equipment. Areas should be identified where maintenance personnel would be better qualified than crewmen to conduct tests and checks, and maintenance personnel should be directed to conduct these tests periodically.

CHAPTER 6

AMMUNITION

The Army in Europe requires that a complete basic load of conventional (nonnuclear) ammunition be available to units at all times. The basic load is to enable units to engage the enemy and to sustain operations until additional amounts of ammunition can be supplied from war reserve stocks prepositioned within corps sectors. Basic load and reserve main gun rounds for combat vehicles are to be stored at prepositioned stock points.

Units visited during our review

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SHORTAGES OF BASIC LOAD

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The table below shows the types and amounts of these rounds not available.

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The M-551 is one of the key tracked combat vehicles available to the 2nd Armored Cavalry Regiment. Any reduction in ammunition directly affects the units' ability to sustain combat. The M-551 Sheridan is armed with two types of ammunition, one of which is the Shillelagh missile. The Shillelagh is accurate and with good visibility gives the Sheridan a range advantage over enemy tanks.

At the time of our visit to the armored cavalry unit, inspectors were performing annual serviceability inspections of the Shillelaghs. The inspections were about 50 percent completed. The inspectors said that they had been finding about DELETED of the missiles unserviceable. A unit official said that after the inspection was completed, the unit would request an exchange of their unserviceables. Officials said this process takes about 60 days on the basis of past requisitions to fill shortages in their basic load. USAREUR officials, however, pointed out that basic load ammunition has priority in Europe, and the unit should be able to obtain serviceable rounds in DELETED DELETED Apparently, unit officials were not aware of this.

USAREUR logistics personnel were concerned with this situation and indicated they would immediately determine how widespread the problem was. They agreed such situations directly affected readiness and should be corrected.

The M-109A1, 155 mm. self-propelled howitzer, provides direct fire support and reinforcing fire. The howitzer is to set up behind the battle lines and is to fire artillery shells, smoke, or illuminating rounds at designated targets in the battle area. Percussion primers and fuzes are necessary to fire these rounds. DELETED Smoke rounds for the howitzer also are necessary. Smoke is used to camouflage offensive and defensive operations.

Among the key weapons an armored division has to deploy, if need be, against the Warsaw Pact forces are the M-60 and M-60A1 battle tanks. The U.S. Army teaches that the most effective antitank round carried in the tank is the Armor-Piercing, Discarding Sabot-Tracer (APDS-T). At the divisional unit visited, DELETED of these rounds on hand were unserviceable--they could not be fired. The unit had excess High Explosive Anti-Tank (HEAT) rounds available to fill this shortage. These rounds are part of the prepositioned war reserves.

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SHORTAGES OF SERVICEABLE AMMUNITION TO RESUPPLY VII CORPS UNITS

Each Corps is supposed to have ammunition supplies (basic load plus prepositioned war reserves) within its sector that will sustain them through at least DELETED DELETED of combat. This ammunition is to be stored at prepositioned stock points.

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USAREUR is well aware of problems in the ammunition area. One of the biggest problems it faces is a lack of available land space to construct new storage areas. Current stock points are not capable of storing total requirements for corps elements. Consequently, corps elements will have to rely more on wartime ammunition stock points (ASPs), which will have to be established at the earliest possible time in an emergency. ASPs are to receive ammunition from depots located behind the Corps areas.

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The table on the following page shows the extent of shortages and unserviceable ammunition in VII Corps Pre-Stock Points as of April 1975.

Rounds at Prepositioned
Stock Points for VII Corps

Type of vehicle and ammunition	Rounds required for basic load and war reserves	Serviceable rounds on hand	Unserviceable rounds on hand (note a)	Percent of required serviceable rounds on hand
		DELETED		

Officials at the 1st Armored Division and VII Corps could not readily tell us whether there was sufficient serviceable ammunition at designated storage locations for all their tracked vehicles. They depend upon the 84th Ordnance Battalion, who manages such stocks, to have sufficient serviceable ammunition in place to meet their needs. An official at VII Corps said that availabliity data could be compiled from monthly reports provided by the 84th Ordnance Battalion but that they do not do this because of the extensive time required to do it manually. He also stated that action had been taken at VII Corps to develop an automated report showing the number of rounds required and on hand at designated locations. However, this report is not intended to indicate the serviceability of rounds on hand. The more detailed monthly reports from the 84th Ordnance Battalion do indicate serviceability. In any case, both serviceable and unserviceable ammunition are stored at the same locations. We believe, and Army officials agree, that unserviceable ammunition could therefore inadvertently be issued as serviceable during an actual uploading.

AVAILABILITY OF STORED AMMUNITION

The 60th Ordnance Group's 84th Ordnance Battalion is responsible for managing ammunition stored at prepositioned stock points. The ordnance battalion is to insure that the right quantities of serviceable ammunition are stored where each corps wants it within allowable explosive and storage limitations.

Basic load ammunition for several units is usually stored at the same prepositioned stock point. Access roads leading to stock points are usually few and narrow, making two-way traffic impossible. This makes it a necessity that the priorities of access to the site be agreed on in advance for a unit to obtain its ammunition expeditiously. Furthermore, units must develop an uploading plan to be able to get their ammunition in the least amount of time.

Officials who had monitored several ammunition uploading exercises said that many units did not have a good uploading plan developed at the time of the exercises as evidenced by problems and confusion. Units, however, took corrective action, according to USAREUR officials. The brigade we visited in the 1st Armored Division had the same problems as other units with their ammunition uploading plans.

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Because of the limited access to the storage site, the units cannot drive their tanks into the storage site, but instead they use trucks to haul the ammunition from the storage site to an assembly area. Loading priorities had been established within the subordinate units. There were agreements on the number of men each unit would provide for ammunition uploading and the number of trucks that each unit would furnish.

Not enough banding cutters were available for each bunker crew to cut the banding around the boxes of ammunition. The brigade was authorized only three sets, even though there were nine ammunition bunkers. Another item to expedite ammunition loading was conveyors. None of the bunkers at the site had conveyors.

The brigade does not have a set of keys to the ammunition bunkers. This is standard practice throughout Germany. Since the 84th Ordnance Battalion is responsible for the ammunition in the bunkers, it wants to maintain control over access. To get the keys as close as possible, the battalion designated its 2041st Labor Service Company as control for access to all the bunkers. The personnel with the key for the site we visited were about 1 hour away. This system could delay entry into the bunkers.

Brigade officials said that it would take them DELETED DELETED to upload their basic load ammunition, but we believe this was questionable at the time of our visit.

Many ammunition storage locations for VII Corps units are DELETED

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expect this situation to improve with the NATO-funded ammunition storage locations to be built in the near future.

Many of the problems related to ammunition have already been recognized by higher headquarters and action has been taken or is planned to correct the deficiencies in this area.

RECOMMENDATIONS TO THE SECRETARY OF DEFENSE

We recommend that the Secretary of the Army be directed to pursue the following suggestions which should improve readiness of ammunition for units under the command of USAREUR.

--Identify unserviceable basic load ammunition at storage points in Europe and take the necessary action to rehabilitate or replace the defective ammunition.

--In conjunction with field commanders, develop procedures to insure that combat units have all their basic load ammunition readily available at all times.

--Subordinate commands should identify the need for materiel handling equipment as well as position this equipment where needed to speed the uploading of ammunition.

We also recommend that the Secretary of the Army be instructed to incorporate basic load ammunition in unit readiness reporting. Readiness to be reported should measure or consider factors, such as:

--Serviceable quantities on hand versus those required for initial combat operations.

--Accessibility of ammunition areas measured in terms of (a) materiel handling and transportation resources available to meet mission uploading time frame and (b) success in achieving uploading exercises within mission time frames. Such exercises should be conducted periodically and be designed to create the minimum of disruption of materiel and other resources. Where several units are to have access to the storage facilities, joint uploading exercises should be conducted to test coordination of unit planning.

CHAPTER 7

UNIT READINESS REPORTING SYSTEM

The Army recognizes that unit readiness reports should accurately show the readiness condition of reporting units. In fact, the Army stresses accuracy in the instructions in Army Regulation 220-1 for preparing the report.

As pointed out earlier on pages 22 to 24 and 33 to 35, the input data to the report is not always accurate because of the lack of firm standards by which to measure personnel and equipment readiness. Even if the input data were accurate and adequately reported, the true readiness position of subordinate units is not revealed to higher headquarters. This is caused by flaws inherent in the reporting system as directed by Army Regulation 220-1.

--At unit level, combat assets, such as tanks, without which missions cannot be performed, and support assets, such as trucks, without which missions are impaired, are consolidated or averaged to prepare the units' overall equipment readiness rating. Thus a situation could occur where many of the critical vehicles in a unit are not combat ready; and yet because of an abundance of other types of vehicles which are combat ready, the unit is classified as ready.

--At regimental and divisional level, the reports of subordinate units are consolidated into a single readiness rating for the regiment or division, and the unit readiness reports are not forwarded to USAREUR. Further, the consolidated readiness rating does not necessarily represent a mathematical averaging of units' ratings but rather reflects the regimental or divisional commander's exercise of judgment as to the organization's overall readiness.

Reports of the 1st Armored Division and the 2nd Armored Cavalry Regiment serve to illustrate

DELETED

As shown below, DELETED of DELETED armor, infantry, field artillery, air defense artillery, and cavalry units reported to the 1st Armored Division in March 1975 that their overall readiness posture was DELETED The other DELETED units rated their readiness as DELETED The 1st Armored Division submitted an overall readiness evaluation of DELETED to USAREUR and the Department of the Army. As indicated, this situation prevailed for several months.

Reporting unit	Reported overall readiness condition January 1975	February 1975	March 1975

DELETED

This should not be construed to mean that field commanders are not reporting properly. The real problem is the constraints placed on the reporting system by Army Regulation 220-1. Commanders are reporting themselves in accordance with the regulation, but because of deficiencies in the system, their readiness problems are not highlighted.

A USAREUR headquarters official said that headquarters are well aware of the distortions created by the division's consolidated readiness report. In fact, there was a discussion at the headquarters concerning USAREUR's recommending to Headquarters, Department of the Army, that individual unit readiness reports be submitted directly through reporting channels. USAREUR officials decided, however, not to make this recommendation. USAREUR's position was that the commanding officer's judgment plays an important role in evaluating the state of readiness.

Army Regulation 220-1 instructs units to determine and report the readiness condition of all their personnel and all of their equipment in a consolidated fashion. Units, however, are composed of combat assets (i.e., tracked combat vehicles and their crew members) and support assets to provide cargo hauling capability, maintenance, and administration to unit personnel. One of the 2nd Brigade units had DELETED DELETED or almost as many trucks as tracked vehicles. It is possible to have all DELETED trucks ready and only DELETED tracked vehicles ready, but the unit could still report C-1. The equipment status readiness condition (C-rating) is computed by determining the percentage of reportable MTOE required equipment that is ready according to equipment serviceability checks. Therefore, if DELETED trucks and tracked vehicles are determined ready and the unit is required to have DELETED according to their MTOE, 90 percent of the equipment being evaluated would be considered combat ready and C-1 would be reported. Actually, it would be possible for this unit to have fewer than DELETED tracked vehicles ready and still report C-1 if the other items included in the computation of equipment status readiness rating were judged combat ready. Conversely, this unit could also be rated C-1 with all of its combat tracked vehicles ready and many of its support trucks inoperative. If the inoperative support trucks affect the ability of the unit to resupply its combat tracked vehicles with additional ammunition, for example, this condition could also impair mission performance, but usually after contact has been made with the aggressor. It is obvious that consolidated reporting does not disclose imbalances of the type just described. Similarly, the consolidation of subordinate units when reporting readiness of divisions does not disclose possible significant deviations of individual units from the overall division ratings.

In our opinion, separate reporting of combat and subordinate units and of combat and support assets would provide commanders at higher echelons vital information. It would, for example, disclose problems occuring at units and would pinpoint the unit having the problem. By identifying the problem and the unit affected, the Army could better evaluate the risks of mission performance.

In June 1975 the Army issued a revised Army Regulation 220-1. The Army cautioned commanders to exercise judgment in applying unit readiness ratings across the board for personnel and equipment. The Army further cautioned against showing a high degree of readiness when lacking key personnel or critical equipment. While the Army recognizes this possibility under the current system, we believe that the system should be changed to show the extent of these very problems so corrective action can be taken.

RECOMMENDATIONS TO THE SECRETARY OF DEFENSE

We recommend that:

--Divisions forward battalion level readiness reports to USAREUR along with the divisional consolidated report. This would give managers at higher levels more specific information on critical situations which are not now shown because of the averaging provision.

--The Secretary of the Army redesign the readiness reporting format so combat and support assets (personnel and equipment) are rated separately.

--The Secretary of the Army permit regimental and divisional commanders to make narrative comments on the ratings, as is done now, but require that overall ratings be strictly a compilation of those submitted by subordinate units.

CHAPTER 8

SCOPE OF REVIEW

We focused our audit on the readiness of tracked combat vehicles because of their importance to unit mission performance. We evaluated the number and qualifications of combat crews, condition of equipment systems, and the amount of serviceable ammunition available for these vehicles at selected units within VII Corps in Europe.

Discussions were held with appropriate Army officials in theater, and relevant records were reviewed, analyzed, and scheduled. Further, we observed several training exercises involving units selected for review.

Principal organizations and locations visited in Germany were:

--Headquarters, U.S. Army in Europe (USAREUR) and Seventh Army, Heidelberg.

--Headquarters, V Corps, Frankfurt.

--Headquarters, VII Corps, Stuttgart.

1. Headquarters, 2nd Armored Cavalry Regiment, Nuremberg.

2. Headquarters, 1st Armored Division, Ansbach.

--U.S. Army Training Center, Grafenwoehr.

--Headquarters, 84th Ordnance Battalion, Kaiserslautern.

REPORT TO THE JOINT ECONOMIC COMMITTEE

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

Continuing Problems With U.S. Military Equipment Prepositioned In Europe

Departments of Defense and the Army

This report is the unclassified version of GAO's SECRET report LCD-76-441, dated July 12, 1976. It discusses the continuing problems affecting the strategic concept of prepositioning military equipment in Europe for use by Army troops airlifted from the United States in an emergency.

LCD–76–453

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

B-146896

The Honorable Hubert H. Humphrey
Chairman, Joint Economic Committee
Congress of the United States

Dear Mr. Chairman:

This report is on the followup review of our March 9, 1973, report entitled "Problems With U.S. Military Equipment Prepositioned in Europe" which we made pursuant to your request of May 15, 1975.

As directed by your committee, we have not obtained written agency comments on the report. We have, however, discussed our findings, conclusions, and recommendations with Department of the Army and Department of Defense officials and considered their comments. In addition, the Department of Defense has reviewed the report for security classification.

This report contains recommendations to the Secretaries of Defense and the Army. 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 he has taken on our recommendations to the House and Senate Committees on Government Operations 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 will be in touch with your office in the near future to arrange for release of the report so that the requirements of section 236 can be set in motion.

Sincerely yours,

Elmer B. Staats

Comptroller General
of the United States

Contents

ABBREVIATIONS

CEGE	Combat Equipment Group, Europe
DOD	Department of Defense
GAO	General Accounting Office
MOS	military occupational speciality
MRLOGAEUR	minimum required logistics augmentation, Europe
MTOE	modified table of organization and equipment
NATO	North Atlantic Treaty Organization
NCO	noncommissioned officer
OPLAN	operational war plans
OSD	Office of the Secretary of Defense
POMCUS	prepositioned equipment configured to unit sets
REFORGER	redeployment of forces from Germany
2 + 10	2 divisions plus 10 support units
USAREUR	U.S. Army, Europe

28-003 0 - 81 - 21

COMPTROLLER GENERAL'S
REPORT TO THE
JOINT ECONOMIC COMMITTEE

CONTINUING PROBLEMS WITH U.S. MILITARY EQUIPMENT PREPOSITIONED IN EUROPE
Department of Defense
Department of the Army

D I G E S T

The Army stores large quantities of equipment in Europe for use in an emergency by troops deployed from the United States by air. The equipment is stored under a concept referred to as prepositioned equipment configured to unit sets. This means that each U.S.-based unit's equipment is stored as a set or entity, at the particular site to which the unit would deploy in Europe. Equipment for three divisions and their related support units are included in this program. In December 1975, the value of prepositioned equipment authorized for stockage was $778.4 million. The value of equipment on hand is classified for security purposes. (See p. 1.)

GAO originally reviewed this program in the 1971-72 period. GAO's report, entitled "Problems with U.S. Military Equipment prepositioned in Europe," (B-146896, March 9, 1973) concluded that units with prepositioned equipment could not effectively perform their assigned missions in the required time, basically because some of the authorized equipment was not prepositioned and much of the equipment was inoperable. (See p. 2.)

To work effectively, the prepositioned equipment program requires two major ingredients--adequate quantities of (1) combat-ready equipment properly stored in Europe and (2) combat-ready troops who can meet the deployment requirements of war plans.

Since GAO's 1973 report, the type of problems with the program and their relative magnitude changed; however, the overall effects are much the same. Thus, GAO's earlier conclusion--that it appears questionable whether the Army could be fully effective in the missions assigned troops with prepositioned equipment--has not changed. Some of GAO's findings follow.

--There were important shortages of combat-essential equipment in prepositioned equipment stocks, many of which will exist for a number of years. In addition to major items there were shortages of certain types of ammunition and repair parts. (See p. 8.)

--The condition of equipment available in the prepositioned equipment program had improved considerably since 1973. However, because of problems in completing maintenance programs, some of the vehicles in the prepositioned equipment program were deteriorated. Further, the equipment readiness reporting system did not provide an accurate report of equipment status. (See pp. 20 and 21.)

--Storage and maintenance facilities had improved but major deficiencies still needed correction. (See p. 32.)

--There were not enough personnel responsible for maintaining prepositioned equipment to handle the workload. (See p. 40.)

--Although accountability and physical control of prepositioned equipment stocks had improved, the equipment locator system was still quite inaccurate and a system was needed to account for smaller items--those particularly subject to pilferage. (See p. 44.)

--Shortages in prepositioned stocks would likely require some forces to bring equipment from the United States, probably by sea, thus increasing their time to deploy. (See p. 51.)

In addition, GAO found that equipment in the hands of these forces was not as combat ready as indicated in readiness reports, and, thus, likely would require maintenance before deploying, further increasing deployment time. (See pp. 54 and 56.)

--The annual deployment of certain troops to Germany for training and the issuance of equipment from prepositioned stocks to them is not done in a manner which provides a realistic test of redeployment under emergency conditions. (See p. 67.)

--U.S.-based units were not plagued with overall personnel shortages as in 1971-72; however, there were still shortages of certain essential skills and noncommissioned officers. (See p. 59.)

The major problem facing the prepositioned equipment program is the important shortage of combat-essential major end items. Some of these shortages will likely exist for some time due to production base limitations in producing sufficient assets to satisfy all outstanding requirements. (See p. 8.)

GAO believes that it is now time to make major decisions regarding the future role of the prepositioned equipment concept and options that may alleviate some existing problems. (See p. 70.)

Accordingly, GAO recommends that the Secretary of Defense and the Secretary of the Army reevaluate the prepositioned equipment program to determine its future role in our wartime commitment to Europe. This evaluation should consider the following alternatives.

--Providing the resources required to make the current prepositioned equipment program workable and effective.

--Reducing the scope of the present prepositioned equipment program; i.e., the amount of equipment stored and number of units to deploy, to a level that could be supported as intended.

--Abandoning the prepositioned equipment concept in Europe and developing another program which could be effectively supported and still meet the NATO commitments of the United States.

If the first alternative is chosen, GAO recommends the following approaches be considered for making the prepositioned equipment concept more viable.

--Assign the program a higher priority for items coming off production lines.

--Consider withdrawing some equipment now in the possession of U.S.-based units that would deploy to Europe under the concept and transferring it to the prepositioned equipment program.

--Consider alleviating program shortages with a combination of these two possibilities.

The above alternatives are somewhat long-term solutions to alleviating the problem of the viability of the prepositioned equipment concept.

In the interim, GAO believes that, by properly managing the existing equipment in prepositioned equipment stocks, there would be greater assurance that, at least, a certain number of units could be satisfactorily deployed to Europe and employed in the field as required by the current war plan.

Therefore, GAO recommends that the Secretary of the Army direct Headquarters, U.S. Army, Europe to

--identify those specific units which can be fully equipped from available assets,

--insure that the equipment for these units is stored in a unit set configuration where practical, and

--take all other steps necessary to insure that these units could be deployed and equipped as envisioned under the current operational war plan.

Other conclusions and recommendations pertaining to specific elements of the current prepositioned equipment program are presented in each chapter of this report.

In accordance with instructions from the Committee, GAO did not obtain written agency comments on this report. However, GAO discussed the report findings, conclusions, and recommendations with representatives of the Department of Defense and the Department of the Army and considered their comments.

CHAPTER 1

INTRODUCTION

The Army stores large quantities of equipment in Europe for use in an emergency by troops deployed from the United States by air. The equipment is stored under a concept referred to as prepositioned equipment configured to unit sets (POMCUS). This means that each U.S.-based unit's equipment is stored as a set at the particular site to which the unit would deploy in Europe. In December 1975, the value of POMCUS equipment authorized for stockage was $778.4 million. Equipment onhand totaled deleted leaving a shortage of

The major operational projects for which the Army has, or plans to have, prepositioned equipment are (1) the 2 + 10 program (two divisions plus support units), (2) REFORGER (redeployment of forces from Germany), (3) minimum required logistics augmentation, Europe, (MRLOGAEUR), and (4) certain medical projects.

The Joint Chiefs of Staff and the U.S. Commander in Chief, Europe, took action to preposition equipment for the 2 + 10 program during the Berlin Crisis in 1961 to increase the speed at which the 7th Army could be reinforced from the United States and to reduce the need for transportation resources. The 2 + 10 program is made up of the deleted and related support units.

In 1968 the Army moved selected combat and combat support units from Germany back to the United States to improve the U.S. balance-of-payments position. These forces, called REFORGER units, remain committed to the North Atlantic Treaty Organization (NATO). The commitment is formalized in a multilateral agreement which also stipulates that certain of these forces will redeploy to Europe annually to conduct field exercises. REFORGER forces consist basically of the 1st Infantry Division (minus one brigade permanently stationed in Europe) and other units.

MRLOGAEUR is a project to provide a mininum of equipment for lines of communications needed to support U.S. Forces deploying to Europe in an emergency. This project replaces the old line of communication/port facilities projects. Under the MRLOGAEUR concept, much of the support of U.S. Forces in a contingency situation would be provided by host countries on the basis of bilateral agreements.

The newly authorized medical projects provide equipment for use by certain units. Some of these units are termed "dummy" since at present none actually exist in the United States. These units will be activated at a later time.

The Combat Equipment Group, Europe (CEGE) is responsible for storing, maintaining, and issuing POMCUS equipment stored in Europe for the four projects discussed above. The equipment is stored at nine locations--eight in Germany and one in England--and much of the equipment is in humidity-controlled warehouses. (See map, p. 4.)

Other U.S. Army, Europe (USAREUR) commands are responsible for other logistics functions relating to POMCUS. These functions include (1) transporting troops from airfields to storage locations in an emergency, (2) providing bulk fuels for vehicles at storage sites, and (3) managing and storing conventional ammunition supplies for POMCUS units.

GAO originally reviewed the POMCUS program in the 1971-72 time frame. Our March 9, 1973, report, entitled "Problems with U.S. Military Equipment Prepositioned in Europe," B-146896, concluded that the Army units that had equipment prepositioned could not perform their assigned missions in the required time because some of the authorized equipment was not prepositioned and much of it was inoperable.

Specifically, we reported that the European part of the prepositioning program was adversely affected because:

--Substantial shortages existed in prepositioned equipment, ammunition, and repair parts.

--CEGE officials did not have accurate lists of units for which they were to store equipment.

--CEGE had poor accountability control over its stored equipment.

--Much of the available equipment was not serviceable.

--The reporting system did not present a clear and accurate picture of readiness of the POMCUS equipment.

--A line of communication for resupply of forces in the European theater had not been established.

In response to that report, DOD commented that the management of the quantity and types of prepositioned equipment was a major area of concern and that USAREUR had begun to correct identified management deficiencies. DOD considered the prepositioning concept a realistic means of achieving the strategic mobility necessary to implement national strategy and said it would continue to review progress and provide adequate funds for the program.

Our current review evaluated DOD's actions to correct the problems identified in our previous review and to report the current status of the equipment. We also evaluated the viability of the POMCUS concept. During this assignment we reviewed records relating to prepositioned stocks of equipment, repair parts, and ammunition in Europe. We conducted and observed inventories and physical inspections; observed maintenance and issue of equipment; analyzed inspection results; and held discussions with personnel responsible for managing the prepositioned stocks and those using the equipment during the 1975 REFORGER field training exercise. In the United States we reviewed records at major REFORGER and 2 + 10 units pertaining to personnel and training readiness and the reporting thereof; selectively tested the readiness of equipment, examined financial records, and held discussions with responsible officials. This work was performed from July 1975 to February 1976.

MAP OF POMCUS STORAGE LOCATIONS IN WEST GERMANY

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CHAPTER 2

PROBLEMS AFFECTING THE SUCCESS

OF THE PREPOSITIONED EQUIPMENT CONCEPT

It is questionable whether the Army could be fully effective in accomplishing the missions envisioned under the POMCUS concept and outlined in existing operational war plans (OPLAN) because of the magnitude and type of problems--some [deleted] we reported in 1973--which affect the POMCUS equipment and the troops that would use the equipment.

There are [deleted] shortages of combat-essential equipment in POMCUS stocks, [deleted] [deleted] As a result, there now are [deleted] In addition to the major end item shortages, there are also shortages of certain types of essential ammunition and repair part stocks. (See ch. 3.)

Tests we conducted indicated the condition of the equipment available in the POMCUS stocks had improved considerably since 1973. However, we found some equipment, [deleted] [deleted] of that stored, in a deteriorated condition due to problems which had prevented the completion of maintenance programs. (See ch. 4.) Further, deficiencies in equipment readiness reporting criteria prevented an accurate presentation of equipment status. (See ch. 8.)

Since our last report, POMCUS storage and maintenance facilities have improved; however, (1) there were still a substantial number of deficiencies in the controlled-humidity warehoues which had not been corrected, (2) the space available in these warehouses was not being fully utilized, and (3) storage of the equipment had not been standardized in all cases; i.e., we found equipment stored by unit set, by commodity, and intermingled between sets in the same storage areas and in different storage areas. Maintenance facilities at the POMCUS storage sites need numerous improvements and are considered to be substandard by the Army. (See ch. 5.)

The number of support personnel assigned the responsibility for maintaining POMCUS stocks had been declining and was inadequate to handle the combined workload of normal cyclic maintenance programs and special projects imposed by higher authorities which involved withdrawing and processing equipment for shipment to Mideast countries. We noted that a manpower survey to establish and validate personnel requirements had not been made in almost 7 years. (See ch. 6.)

Improvements have been made in the accountability and physical control of POMCUS stocks since 1973. Accountability for both 2 + 10 and REFORGER stocks has been centralized in one unit and a cyclic inventory recently implemented. However, there was, for practical purposes, no effective accounting control over components of kits and sets, many items of which are highly subject to pilferage. In addition, we found the equipment locator system to be quite inaccurate. (See ch. 7.)

deleted

Further, for this option to be fully effective, the equipment on hand in these units would have to be maintained in a combat ready condition. However, we found it likely would require a substantial amount of maintenance to meet accepted criteria for serviceability and reliability. deleted

Also, there are certain other problems which would affect deployment. These include (1) the necessity to make many transfers of equipment between unit sets to provide complete sets of equipment for early deploying units, (2) the need to transport repair parts and batteries from a central storage location in Germany to the eight POMCUS storage sites, (3) lack of arrangements for transportation from arrival airfields to storage sites for certain units, (4) expected congestion at ammunition storage sites that could delay employment of some units and (5) failure to store some ammunition at scheduled pickup sites.

In addition, the annual deployment of certain REFORGER troops to Germany for training and the issuance of equipment from POMCUS stocks to them deleted (See ch. 11.)

Our review of the major U.S.-based units which would use the POMCUS equipment showed that personnel shortages in these units had been reduced substantially since our last review, but there were still shortages of certain skills and noncommissioned officers. Also, personnel turnover in these forces had been high due to the formation of two brigades for duty in Europe that will be rotated among eligible personnel of the 2nd Armored and 4th Infantry (Mechanized) Divisions. (See ch. 10.)

The following chapters of this report discuss these matters in more detail and present our recommendations for actions that can be taken to improve the viability of the POMCUS concept--those that can be accomplished in the near term and long term.

CHAPTER 3

SHORTAGES IN PREPOSITIONED EQUIPMENT, AMMUNITION, AND REPAIR PARTS

At the time of our earlier review, an accurate record of the value of POMCUS equipment authorized and onhand did not exist; however, a September 1971 Army study included the following information on POMCUS quantities authorized and onhand.

Project	As of September 1971 Authorized	Onhand	Shortage
	------------(000 omitted)------------		
2 + 10	$269,475	$203,510	$ 65,765
REFORGER	241,025	224,174	16,852
LOC/PORT (note a)	153,249	57,578	95,670
Total	$663,749	$485,262	$178,487

a/Line of Communication and Port Facilities.

In a November 1972 response to our previous report, DOD said the Army in Europe had undertaken a program to correct deficiencies in POMCUS stocks and that the shortages then current did not include major end items. DOD acknowledged that the shortages of repair parts affected combat readiness and that such shortages were brought about by changes in the Army's basis equipment authorization documents. DOD estimated that the parts shortages would be corrected by the end of fiscal year 1973 and that sufficient storage space would be available by fiscal year 1975 to alleviate existing shortages of ammunition.

However, deleted shortages of equipment, ammunition, and repair parts still exist. In fact, since 1971 the dollar value of shortages has increased deleted deleted--from $178.5 million to deleted deleted in 1975. Moreover, equipment shortages in POMCUS stocks now include large numbers of major end items, such as, deleted According to Army estimates, some of these shortages will not be filled until about deleted deleted

Although shortages of ammunition and repair parts still existed, they had been reduced considerably since 1971-72. There is still a need, however, to establish procedures to update the requirements for ammunition and repair parts to insure that the quantities and types of items needed in an emergency are available.

COMBAT EQUIPMENT SHORTAGES

deleted increase in POMCUS shortages since the time of our last report was primarily due to (1) an increase in the amount of equipment authorized for stockage and not yet furnished and (2) the shipment to Israel and other Middle East countries of certain major, combat essential items during and after the 1973 Middle East War. A list of the types of POMCUS equipment shortages is shown in appendix II.

Authorizations

Up-dates of the equipment authorizations for POMCUS units are required periodically to take into account (1) changes in a unit's modified table of organization and equipment--the basic document authorizing equipment for a combat unit, (2) introduction of new equipment and replacement of out-dated items, and (3) additions and deletions of units and/or projects for which equipment will be prepositioned in POMCUS. Authorization updates require CEGE to inventory existing stocks, compare onhand quantities to the new authorization, and submit requisitions for equipment not on hand in POMCUS to satisfy the new requirements. Through 1973, the Department of the Army updated POMCUS authorizations every 6 months; however, beginning in 1974, up-dates have been published annually. CEGE was unable to implement the 1974 authorization because of the numerous errors contained in that document.

During our review, CEGE was in the process of implementing the 1975 POMCUS authorization. The major change in 1975 was the authorization of equipment for two additional projects--one for medical units and the other for MRLOGAEUR. The logistics augmentation package replaced the old line of communication/port facilities projects. The 1975 authorization also (1) deleted equipment which was issued to Brigade 75, a brigade deleted which was moved to Germany during 1975 and (2) implemented the results of the Army's analysis of unit transportation and communication needs (Wheel's study and Spanner study, respectively). Overall, the 1975 authorizations increased the number of POMCUS units from deleted The status of the 1975 authorization in December 1975, follows.

Project	Number of units	Authorized	Onhand	Shortage
2 + 10	deleted	$360.3	deleted	
REFORGER		325.9		
Medical		15.7		
MRLOGAEUR		76.5		
Total		$778.4		

a/Some of the units authorized for MRLOGAEUR and medical projects are termed "dummy units" since no United States unit exists. These units will be activated at a later time.

Shipments of POMCUS equipment

During and following the 1973 Middle East war, about deleted major end items of equipment were shipped from POMCUS stocks to support Israel and two other Middle East countries. These shipments created critical shortages for the combat essential items listed below.

Item	Authorized for POMCUS stocks	Shipped from POMCUS stocks	Onhand in POMCUS stocks June 1975	Percent of shortage in POMCUS stocks June 1975
M60 tank	deleted			
M113 armored personnel carrier				
M109 howitzer				
M54 truck, 5-ton				
M2 machine gun				
AN/VRC-46 radio				

The total value of this equipment, based on acquisition cost or current book value, was over $90 million. Replacement of this equipment is estimated to cost over $227 million.

Other actions

Part of the shortage (about $5 million) results from CEGE's decision to await the arrival of the new 1975 authorization before requisitioning to fill equipment shortages for units stored at Burtonwood Army Depot in England.

Other shortages have resulted from CEGE's turning in deleted M60A1 tanks (valued at over $7 million) in May 1974, for issue to active Army units, and deleted M109 howitzers in January 1974, for an upgrade program in which active Army howitzers were converted to long barrels. Officials at USAREUR told us that all the howitzers will eventually be returned to POMCUS, probably after deleted

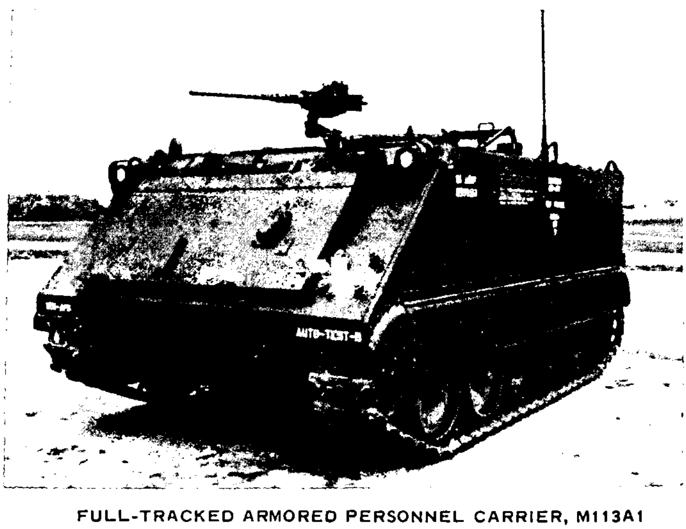
Replacement of shortages

The Commander in Chief, USAREUR, has placed a high priority on reconstituting POMCUS stocks; however, there are constraints in this area which are out of his control. These include funding limitations, production base capacity, and asset distribution priorities. deleted As a result, shortages in POMCUS for some major items will continue to be a problem until deleted deleted Delivery dates for POMCUS replenishment for some major equipment items are shown below.

Item	Projected delivery completion dates
deleted	

PHOTOGRAPHS OF SOME TYPES OF EQUIPMENT IN POMCUS

TANK, COMBAT, M60 WITH INFRARED SEARCHLIGHT KIT



FULL-TRACKED ARMORED PERSONNEL CARRIER, M113A1

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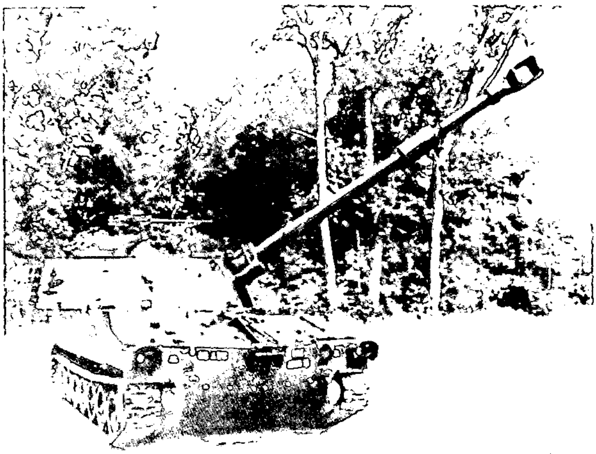
PHOTOGRAPHS OF SOME TYPES OF EQUIPMENT IN POMCUS



SELF-PROPELLED HOWITZER, 155 MM., M109 WITH LONG GUN BARREL
Source: U.S. Army

5-TON CARGO TRUCK, M809
Source: U.S. Army

Potential use of theater war reserve stocks to fill some POMCUS shortages

As indicated above, shortaoes of essential combat items will likely exist for a deleted Some shortages, however, could be alleviated currently by tranferring equipment now held in lower priority war reserve stocks to fill POMCUS requirements.

An October 1975 audit, conducted by the Office of the Secretary of Defense (OSD), found that, although POMCUS requirements have a higher distribution priority than theater war reserve stocks, items for which shortages existed in POMCUS were onhand in these reserves.

OSD identified equipment shortages valued at $35 million in 30 POMCUS units selected at random. By transferring $26 million of equipment available in war reserve stocks to fill most of the shortages in these units, OSD found that unit equipment readiness for deleted units could be raised from a rating of C-3 or C-4 (marginally ready or not ready--the two lowest ratings) to C-1 (fully ready, the highest rating).

In addition to improving the readiness of these units, OSD concluded that annual maintenance cost savings of about $351,000 could be realized from this action since war reserve stocks could be taken from open depot storage to CEGE's controlled-humidity warehouse storage. The OSD audit report recommended that USAREUR redistribute war reserve stocks to meet the higher priority POMCUS requirements.

In commenting on this report, USAREUR stated that wholesale redistribution was felt to be inadvisable at the time of the OSD audit because

--POMCUS equipment authorization documents were due to be superseded,

--distribution plans for new equipment to replace items shipped under foreign military sales were not available, and

--the priority for theater war reserves was higher than for POMCUS units (the priority was subsequently changed).

However, USAREUR commented that limited redistribution of selected items of equipment from war reserves to POMCUS would be accomplished subject to Department of the Army approval. Plans were to (1) limit transfers to equipment not otherwise available, (2) transfer equipment in conjunction with the cyclic maintenance program insofar as is practicable, and (3) shift equipment only when it would result in a fully or substantially ready POMCUS unit set.

USAREUR acknowledged that maintenance costs are lower for equipment stored in controlled-humidity warehouses. However, it anticipated that such savings would be offset by the expenses of redistributing the equipment.

CONVENTIONAL AMMUNITION SHORTAGES

At the time of our last review, there were severe shortages of ammunition available in Europe for POMCUS units. The primary reason for these shortages was attributed to insufficient storage space.

Our followup review showed that, on an overall basis, ammunition is prepositioned to cover about deleted deleted of the stated European requirements. According to USAREUR officials, about deleted of the ammunition stockpile is serviceable and deleted deleted is considered shootable under emergency combat conditions. This, however, does not present an accurate picture of the status of ammunition in Europe because (1) the data needed to compute ammunition requirements was both inaccurate and out-dated, thereby, invalidating some of the stated requirements and (2) deleted

Requirement computation problems

In general, ammunition requirements are based on

--the number of each type of weapon in a force group (weapons density),

--projected daily consumption rates per weapon, and

--the stockage objective stated in days of supply for each weapon.

The source for weapons density is a listing prepared by the U.S. Army Major Item Data Agency. Although due annually, the last such report CEGE received was in February 1974. Three important equipment items were omitted from that listing--the M57 combat engineer vehicle, the M114 armored personnel carrier and the UH-1M helicopter. Available correspondence indicated numerous other errors had occurred in the 1974 listing. A partial update received in December 1975 had obvious omissions and errors similar to those in the earlier listing.

In the weapons density listing, densities for REFORGER and D-day forces are combined but 2 + 10 are shown separately. We selected 24 conventional ammunition items for a check of requirements computation accuracy. Included was ammunition for 8-inch and 155mm howitzers, M60 tanks, M16 rifles, 40mm grenade launchers, 4.2 inch mortars and .50 caliber machine guns. We found problems such as:

--Some POMCUS basic load requirements were omitted for deleted

--2 + 10 basic load requirements were understated for deleted

--2 + 10 basic load requirements were overstated for deleted

An official of the 60th Ordnance Group, which is responsible for ammunition storage, said all POMCUS basic loads were being recomputed due to errors in prior computations.

Shortages

For the 24 items selected above, we found that serviceable items onhand averaged deleted of requirements (including serviceable substitutes). Twenty items were in short supply, with 6 of the 20 having deleted deleted of required items in serviceable condition. One of the items in short supply, an deleted deleted is experiencing production problems, according to an Ordnance Group official. The stock status of these 24 items is shown in appendix III.

Not all the items in short supply were on requisition. One reason given for not immediately requisitioning all shortages was that anticipated changes in the types of weapons could reduce some requirements.

REPAIR PARTS SHORTAGES

In our 1973 review, we found that, for those units not participating in the annual REFORGER exercises, repair parts stockage was almost nonexistent. Further, as much as 75 percent of the repair parts used by units involved in the exercises, had been obtained specifically for that purpose.

In commenting on our 1973 report, DOD stated that these shortages had been caused by changes in the tables of organization and equipment to recognize current need. According to DOD, these changes had a large impact on the quantity and type of equipment authorized and, therefore, directly affected the composition of repair parts stocks. DOD projected that the parts shortages would be corrected by the end of fiscal year 1973.

Our followup review showed that most repair parts stocks had been replenished and filled to the minimum requirement of [deleted] of authorization.

However, these stocks were based on the old 1973 authorizations and many outdated, obsolete, or unneeded items were included in the parts stocks. In 1975, the Army Inspector General concluded that procedures to monitor and insure that spare parts were on hand in sufficient quantities to satisfy planned contingency missions were inadequate and that the information on exact quantities of authorized line items onhand was highly suspect.

Repair parts stockage

There are two levels of repair parts stockage authorized to support POMCUS units--(1) prescribed load lists (load lists) which support the needs of a unit at the organizational level and (2) authorized stockage lists (stockage lists) which support needs at higher echelon maintenance levels. In general terms, such lists are based and computed on repair parts usage experience and are designed to support a unit for a certain period of time. CEGE is authorized to store stock for [deleted] units' load lists and 3 stockage lists. In addition, the U.S. Army Materiel Management Agency, Europe, is authorized to store stock for three stockage lists.

At the time of our review all load and stockage lists, except two, were over deleted filled, as required. However, neither USAREUR nor CEGE officials knew when all of these lists were last updated, although they believed it to be in the 1972-73 time frame. Further, no standard procedure existed for overall periodic updates and CEGE officials did not know the number of days support POMCUS repair parts lists were, or should be, designed to cover.

The effects of failing to update the lists can be illustrated with one of the stockage lists stored by the Materiel Management Agency to support the entire deleted In early 1975 a brigade of the deleted and the Materiel Management Agency made an extensive analysis to determine the specific line items and quantities of items that should be carried in the stockage list to support the operation of the brigade's equipment. The basis for their determination was the past usage experienced by similar brigade-sized units. As a result of this analysis, a stockage list was developed which contained 2,500 line items, valued at about $675,000.

We compared over 300 line items in the new stockage list with line items contained in the one stored by the Materiel Management Agency for deleted and found that deleted of the items in the demand-supported list could be supported from the stored list. CEGE officials stated that the disparity was attributable to the lack of updating and inadequacies in the original computation of the stored list.

In addition to the above, we found that the stored stockage lists have not been adjusted to compensate for higher wearout or failure rates of some parts caused by the long-term storage of equipment. Experience on past REFORGER exercises has shown that POMCUS vehicles and equipment stored for extended periods have requirements greater than active units for parts such as filters, seals, and gaskets.

This was reported in Brigade 75 trip reports. In some cases, it took from 6 weeks to 3 months to get equipment into a dependable working condition because parts were not available in the quantities needed.

CONCLUSIONS

Enough combat-ready equipment stored in Europe to outfit the units scheduled to deploy in an emergency is the heart of the POMCUS concept. Further, sufficient quantities of ammunition must be available to enable units to effectively carry out their combat mission and enough repair parts must be available to support the operation of the equipment.

Chapter 12 presents our conclusions regarding the overall POMCUS concept and our recommendations for actions that should be considered in view of the problems, including equipment shortages, affecting the viability of the concept. We believe, however, that some specific actions are possible to alleviate some of the equipment shortages in the near term.

RECOMMENDATIONS

We recommend that the Secretary of the Army

--transfer equipment now held in theatre war reserve stocks to fill shortages in POMCUS stocks,

--develop a system for computing ammunition requirements based on the asset density authorized in the annual POMCUS authorization updates, and

--develop a system for computing and updating repair parts stock lists.

CHAPTER 4

CONDITION OF AVAILABLE EQUIPMENT

In our last review, we found that much of the POMCUS equipment was inoperable and could not perform its mission due, in large part, to a general lack of maintenance. About 90 percent of the total maintenance effort being expended on POMCUS equipment was being directed toward only that used in the annual REFORGER exercises. As a result, about 80 percent of the POMCUS equipment had received little, if any, maintenance.

At the conclusion of our earlier review, the Army undertook an extensive program to repair equipment and return it to storage. In commenting on the earlier report, DOD stated this program had been completed in July 1972 and that an Army inspection team had concluded that the stocks, as of November 1972, met acceptable serviceability standards. DOD further commented it would continually review the prepositioning program to insure sufficient resources were made available and that a cyclic maintenance program had been established to preclude the need for future get well programs.

At the time of our current review there were approximately [deleted] vehicles in the POMCUS inventory. About [deleted] vehicles were stored in controlled-humidity warehouses and about [deleted] vehicles were in open storage. All but about 1,340 vehicles [deleted] [deleted] had either been stored in controlled-humidity warehouses or had been through at least one annual maintenance program during the last 3 years.

We found that the overall combat readiness of POMCUS vehicles had improved since our earlier review. Our evaluation of technical inspections of 778 vehicles that had either been (1) stored in controlled-humidity warehouses or (2) through at least one annual maintenance program showed that about [deleted] were combat ready.

Although we did not conduct technical inspections of the 1,340 vehicles that had been stored in the open and had not been maintained during the past 3 years, we observed that this equipment had deteriorated [deleted] We believe the deteriorated condition of the 1,340 vehicles demonstrates the importance of periodic maintenance for POMCUS equipment--especially that which is stored in the open. An annual maintenance program was established following our last review. However, we found that CEGE had fallen behind schedule in its maintenance program because of other priorities imposed by higher commands. Further, CEGE lacked an adequate management information system to provide visibility and control over the condition of POMCUS equipment.

EQUIPMENT READINESS CRITERIA

The POMCUS concept establishes the need for storing equipment in combat ready condition for issue within a minimum reaction time. POMCUS stocks are considered combat ready when the following criteria are met.

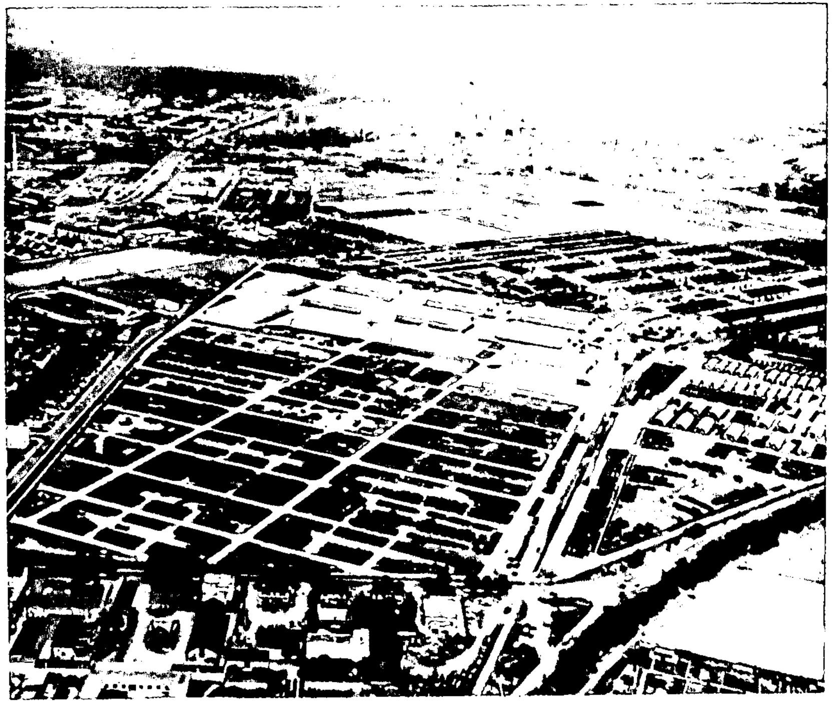
1. Equipment is free from deficiencies that would limit the reliable performance of its primary mission for 90 days in operation.
2. Equipment requires only organizational level maintenance skills and repair parts authorized for stockage at organizational level to make it ready for issue. The organizational level maintenance man-hours required cannot exceed prescribed limits. For example, 6 man-hours are authorized for tanks while 4 man-hours are authorized for tactical wheeled vehicles.

EQUIPMENT CONDITION

To test equipment serviceability we compiled information from the technical inspection sheets prepared by CEGE site personnel during August and September 1975. This equipment had either been stored in controlled-humidity warehouses, had been through a maintenance program during the last 3 years, or both. About deleted POMCUS vehicles were in this category.

Our sample also included equipment that had been inspected in early 1975 before the 1975 REFORGER preparation period.

A total of 778 pieces of equipment from 9 types of tactical wheeled and tracked vehicles, assigned to 10 units to be issued during the 1975 REFORGER field training exercise, were selected. REFORGER vehicles were selected to avoid disrupting CEGE's programed support for this NATO exercise.



1ST COMBAT EQUIPMENT COMPANY, MANNHEIM, GERMANY, SHOWING CONTROLLED-HUMIDITY WAREHOUSES IN CENTER AND OPEN EQUIPMENT STORAGE IN LOWER PORTION.

Source: U.S. Army

Our test included vehicles

--from six CEGE storage sites;

--from inside (535) and outside storage (243);

--that had been through cyclic maintenance (596) and had not (182); and

--that are critically short in POMCUS, such as 155mm. howitzers, armored personnel carriers, and combat tanks.

We included vehicles regardless of their maintenance status at that time. Our test did not include vehicles from open storage that had not been through cyclic maintenance because none of these vehicles was included in the REFORGER exercise.

Sample results

A total of 262 vehicles had readiness deficiencies but only 31 could not be repaired in the allotted time period. The results of our test follow.

Type vehicle	No. in test	No. of ready vehicles	Percentage of ready vehicles
Tactical wheels	571	deleted	
Tracks	207		
Total	778		

Visual inspections of equipment in open storage

To get a better feel for equipment that had been in open storage and had not been through cyclic maintenance (about 1,340 vehicles in total), we looked at 314 vehicles and trailers at four CEGE storage sites and found that:

--One hundred and fifteen vehicles had missing, faulty, or improperly installed parts. One unit had 23 1/4 ton trucks, 22 of which had something either broken or missing.

--About 130 pieces of equipment were rusted, some in weakened condition that could adversely affect their ability to perform their missions. In one particular unit we inspected 68 vehicles and trailers. Forty-nine were rusted in various degrees, 10 of which were obviously in advanced stages.

--Some vehicles had flat tires, broken window glass, broken mirrors, and broken headlights, which made it appear that they had been vandalized; however, this did not appear to be an extensive problem.

--Few vehicles had been properly preserved and many showed no sign of any preservation.

Our visual inspection also included the equipment stored for an engineering construction battalion. It was not clear if the battalion had ever been through cyclic maintenance.

CEGE officials felt that about 50 percent of the 409 pieces of equipment in this unit could be issued within contingency time constraints. We were told that vehicles and equipment that are not in bad shape and for which parts are readily available would not present a problem. However, the following problems were stated:

--All 21 of the wheeled tractors in this unit would need work for various deficiencies including missing parts and corroded turbochargers. These tractors had been stored outside for at least 6 years and had not been through cyclic maintenance.

--All 48 5-ton dump trucks in this unit, although serviceable automotively, were incapable of hauling dirt because the beds were rusted and deteriorated. As a result, all of these dump trucks were scheduled for CEGE's upgrade program. (See p. 30.)

During the inspection, we also looked at 104 vehicles in one unit that had been stored inside and had been through cyclic maintenance in 1973. We did not find problems with missing parts, rusting, or deterioration on this equipment as we found with the vehicles, construction equipment, and trailers discussed above.

<u>Army serviceability tests</u>

In July 1972, August 1973, and August 1974, the Army sent survey teams to Europe to review the effectiveness of actions taken to improve the serviceability and asset management of POMCUS stocks. The Army teams selected at random 540 pieces of equipment each year--180 items each from tactical wheeled and tracked vehicles and communications/electronics equipment. The 1972 and 1973 surveys selected equipment from both the 2 + 10 and REFORGER stocks while only

REFORGER equipment was initially selected for the 1974 survey. The 1974 survey report stated that only REFORGER equipment was selected to minimize disruption of CEGE's preparations for the 1974 REFORGER exercise.

The teams did not include items scheduled for higher echelon maintenance or items which were planned to be dropped from accountability records: Thus, the results of these surveys would not be representative of the POMCUS universe.

The results of the Department of the Army surveys follow.

Year	Percent rated acceptable: Tactical wheels and tracks	Percent rated acceptable: Communications/ electronics
1972	90.3	96.6
1973	92.2	97.2
1974	99.4	99.4

We were told that in 1974 the teams also sampled from the entire POMCUS universe after arriving at the very high acceptability rate for equipment in the sample of REFORGER vehicles. We were also told the second sample resulted in the same high acceptability rate.

EQUIPMENT MAINTENANCE AND REPAIR PROGRAMS

USAREUR established a cyclic maintenance program in March 1973 to insure that stored equipment was periodically removed from storage, inspected, functionally tested, repaired as necessary, inventoried, preserved, and placed back in storage. Cycles of 60 months for equipment stored in humidity-controlled warehouses and 30 months for other equipment were set up. Such a systematic program is essential to maintain the [deleted] vehicles in POMCUS in a combat ready status. This is particularly true for the [deleted] vehicles stored outside--not in humidity-controlled warehouses.

Since the program was established, however, not one annual maintenance cycle has been completed. Further, the first two programs, 1973 and 1974, consisted entirely of vehicles from the REFORGER exercises. Failure to complete the maintenance cycles was attributed to (1) additional workloads resulting from approved special projects such as the shipment of POMCUS equipment to support Israel, Ethiopia, and Jordan and (2) funding limitations and personnel shortages.

Cyclic maintenance program results and problems

The results of the first two cyclic maintenance programs (1973 and 1974) are shown in the following schedule.

Vehicles (tracked and wheeled)

	1973	1974	Total
Programed	3,356	5,716	9,072
Completed	2,162	4,419	6,581
Carry over	1,194	1,297	2,491

The combined 1973 and 1974 programs included the equipment for 65 POMCUS units, all of which belonged to the REFORGER project. Because of the emphasis given to REFORGER equipment during 1973 and 1974, the 1975 program included a heavy schedule of vehicles stored in the open in an effort to catch up with the program. Before the 1975 program, 61 units, about deleted of all POMCUS units which were either wholly or partially stored in the open, had never been through cyclic maintenance. Fifty-six of these units were scheduled for the 1975 program; however, most were either not completed or not started at all. As happened in 1974, CEGE's efforts during the 1975 program were diverted to other projects--primarily shipments of equipment to Israel. In adddition, CEGE personnel were required to prepare equipment for issue to Brigade 75, and, due to funding limitations, higher authorities imposed a requisition constraint for 3 months beginning in December 1974. The constraint affected repair parts for the cyclic maintenance program. Each of these diversions detracted from CEGE's ability to maintain POMCUS equipment.

The results of the 1975 cyclic maintenance program are shown below.

Vehicles (tracked and wheeled)

Scheduled (note a)	deleted
Maintenance completed	
Preserved and stored	
Percentage maintenance completed	
Percentage preserved and stored	

a/Does not include Brigade 75 equipment issued or the projected issue to Brigade 76.

The status of the equipment not completed is shown below.

	Tactical wheels	Tracks	Total
Awaiting initial inspection	deleted		
Awaiting parts to correct serviceability deficiencies			
Awaiting shop			
In shop			
Awaiting final inspection			
Requiring higher level maintenance, including upgrade			
Total			

About $12.8 million was spent on the 1975 maintenance program which ended on August 15, 1975. It was estimated that the cyclic maintenance backlog could be reduced to manageable size by the end of calendar year 1976 if no extra projects were imposed on CEGE. CEGE personnel believe the backlog can be reduced through the increase productivity expected to result from the impending civilianization of maintenance activities. Further, if the 1976 program is completed, the cyclic maintenance program will be back on schedule. However, future diversions are anticipated for

--rewarehousing--to fill 10 new warehouses at 1 storage site;

--painting camouflage patterns on POMCUS equipment (none of the POMCUS equipment is camouflaged and Headquarters, USAREUR officials said painting will probably be spread over a 4-year period, beginning in fiscal year 1977); and

--installation of modification work orders by U.S.-based teams.

Repair parts

As indicated in the above schedule, shortages of repair parts is a major bottleneck in completing the maintenance program. This can be attributed to (1) the relatively low priorities for requisitioning repair parts for cyclic maintenance and (2) funding constraints.

M60 TANKS NOT READY FOR ISSUE--AWAITING PARTS

Source: GAO

28-003 O - 81 - 23

Requisitioning priorities for the 1975 program were 05 and 12 for tracked vehicles and tactical wheeled vehicles respectively. An 05 priority is that normally used for ordering replenishment stocks when a stocked line item is at a zero balance. A 12 is the normal replenishment priority. During the REFORGER exercise, however, CEGE was authorized to use the 02 priority which is normally used by active units to requisition a part which is deadlining a piece of equipment. For the 1976 program, CEGE has been authorized to use the 02 priority if the part is needed to take a vehicle out of a "red"--not combat ready--condition.

Further, because of funding limitations, a requisition constraint was placed on CEGE for a 3-month period beginning December 1974. This constraint adversely affected the supply of repair parts for the cyclic maintenance program.

Special projects

Other impediments to accomplishing the cyclic maintenance programs were (1) special projects to send equipment to Israel beginning in late 1973 and (2) preparation of equipment for issue to Brigade 75.

Projects to send equipment to Israel began in late 1973 and ended in February 1975. For the first project, CEGE expended about 236,000 man-hours (both military and civilian) which cost about $1.6 million. The second project cost about $196,000.

The equipment for Brigade 75 was prepared for issue during February-June 1975. CEGE expended $403,000, including about $166,000 for repair parts, but excluding military labor costs for this project. Shortly after issuing equipment for Brigade 75, CEGE had to begin preparing equipment for the REFORGER exercise.

Equipment upgrade program

CEGE has attempted to identify equipment which requires excessive parts and man-hours to repair. These items, characterized as "dogs," are identified during cyclic maintenance and quality assurance inspections. This equipment has been referred to higher echelon maintenance activities for repair or disposal if the equipment is not economically reparable. During 1974 and 1975, 1,228 pieces of equipment were placed in the upgrade program and, as of August 1975, 269 had been repaired and 173 had been classified not economically reparable.

Some of the equipment in this program is the worst in POMCUS primarily because of age--these stocks include about 1,100 vehicles that are from 12 to 16 years old. A CEGE official stated that some vehicles in upgrade are missing parts because of cannibalization.

Corrosion control program

CEGE intends to begin a corrosion control program to overcome rust accumulated on equipment. The need for this program was created by the low priority afforded the preservation of equipment in POMCUS stocks in prior years.

Having previously recognized the poor serviceability of equipment in POMCUS, the Department of the Army, and USAREUR initiated a program in 1972 (called EURIP III B) to repair and modernize the stored equipment. About 95 percent of the POMCUS stocks went through this program.

The EURIP III B program did not concentrate on equipment preservation before the equipment was put back into storage. As a result of this and CEGE's inability to complete annual cyclic maintenance programs, corrosion has become a major problem.

As of November 1975, CEGE had identified about 1,900 vehicles and trailers in POMCUS that had major rust problems--the metal was weakened to the point of affecting mission capability. We were informed that many of the trailers identified will have to be replaced.

MANAGEMENT INFORMATION ON EQUIPMENT SERVICEABILITY

CEGE does not have a management information system that can readily show the overall serviceability of POMCUS equipment. The Logistics Evaluation Agency, Department of the Army, has been tasked to assist in developing an adequate information system to provide the visibility needed to manage POMCUS.

CEGE has stated that it needs, among other things, programs that will provide the following information on equipment serviceability.

--A profile of each end item with critical components to show which items are serviceable and which are not.

--The status of major end items while in maintenance.

--The status of exercising gun recoil mechanisms.

--The status of modification work order applications.

--Maintenance workload programing.

--A prediction of repair parts usage.

In its June 13, 1975, survey report on POMCUS, the Department of the Army recommended that USAREUR give priority support to the ongoing effort to develop a management information system for POMCUS. The report stated that CEGE efforts to improve maintenance management are inhibited partly by the lack of a management information system.

CONCLUSIONS

The need for regular, periodic maintenance is graphically demonstrated by the condition of the 1,340 vehicles we observed stored in the open and never put through a maintenance cycle. We believe that the POMCUS stocks must be properly maintained to insure that they will be in a combat ready condition in the event of an emergency as well as to protect the substantial dollar investment this equipment represents.

RECOMMENDATIONS

We recommend that the Secretary of the Army provide USAREUR with sufficient resources--personnel and funds--to (1) insure that the cycle maintenance program backlog is reduced to an acceptable level, as expeditiously as possible, (2) prevent a subsequent maintenance backlog buildup, and (3) complete the upgrade and corrosion control programs. See chapter 6 for our recommendations on the adequacy of support personnel to maintain POMCUS stocks.

We recommend that the Army survey team recommendation to establish a management information system for POMCUS equipment be given priority attention.

CHAPTER 5

ADEQUACY OF STORAGE

AND MAINTENANCE FACILITIES

The prepositioning concept for POMCUS equipment assumes that the equipment will be properly maintained and stored in a combat ready condition for several years. To be effective, this long-term storage system requires use of warehouses which can be sealed sufficiently to prevent excessive leakage of air and special machines to maintain desired humidity levels.

During our previous review, we found that this storage system was not completely successful because

--many of the 53 controlled-humidity warehouses then available were not effective in controlling humidity due to design and construction problems and operational requirements and

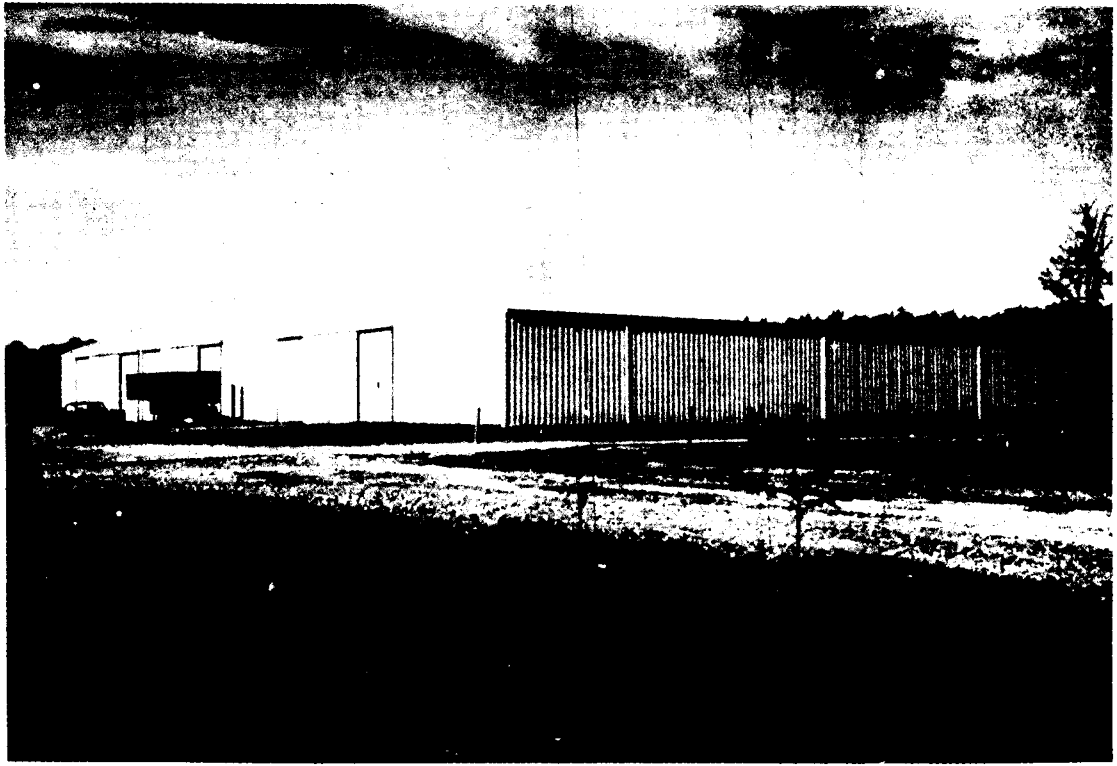
--sufficient warehouses did not exist, thereby requiring much equipment to be stored in the open.

In commenting on our earlier report, DOD conceded that all design parameters were not met in some of the warehouses but stated that the facilities were effective in reducing the maintenance required for equipment stored in them. DOD advised that design deficiencies were corrected after the first increment of warehouses was built.

During our followup review, we found that some additional warehouses have been built but the system still has not achieved its objectives. Details are discussed below.

CONTROLLED-HUMIDITY WAREHOUSES

In December 1971, there were 53 operational warehouses. At the time of our current review, there were 57 warehouses in use, 12 more had been completed but not yet accepted or in use, and 10 more were under construction. It was estimated that these 79 warehouses would provide sufficient storage space for all authorized POMCUS equipment with the exception of trailers, oversized engineering equipment, and MRLOGAEUR equipment.



EXTERIOR VIEW OF CONTROLLED-HUMIDITY WAREHOUSE
Source: U.S. Army

INTERIOR VIEW OF CONTROLLED-HUMIDITY WAREHOUSE
Source: U.S. Army

We found, as we had in our previous review, that the warehouses were being opened excessively and for the same reasons as before:

--Upgrading or replacing equipment.

--Modifying equipment.

--Modifying a unit's equipment allowance.

In addition, the warehouses were not kept closed as contemplated because the shipments of POMCUS stocks to support Israel and other Middle East countries from 1973 to 1975 required frequent opening of the warehouses. The turbulence caused by these support projects also resulted in inefficient use of warehouse space by leaving warehouses partially filled after vehicles had been removed while, at the same time, other vehicles were stored in the open. For example, the Inspector General in 1975 found that at two POMCUS storage sites, the controlled-humidity warehouses were only about 50 percent full. In addition, five warehouses were being used to store nonmechanical equipment items. In each case, other equipment which should have been stored inside was being stored outside.

Condition of controlled-humidity storage

During annual NATO inspections of controlled-humidity storage during 1974 and 1975 numerous deficiencies were noted. In 1974 the NATO inspector rated warehouse maintenance unsatisfactory at four of the six CEGE sites that had controlled-humidity warehouses. Three sites were rated unsatisfactory during 1975 and the inspector noted that better cooperation or effort was required either by the facilities engineers responsible for the warehouses or CEGE site personnel.

Fifty-seven warehouses were inspected during 1975. Among others, the inspector noted deficiencies in the following areas.

Deficiency	No. of warehouses
Vehicle doors	24
Electrical contact switches	10
Lights inside and outside	12
Dehumidifying equipment	23
Humidity not maintained within acceptable levels	11
Controlled-humidity recorder	20

Data supplied by facilities engineers shows that $263,000 had been spent during fiscal years 1973, 1974, and 1975 to maintain CEGE facilities. Ongoing projects include another $283,400.

Work specifically for controlled-humidity warehouses includes

--installing translucent roof panels;

--repairing and replacing controlled-humidity equipment;

--repairing warehouse doors, walls, and floors.

MAINTENANCE FACILITIES

Many of CEGE's maintenance facilities are inadequate because they are too small, unheated, and ill equipped, which adversely affects CEGE's maintenance program.

We were told that overall the storage sites need

--larger maintenance facilities,

--more secure weapons storage facilities,

--better shipping and receiving facilities to handle incoming and outgoing shipments,

--more wash racks to clean equipment before it goes into maintenance and storage, and

--better equipment preservation areas.

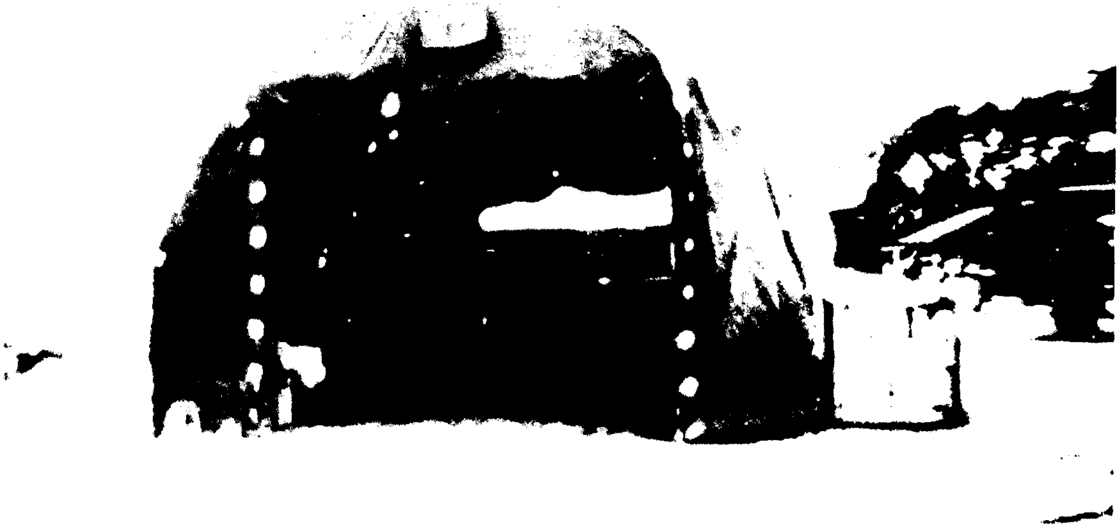
As shown in chapter 4, 7,043 vehicles were scheduled for cyclic maintenance in 1975. CEGE officials stated, however, that there is only one maintenance shop that is completely adequate at their eight sites in Germany. During our site visits we saw some of the inspection and maintenance work being done in open areas, which were very muddy and rutted by vehicles driving through the area. One site did not have water, heat, or electricity (except for an outside generator) at its maintenance facility.

In survey reports in December 1973 and June 1975, a Department of the Army team recommended that USAREUR improve the maintenance facilities at each CEGE site. Specifically, the 1973 report recommended that:

> "USAREUR take the necessary action(s) to identify and program for the establishment of additional maintenance facilities and the repair or alteration of existing maintenance facilities, as required, to adequately support the maintenance mission inherent in the POMCUS concept."

At the time of our review an additional maintenance facility was under construction at one CEGE storage site.

The Department of the Army is developing a program to improve maintenance facilities worldwide. CEGE has surveyed their facilities and listed their needs by storage site. We were told the requirements were developed by CEGE but no cost estimates have been prepared.



ENGINEERING TENT USED FOR PRESERVATION FACILITY
Source: GAO

CONCLUSIONS

Inherent in the POMCUS concept is the proper storage and maintenance of the POMCUS equipment so that it will be serviceable when needed. Controlled-humidity warehouses, properly maintained and used, permit long-term storage of equipment with minimum deterioration and lessen the frequency of periodic maintenance requirements. When cyclic maintenance is required, however, adequate facilities are necessary to insure that the maintenance mission can be achieved in a timely and efficient manner.

our review showed that there are still improvements that should be made in the maintenance and use of controlled-humidity warehouses and in CEGE maintenance facilities.

RECOMMENDATIONS

We recommend that the Secretary of the Army require USAREUR to

--identify existing warehouse deficiencies and establish repair programs to alleviate them,

--take actions necessary to transfer items in open storage to fill available space in the controlled-humidity warehouses and to insure that the warehouses are kept closed to the extent possible, and

--improve maintenance facilities.

CHAPTER 6

ADEQUACY OF POMCUS SUPPORT PERSONNEL IN EUROPE

Since the time of our last review, CEGE's manpower authorization had declined from 2,795 in late 1972 to about 2,400 in June 1975. It is projected to decline to about 2,200 by June 1976. Further, CEGE has been directed to substantially civilianize its work force by the end of fiscal year 1976.

These substantial changes have been made without the benefit of a manpower survey to validate personnel requirements, and occurred during a period when CEGE's workload increased due to (1) the start of the cyclic maintenance program and (2) special projects to support Israel and other Mideast countries. Within the current authorized work force, there were some significant shortages of skills needed to maintain POMCUS equipment.

PERSONNEL AUTHORIZATIONS

The last manpower survey of CEGE activities was done in 1969. No such surveys have been conducted since that time although CEGE implemented its cyclic maintenance program in March 1973.

The authorized and actual personnel strengths for CEGE for November 1972 projected through June 1976 are shown below.

	Authorized	Actual	Shortage
November 1972	2,795	2,699	96
June 1973	2,493	2,421	72
June 1974	2,477	2,035	442
June 1975	deleted		
June 1976			

CEGE officials stated they did not know if their current authorization was adequate to accomplish CEGE's mission because each annual maintenance program had been interrupted to support special projects and CEGE personnel had not been augmented during the special projects. USAREUR officials acknowledged that diversion of CEGE effort to special projects adversely affected CEGE's maintenance program. A manpower survey of CEGE was scheduled during the first half of calendar year 1976.

Civilianization of work force

Headquarters, USAREUR directed CEGE to substantially civilianize its work force by June 30, 1976. The September 1975 authorized personnel strength includes some new civilian positions not yet filled and some military positions (about 640) that must be eliminated by June 30, 1976. CEGE was advised by the 1st Support Brigade, the next higher command, that military positions will be withdrawn as civilian employees became proficient in their jobs.

For fiscal year 1976, Headquarters, USAREUR authorized CEGE the following civilian and military strengths.

	Total	Civilian (note a)	Military	Military command reduction
September 23, 1975				
March 31, 1976				
June 30, 1976			deleted	

a/At the time of our review an additional 21 spaces were awaiting USAREUR approval.

b/Includes 495 new civilian positions and 642 military positions to be attrited by June 30, 1976.

As shown above, CEGE was authorized about 8 civilian positions for each 10 military spaces lost; however, CEGE officials believe productivity may increase as a result of civilianization because civilians will spend more time at their jobs than military personnel do. Civilians will not be required to perform extra duties such as guard duty or to attend various training seminars such as drug and alcohol abuse.

CEGE's commander said he intends to keep military personnel in key positions. Other spaces, including some supervisory positions, will be civilianized. He said that even if civilians are not available for wartime duty, CEGE's equipment issue mission should not be adversely affected because he intends to have the deploying troops activate their own equipment. CEGE's military personnel will merely supervise the issue and will not attempt to get all the equipment ready for them as has been done before the 1975 REFORGER exercises. As a test, two units successfully activated their own equipment during the 1975 exercise.

PERSONNEL SHORTAGES

As of August 1975 CEGE had both personnel shortages and excesses. Examples of the shortages follow.

Job description	Authorized	Onhand	Shortage
Track vehicle mechanic	142	90	52
Vehicle material supply specialist	62	43	19
Fuel/electrical systems repairman	14	5	9
Stock control and accounting specialist	49	40	9

The effect of the track vehicle mechanic shortage is offset in part by the shortage of track vehicles. (See ch. 3.)

We found that personnel shortages have had some adverse effect on CEGE's operations but we were not able to assess the overall impact.

--Twenty-eight combat tanks have not been ready for issue since November 1974 when returned from the REFORGER exercise, primarily because the storage site has not had a turret mechanic available.

--CEGE officials and a Department of the Army survey team stated that warrant officers are needed in supply and maintenance operations. The survey team stated that the lack of company-level maintenance warrant officers at CEGE storage sites adversely affects maintenance operations. We were told that warrant officers are trained as specialists; therefore, they can bring highly specialized training and experience into their work while an officer's training and experience is more general.

CONCLUSIONS

A work force geared to the workload dictated by the missions of CEGE is an essential element in maintaining POMCUS equipment in a combat ready condition. Yet, about 7 years elapsed between manpower surveys of CEGE activities. Although CEGE, for the past several years, has been unable to keep up with its normal maintenance functions because of high priority special projects, overall personnel strength has been reduced.

RECOMMENDATIONS

We recommend the Commander, USAREUR insure that

--contingency arrangements for work force augmentation be made in the event additional special projects occur in the future, and

--manpower surveys be conducted at regular intervals and CEGE's workforce be maintained at a level consistent with survey results.

CHAPTER 7

INVENTORY ACCOUNTABILITY AND CONTROL

In our prior report, we found that the Army had not maintained effective accountable control over equipment. For example, errors in excess of $32 million in accounting for some prepositioned equipment were found. At that time, CEGE was accountable for REFORGER stocks while the U.S. Army Materiel Agency was accountable for 2 + 10 stocks. Neither of the two organizations had procedures to provide data concerning the total stocks authorized or on hand by unit. The POMCUS concept requires control of stocks by unit sets of equipment.

DOD acknowledged that Army accounting records and procedures did not meet desired standards. The Army's "Project Balance" was initiated to correct deficiencies, including the review and improvement of supply accountability.

Our current review indicates that improvements in accountability and control of POMCUS equipment have been made. For example, the accountability of stocks has been centralized in one unit, the CEGE, and, to a large extent, the stocks are accounted for in unit sets. Further, a cyclic inventory program was just recently implemented. Improvements, however, are still needed in the (1) accountability for components of kits and sets and (2) equipment locator system.

PHYSICAL INVENTORIES

CEGE has directed that, beginning October 1, 1975, accountable property officers will inventory approximately 10 percent of the property on hand each month to insure that a 100 percent inventory is taken annually. In the past physical inventories of POMCUS equipment have been conducted (1) at the discretion and direction of the accountable property officers at each storage site, (2) in conjunction with the annual cyclic maintenance program, (3) during REFORGER equipment preparation; and (4) when accountable property officers were changed; thus there had been no assurance that 100 percent of the POMCUS stocks were being inventoried annually.

In addition to establishing the cyclic inventory procedures, in early 1975, CEGE began a one-time wall-to-wall inventory of all POMCUS storage sites. This inventory, which includes a kit and set components inventory in addition to major end items of equipment, was undertaken to correct problems caused by the shipments of POMCUS equipment to Middle East countries since late 1973. As of August 31,

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1975, the site inventories of major end items were about 88 percent complete while the kit and set components inventories were about 57 percent complete.

Inventory losses

During fiscal year 1975, inventory activity resulted in a net reduction of $1.0 million in end item property accounts as indicated below.

Adjustments for losses	$1.4 million
Adjustments for gains	0.4 million
Net reduction	$1.0 million

Losses were recorded in property accounts for items which were supposed to be on hand but which were not found during inventories. Gains were recorded when inventories showed that items were on hand but not included in property accounts or when an item was found during an investigation of its loss.

Some of the items lost were trailers, radios, tool kits, binoculars, radar sets, and cargo trucks. We noted, however, that quite often items were found during the investigation of reported losses. Based on documents we reviewed and discussions with CEGE personnel, no items such as combat tanks, armored personnel carriers, or howitzers were reported lost during fiscal year 1975.

However, as reported in the 1975 Inspector General's inspection of USAREUR, there are excessive delays in initiating and processing reports of surveys and inventory adjustments. For example, of the 64 reports of surveys initiated in fiscal year 1975 only 6 had been completed. Fifty-six were over 6 months old. Further, the Inspector General commented that there was no system at CEGE whereby circumstances surrounding repetitive losses could be analyzed to determine if existing security and control procedures were adequate.

Components of kits and sets

A problem existed concerning components of sets and kits, which themselves are not accountable items. For example, a tool set is an accountable items and it is recorded in property records. However, the tools in the set are classified as expendable items and, therefore, are not recorded in property records. Many of these items are pilferable and losses occur annually during the REFORGER exercises.

The Inspector General looked at these and other items and made the following comments:

--There was no system within CEGE to provide visibility of and accountablity for such items.

--These items were not properly stored and maintained. Items by the trailer load were found, some of which had been under no control or received no care or preservation in years. Warehouses, metal freight containers and vehicle cargo loads were all observed to contain such items.

--Requisitions were being submitted for nonmechanical items which were available at other equipment sites.

--The loss of accountability and observed condition of some of this equipment significantly degraded CEGE's ability to react in a timely manner to a specified contingency.

As of November 1, 1975, CEGE had identified important shortages in kit and set components. Examples of items which are short are tent poles, wire brushes, wrenches, teaspoons, and bolt cutters. In total, CEGE had prepared about 8,000 requisitions totaling about $640,000 to fill shortages identified by the ongoing component inventory.

ERRORS IN EQUIPMENT LOCATOR SYSTEM

We tested the accuracy of the locator system for seven units at five CEGE sites and found that only 70 percent of the items checked were actually where the locator system indicated they would be. We believe that the errors in the locator system would inhibit timely equipment issue in an emergency, particularly since the equipment shortages in POMCUS units will require equipment transfers or movement of units to more than one site to fill each unit to the required [deleted] of authorization.

CONCLUSIONS

A dependable, accurate system which provides up-to-date information on asset balances, location of equipment, and trend data on losses or errors is essential to effective management and maintenance of the POMCUS stocks. Further, this information is needed to process the annual equipment authorization updates which insure that the correct types and quantities of equipment are obtained to support deploying units.

RECOMMENDATIONS

We recommend that the Commander, USAREUR

--insure that the cyclic inventory program inititated by CEGE in late 1975 is a permanent program,

--require the expeditious processing of survey and inventory adjustments,

--insure that CEGE develops a system to provide visibility and accountability for components of kits and sets, and

--take actions necessary to correct inaccuracies in the equipment locator system.

CHAPTER 8

WEAKNESSES IN READINESS REPORTING

In our previous report, we found that the actual readiness condition of POMCUS equipment was not being reported to Department of the Army Headquarters because of inaccuracies in the internal readiness reporting system at CEGE. Thus, at that time, the majority of the POMCUS unit equipment was reported to be combat ready or substantially combat ready in both equipment availability and serviceability when, in fact, it was marginally ready or not combat ready.

In our current review, we found that while the readiness reporting system is accurate in reporting that POMCUS is not ready to support its overall mission, the system is not definitive enough to show what missions POMCUS can support or pinpoint specific problems.

Overall, POMCUS has been rated deleted The latest "Unit Readiness Report," based on 1973 authorizations and dated June 20, 1975, included the status on deleted units.

Readiness condition	Number of units	Percentage
Ready		
Substantially ready		
Marginally ready		
Not ready		
Total	deleted	

deleted

The Unit Readiness Report is prepared quarterly and the report goes to the Department of the Army, Headquarters USAREUR, and the 1st Support Brigade. The system reports status of readiness of the POMCUS equipment using only two criteria. The first is availability which is expressed as a percentage of equipment on hand versus that authorized. The second judges equipment serviceability according to whether it is in storage (ready) or in the maintenance cycle (not ready). The weaknesses in the system are discussed below.

--The criteria for reporting the percentage of equipment on hand versus that authorized treats each item equally regardless of its combat essentiality. For example, trailer-mounted bakery plants and portable bath units are given the same weight as combat tanks, machine guns, howitzers, and armored personnel carriers.

--The system does not link a combat tank with its armament, fire control, or communications. Without these, the tank cannot be fully effective.

--The system does not provide for commanders' comments as is the case in normal Army units. Therefore, the reporting system does not provide judgmental appraisals.

--Equipment condition is based on whether or not equipment is in storage (ready) or in maintenance (not ready). As discussed in chapter 4, some of the equipment in storage is known to be in poor condition (not combat ready); thus equipment should not be reported ready merely because it is in storage and not in maintenance. Further, not all equipment in the maintenance cycle is likely to have deficiencies of such magnitude as to be rated not combat ready.

--Since the 1974 authorizations were not implemented, readiness reporting was based on 1973 authorizations which did not reflect actual authorizations at the time.

Finally, the reporting system does not relate available assets to requirements of units in their order of deployment--it does not show what units can be supported when shortages exist. For example, the deleted

In spite of the equipment shortages at the time, POMCUS could support most of

deleted

units were rated ready to enter combat.

Headquarters, USAREUR has requested the U.S. Army Logistics Evaluation Agency to assist in developing a meaningful readiness reporting system for POMCUS. However, we were told that it will probably take 2 years or more to develop and implement improvements.

CONCLUSION

We believe that the inadequacies of the present reporting system are obvious; however, since USAREUR has initiated action to develop a better system, we are making no recommendation at this time.

CHAPTER 9

DEPLOYMENT OF TROOPS

deleted

Also, other problems concerning issuance of equipment and ammunition and fuel tank truck shortages could affect their becoming fully operational promptly after reaching Europe.

DEPLOYMENT PLANS FOR REFORGER AND 2 + 10 UNITS

USAREUR and Seventh Army OPLAN 4360, the plan for deploying REFORGER and 2 + 10 forces to Germany, provides plans and guidance for deployment during general mobilization and augmentation of USAREUR forces and supports USAREUR and Seventh Army OPLAN 4102--the general war plan for transferring U.S. forces to NATO.

Under OPLAN 4360, REFORGER units may be deployed from the United States during periods of heightened international tension or may be deployed under general war augmentation concurrently with 2 + 10 units. The plan anticipates that the United States will have sufficient warning to mobilize at least deleted before the outbreak of hostilities. However, CEGE recognizes, in its implementation of OPLAN 4360, that in the deleted These plans further anticipate that:

--2 + 10 and REFORGER units will arrive by air concurrently from deleted days following mobilization.

--Each division will require deleted from the date the first unit arrives in Germany to become fully combat ready.

Upon arrival at predetermined airfields, the deploying units' advance parties are to be transported to POMCUS storage sites where CEGE is required to issue the units' equipment at deleted of authorized strength, in combat ready condition, and with all urgent modifications applied. Each vehicle must be filled with fuel and equipped with necessary batteries.

The advance parties move the equipment to their initial unit assembly areas where they are joined the following day by the rest of the units' personnel. At the initial unit assembly areas, battalion-sized and individual company-sized units form and receive their equipment. Units also use the initial assembly areas as their base for picking up and distributing the basic load of ammunition. The units move from the initial assembly area to the major unit assembly area where major tactical unit commanders gain control of their units.

According to the plans, units from the United States would arrive deleted days following mobilization. The plan estimates that from the date the first unit arrives in Germany, deleted deleted to reach combat ready status. Thus, a period of about deleted would be required for all units to become combat ready.

USAREUR officials believe that the United States must have deleted

ALTERNATIVES TO EXISTING PLANS

Recognizing that OPLAN 4360 was not viable because of the critical equipment shortages in POMCUS, Headquarters, USAREUR in about mid-1975, proposed an interim change to the plan whereby deleted

deleted

deleted

The deployment delays inherent in the proposed interim plan versus the plan in effect-- deleted deleted in the Army's ability to augment USAREUR forces as is intended by the POMCUS concept. Thus, if the United States deleted As a result USAREUR officials believe that the deleted

An alternative to USAREUR's proposal would be to have the 2 + 10 and REFORGER units deleted deleted required to move only the troops and the equipment that would normally accompany them.

Our review showed that about deleted of combat-essential equipment, including tanks, personnel carriers, and howitzers, would have to be airlifted to cover POMCUS shortages. The following graph reflects the impact on airlift requirements to transport these shortages.

deleted

The number of flights shown above are conservative because (1) only shortages of combat essential equipment are included and (2) the figures do not include the 2 + 10 and REFORGER support units or any of their shortages.

Further, the ability to deploy effectively under this alternative would require that the equipment in the hands of the 2 + 10 units be maintained in a ready condition. To test the condition of this equipment we inspected 110

AN M60 TANK BEING OFF-LOADED FROM A U.S. AIR FORCE C-5A AT FORT HOOD, TEXAS
Source: Air Force

pieces of combat-essential equipment selected on a random basis, at the deleted deleted We found that about deleted of our selected equipment failed to meet the requirements of equipment serviceability criteria. This means that the equipment would be unable to perform its primary mission immediately or with reliability for a sustained period (90 days).

deleted items had deficiencies which would have required 12 or more hours to repair--assuming that the needed repair parts and/or manpower were available.

The increased requirements for transportation assets along with the possible need for maintenance to correct equipment problems, would obviously have an adverse impact on the deployment of these units under this alternative.

OTHER PROBLEMS

Even assuming that sufficient combat ready equipment was available in Europe to support the deploying units or that they deleted the following problems would adversely affect their ability to become fully ready for employment against an enemy force.

Storage problems

--The CEGE storage sites have not standardized the storage of POMCUS equipment to facilitate issue. During our site visits we found equipment was stored by unit set, by commodity, intermingled between sets in the same storage area and in different storage areas, and also that the equipment locator system had many errors.

--Equipment shortages are scattered throughout the POMCUS units and many lateral transfers would be required to fill unit sets for deploying units, as was the case for the 1975 REFORGER exercise. CEGE officials told us that they intended to fill sets as much as possible, to include equipment transfers between sites, as part of the implementation of the 1975 POMCUS equipment authorization update.

--All POMCUS repair parts in authorized stockage and prescribed load list items and most batteries for units in Germany are stored at CEGE's central supply operation. While USAREUR officials have approved centralized storage for control and more efficient management, the repair parts and batteries will have to be transported to CEGE storage sites at the time of issue. This requirement will increase CEGE's workload at that time.

<u>Transportation problems</u>

--Sufficient tank trucks have not been provided to fuel all vehicles during the equipment issue. During the 1975 REFORGER exercise the 1st Support Brigade found that it did not have enough organic carrying capacity to meet the issue-day needs of the two units that activated their own equipment. Brigade officials said that during prior REFORGER issues, vehicles were fueled before the arrival of the troops. During the two special issues in 1975, vehicles were fueled as they were activated which required tankers to be available throughout the issue. Brigade officials told us they will have to study the problem to determine the extent of the tanker shortage.

--Transportation has not been arranged for the deleted in Germany and to pick up equipment at two CEGE storage sites. For the other storage sites transportation would be arranged through German military authorities.

<u>Ammunition problems</u>

--USAREUR officials believe that problems in the deleted deleted are attributed to expected deleted

deleted We were informed that (1) no plans existed to facilitate the pick up of each units' ammo load, (2) since POMCUS does not have 5-ton cargo trucks or 8-ton M520 (GOER) cargo vehicles for hauling ammunition, 2-1/2 ton trucks will be used for this purpose, thus increasing the number of trips required and deleted deleted and (3) some ammunition for POMCUS units is not stored at the sites where the units are supposed to pick up their ammunition.

CONCLUSION

The potential deployment problems discussed in this chapter, coupled with the critical equipment shortages, lead to the conclusion that the Secretary of Defense and the Secretary of the Army should reexamine the present POMCUS concept. See the conclusions and recommendations in chapter 12.

CHAPTER 10

READINESS OF TROOP UNITS

Our previous report identified severe personnel and training problems with the 2 + 10 and REFORGER units based in the United States. These included overall personnel and skill shortages, extensive turnover of personnel, and training problems.

Our current review shows that, overall, the readiness condition of these divisions are substantially better. All three divisions were reporting an overall readiness condition of deleted Personnel strength had increased from a severe understrength position to slightly overstrength. Statistics are shown below.

Project	Authorized	Onhand	Overage
	deleted		
REFORGER:			
1st Infantry Division (note a)			
Total			

a/Includes nondivisional REFORGER units.

However, there are still problems--some of which are beyond the control of these units. They include:

--Shortages in certain critical or combat essential military occupational specialities (MOS), particularly in the noncommissioned officer (NCO) or middle management area.

--High personnel turnover rates.

--Funding constraints which affect troop training, logistical support, and ultimately combat readiness.

In addition, personnel and training readiness reports were of doubtful use or validity because the subjectivity of the reporting criteria allows commanders to make certain questionable assumptions.

SKILL AND MILITARY SPECIALITY SHORTAGES

Although these divisions are slightly overstrengthed, there are (1) shortages in certain combat-essential MOSs and (2) significant shortages of NCOs particularly in essential MOSs. Examples of shortages for both 2 + 10 and REFORGER units are summarized below.

		Shortages						
		2 + 10		REFORGER		Total		
MOS	Description	Auth	On-hand	Auth	On-hand	Auth	On-hand	Percent
deleted								

Almost without exception the shortages in the above MOS list occur in the NCO or middle management categories. These are enlisted paygrades E-5 thru 9. In fact, the true extent of NCO shortages is masked by overages in the lower paygrades of E-1 thru 4. For example, the total authorized strength for deleted deleted for the deleted deleted During our review there were deleted personnel assigned, deleted short of the authorization. The total shortages of NCOs in this MOS, however, was deleted percent of the NCO authorizations) which was offset by the overages in lower ranking grades E-1 thru 4.

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These two problems are basically Army-wide. 1/ It is difficult, if not impossible, to quantify the impact these shortages would have on the capabilities of these divisions in an emergency situation; however, we believe that they must cause some degradation. We noted that one division commander considered these conditions as one of the major problems facing his command and had indicated that if improvements were not made, he would downgrade his division's overall readiness ratings.

The Army's Military Personnel Center is sponsoring a nonvoluntary program (for participating commands) to train personnel in excess MOSs to reduce the shortages in MOSs and skill levels. Retraining is, basically, being done through on-the-job training programs at each location involved. This program is being undertaken partly in response to congressional direction to balance the enlisted MOS grade structure.

PERSONNEL TURNOVER

Personnel turnover and turbulence continue to affect the deleted During the year ending November 1975, 50 and 68 percent, respectively, of the personnel assigned in December 1974 to the deleted deleted were transferred to other units outside the division. Personnel turnover does not affect deleted deleted because personnel are stabilized for a good part of the year to support the annual deleted exercise.

Deployment of Brigades 75 and 76

The personnel turnover rates discussed above do not reflect the additional intradivision turbulence caused in the 2nd Armored Division by the deployment of Brigade 75 and that projected to occur in the 4th Infantry Division with the deployment of Brigade 76.

Public Law 93-365 (the Nunn Amendment) reduced the authorized noncombat component U.S. military strength in Europe by 18,000. However, the law correspondingly authorized the

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1/See GAO report "Improvements Needed In Determining Skill-Training Requirements (B-160096, Feb. 10, 1976). This report identifies the basic causes for this situation.

Secretary of Defense to increase authorized combat component strength of U.S. forces in Europe by amounts equal to reductions in noncombat personnel. Thus the Army will be deploying to Europe, on a 6-month rotational basis, one brigade each from the 2nd Armored and 4th Infantry Divisions. The program under which 2nd Armored Division units deploy to Europe (Federal Republic of Germany--FRG) is referred to as Brigade 75. For the 4th Infantry, the program is called Brigade 76.

A 3,800-man brigade of the 2nd Armored Division deployed to Europe in March 1975. The brigade consisted of a brigade headquarters, a support battalion, a tank battalion, two mechanized infantry battalions, a field artillery battalion, a cavalry troop, and an engineer company. Equipment for the brigade was withdrawn from POMCUS stocks.

The brigade headquarters and the support battalion, totaling approximately 660 troops, deployed to Europe on a permanent basis in March 1975. The remainder of the brigade units deployed to Europe in a temporary duty status without dependents for periods not to exceed 6 months each. By June 1975, the initial brigade deployment was completed. Temporary duty units will rotate between their bases in the United States and Europe in a sequence that will continually maintain a brigade in Europe under command of the brigade headquarters permanently stationed there.

Since one of the 2nd Armored Division's brigades will continually be stationed in Europe as Brigade 75, a fourth brigade was established in the Division in early 1975 to replace the brigade initially deployed to Europe. The new brigade was established by using the deployed brigade's equipment that remained at Fort Hood, and staffing it initially with nondeployable personnel (not eligible for overseas duty). This unit's activation was not, however, accompanied with a

deleted

The Division's evaluation of Brigade 75 deployment indicates turnover was most severe from January to June 1975 and affected not only the first Brigade 75 battalions to deploy but also affected, to an even greater extent, the nonrotating battalions that lost personnel to those battalions. The study indicated that the nonrotating units sustained significant skill and key NCO losses. Total turbulence for the Division attributable to the Brigade 75 deployment units amounted to 88 percent of authorized strength, reflecting 1,495 reassignments into and 1,120 reassignments out of these units.

The evaluation report indicated that the personnel turbulence impact on readiness was significant and generally adverse in the nonrotating battalions, including newly formed units that replaced the deploying units. Several of the nonrotating units dropped from a readiness rating of ready to not ready and the Division dropped from ready to substantially ready principally because of training deficiencies that are directly related to personnel shortages and turbulence. The nonrotating units suffered because they were stripped of their trained deployable personnel and received in their place nontrained, nondeployable personnel. In addition, they had no priority on personnel replacements.

Officials stated in the Division study that if the Brigade 75 program continues on a temporary duty basis to the extent second tours of duty are required, the turbulence may become of such magnitude that the units will find it difficult, if not impossible, to sustain a reasonable readiness posture for many months after returning from a Brigade 75 tour of duty.

REPORTING PERSONNEL AND TRAINING READINESS

Personnel

Personnel readiness status is determined by the (1) operating strength of the unit and (2) skill qualifications of personnel assigned to the unit. A fully combat ready personnel strength readiness rating requires the unit to have onhand at least 95 percent of the personnel authorized in its modified table of organization and equipment (MTOE). For a ready rating in skill qualification, a unit must have at least 86 percent of the MTOE authorized positions filled by personnel qualified to perform the duties required of the position.

The first criteria--operating strength of a unit--is straightforward and objective. The second, however, is not and tends to allow distortions in reported personnel readiness.

Unit commanders are required to report personnel as qualified if they can be used in their primary, secondary, additional, or substitute MOS. The criteria, however, allows commanders to report the personnel as qualified using only the first three of the four characters in the MOS. The fourth character, which shows the grade/skill level, is not used. If certain grade/skill level shortages affect unit readiness, in the commander's opinion, they are to be reported on the remarks cards attached to the report. This permits the commander to address skill shortages without degrading reported skill qualification readiness. The criteria is flexible enough to permit a unit to report any rating--from ready to not ready--based solely on the Commander's opinion. For example, we noted two battalions in the 2nd Armored Division with essentially the same number of authorized personnel, total personnel on hand, and shortages of NCOs. One battalion was reporting fully ready and the other not ready.

Training

The goal of each active Army unit is to be capable of accomplishing the mission for which it was organized or designed. Training in its basic mission and other assigned contingency missions is defined as operational readiness training. Qualification for a ready training status readiness rating means that at division, brigade and battalion level, the units could reach a "fully trained" status in two weeks or less. Company, battery, and smaller units must be capable of achieving that status in 1 week or less.

We found it difficult, if not impossible to verify the validity of reported training readiness because (1) rationale supporting a unit's reported training readiness is a subjective determination of the commander and (2) the criteria permits the commander to assume that all the resources needed--personnel, equipment, firing ranges and ammunition--will be available for training if the division is mobilized.

Since a unit's training readiness condition is determined by the number of weeks it will take to become fully capable of performing its mission or tactics and function, we believe it is only reasonable to assume that the determination of the weeks required to become fully combat ready would include a detailed and documented comparison of individual, crew, and unit training proficiency as measured against the applicable training standard. This process would then identify the training "shortfalls" which collectively would then have to be assessed in terms of the time required to become combat ready.

We found, however, that training shortfalls are not being documented and that a commander does not make a detailed quantitative comparison when he assesses the amount of time (weeks) it will take his unit to attain a fully combat ready condition. Further, considering that training resources--ranges and ammunition--are, in normal circumstances, tightly controlled and scheduled, priorities would have to be set on making those fixed resources available. Therefore, we believe some units' assumptions concerning ready availability of training resources in an intensified post mobilization environment would be invalid. This problem was highlighted in the Brigade 75 evaluation report prepared by the 2nd Armored Division. When the initial units were in an intensified training status preparing for their deployment to Europe, their demands for training resources caused numerous scheduling conflicts that required constant adjustments to meet their requirements.

FUNDING CONSTRAINTS

Each of the deleted included in our review--the deleted deleted --was being confronted with a shortage of operation and maintenance funds in fiscal year 1976. The shortages were due to (1) a higher obligation rate over the previous year, because of overall training efforts, (2) a surcharge being applied to spare parts by inventory control points, and (3) increased costs associated with Brigades 75 and 76.

The total shortfall for the deleted totaled about $15 million based on the rate of expenditure experienced for the first half of 1976 continuing through the second half.

The deleted were taking or planned to take actions which included the following:

--Suspending additional orders for repair parts and supplies, although significant shortages of these items already existed.

--Repairing end items with cannibalized parts.

--Reducing excess inventories of spare parts.

Taking such actions ultimately may affect readiness because training will have to be greatly reduced and equipment will not be repaired when needed.

CONCLUSIONS

A sufficient number of combat ready troops is just as important to the successful execution of POMCUS as sufficient quantities of combat-ready equipment. It is much more difficult, however, to objectively quantify the level or status of troop personnel and training readiness. We believe, however, that the shortages of combat-essential MOSs and the grade structure imbalance--overages of low ranking enlisted personnel and shortages of experienced NCO's--must have a detrimental effect, especially in an emergency. Further, we believe that the present criteria for reporting readiness in the areas of personnel and training are weak, do not accurately reflect readiness status, and can be improved.

RECOMMENDATIONS

We recommend that the Secretary of the Army

--closely monitor the MOS cross training program to insure its success.

--emphasize training of personnel entering Army service to fill projected needs and shortages, thereby, providing a pool of trained personnel to move into the middle and higher NCO ranks; and

--revise the present criteria for reporting the personnel and training readiness of Army troops.

We believe consideration should be given to

--requiring the full, complete MOS to be used in computing whether personnel are qualified for the position they hold;

--establishing criteria to recognize the impact on readiness caused by excessive personnel turnover and turbulence;

--quantifying, at least periodically, the training deficiencies/shortfalls--training resources demands versus resource availability--for major units (divisions).

CHAPTER 11

REFORGER EXERCISES

HAVE NOT FULLY

DEMONSTRATED READINESS

In our prior report we concluded that the annual REFORGER exercises did not demonstrate the ability of U.S. forces in Europe to prepare and issue equipment to deploying forces in a contingency because the OPLAN deployment schedules were not followed and greater maintenance than would be feasible in an emergency was used to make the equipment ready for issue. Also, the maintenance was done well in advance of troop deployment, a situation not likely to occur in a real contingency deployment.

In commenting on that report, DOD agreed that excessive time was used to prepare equipment for field exercises but stated that peacetime requirements for safety and property accountability were contributing factors.

In our current review, we noted that the same situation reported earlier still exists. Four REFORGER exercises were conducted during the past 3 years. For the units involved, these exercises provide valuable training in the logistics aspects of a sizable overseas deployment and in tactics during the field exercises conducted in Germany.

However, the exercises did not provide a relevant basis for assessing CEGE's ability to perform its basic mission--to issue POMCUS stocks in combat-ready condition during a contingency. Instead, these exercises have had a negative impact on CEGE's ability to maintain its equipment in serviceable condition under its cyclic maintenance programs. Resources--personnel, equipment, and repair parts normally dedicated to cyclic maintenance--have been diverted to support these exercises while the cyclic maintenance program fell behind schedule, as discussed in chapter 4.

DEPLOYMENT PLANS

OPLAN 4360, covering the reinforcement of Europe, provides a minimum of deleted warning time for CEGE to begin preparing equipment for units deployed from the United States. These troops, according to the plan, would begin arriving deleted days after mobilization. Further, it is estimated that deleted will be required after arrival for these units to become combat ready. Thus, under ideal conditions, the period needed for all units to become fully ready is estimated to range between deleted According to the OPLAN, CEGE is required during a contingency, to issue equipment to the equivalent of deleted

ISSUE OF EQUIPMENT

For the 1975 REFORGER exercise, CEGE issued 30 unit sets of equipment from POMCUS stocks. This equipment represented deleted percent of the total stocks. CEGE was allowed 45 days to remove the equipment from storage, activate, inspect, and repair it. This effort was complicated by equipment shortages which required CEGE personnel to make over 1,200 transfers between sets--about 460 of which involved transfers between storage sites--to issue complete units. During the 45-day period--from about mid-August to the end of September 1975--almost all CEGE efforts were devoted to preparing the REFORGER equipment for issue.

Since the REFORGER exercise is a test of deploying only a limited number of REFORGER units, it does not adequately test the Army's ability to provide within contingency time frames:

--Sufficient transportation to move all deploying troops from arrival airfields to equipment storage sites. During a contingency, about deleted troops may be deployed over a period of deleted deleted Eight CEGE sites would be required to equip these units--51 of which would be equipped at one storage site. deleted

—Enough ammunition to satisfy each unit's needs. There are theater shortages of ammunition and some ammunition is not stored where deploying units are supposed to pick it up.

--Fuel for about deleted vehicles stored in POMCUS. POMCUS vehicles are stored without fuel so each must be fueled before it leaves the CEGE sites. Most vehicles in the 1975 REFORGER exercise were fueled before the arrival of the REFORGER troops. deleted providing sufficient fuel at each site could present a bottleneck during equipment issue.

In its February 26, 1974, report on CEGE operations, the U.S. Army Audit Agency also concluded that the REFORGER exercise was not designed to test reaction time, nor could results be used to adequately evaluate the CEGE's capabilities to issue all stocks under full mobilization conditions.

CONCLUSION

We believe the REFORGER exercises in the past, have not tested the Army's ability to deploy POMCUS units under contingency conditions. We believe the exercises should be conducted to simulate implementing OPLAN 4360 on a limited basis using only that USAREUR support which could reasonably be expected to be available in an emergency.

RECOMMENDATION

We recommend that future exercises simulate minimum warning time to USAREUR commands and selected REFORGER units with deployment of these units to be accomplished according to scheduled contingency plans.

CHAPTER 12

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

To work effectively, the POMCUS program requires two major ingredients--adequate quantities of (1) combat-ready equipment properly stored in Europe and (2) combat-ready troops who can meet the deployment requirements of war plans. Since our 1973 report, the POMCUS problems and their relative magnitude have changed; however, the overall effects are much the same. Thus, our earlier conclusion--that it appears questionable whether the POMCUS units could be fully effective in their missions--has not changed.

The biggest problem confronting POMCUS is the deleted deleted shortage of combat-essential major end items, deleted For a number of reasons, the production base in the United States is unable to produce these items at a rate sufficient to satisfy all requirements--the three new Army divisions, existing overall inventory shortages, and POMCUS--in a short period.

Conclusions and recommendations to correct specific problems we identified during the course of this followup review are included in each chapter of this report. The following recommendations address the overall POMCUS concept.

RECOMMENDATIONS

We believe that a major decision point has now been reached regarding the role of the POMCUS concept in the future and options that may alleviate some of the existing problems.

Accordingly, we recommend that the Secretary of Defense and the Secretary of the Army reevaluate the POMCUS program to determine its future role in our wartime commitment to Europe. We believe this evaluation should include consideration of the following alternatives:

--Providing the resources required to make the current POMCUS program workable and effective.

--Reducing the scope of the present POMCUS program; i.e., the amount of equipment stored and number of units to deploy, to a level that could be supported as intended.

--Abandoning the POMCUS concept in Europe and developing another program which could be effectively supported and still meet the NATO commitments of the United States.

If it is determined that the present scope of POMCUS is an essential ingredient to our NATO commitment, we recommend the following approaches be considered for making the POMCUS concept more viable:

--Assign POMCUS a higher priority for items coming off the production lines.

--Consider withdrawing some equipment now in the possession of U.S.-based units that would deploy to Europe under the POMCUS concept and transferring it to POMCUS.

--Consider alleviating POMCUS shortages with a combination of the two possibilities discussed above.

The alternatives discussed above are somewhat long-term solutions to alleviating the problem of the viability of the POMCUS concept. In the interim, we believe that, by properly utilizing the existing equipment in POMCUS stocks, there would be greater insurance that at least certain units, deleted deleted could be satisfactorily deployed to Europe and used in the field as required by the current war plan. We therefore recommend that the Secretary of the Army direct USAREUR to

--identify those specific units which can be fully equipped from available assets,

--insure that the equipment for these units is stored in a unit set configuration where practicable, and

--take all other steps necessary to insure that these units could be deployed and equipped as envisioned under the current OPLAN.

COMPARISON OF AUTHORIZED AND ON HAND QUANTITIES OF SELECTED POMCUS EQUIPMENT AS OF MID-1975

	Quantity			Percent
Category	Authorized	On hand	Short	short
	deleted			

COMBAT-ESSENTIAL EQUIPMENT NEEDED TO DEPLOY WITH REFORGER AND 2 + 10 DIVISIONS IN AN EMERGENCY (AS OF 9/30/75)

Equipment description	Quantity short 2 + 10	REFORGER 1st Inf	Total
deleted			

STATUS OF 24 AMMUNITION
ITEMS SELECTED FOR REVIEW
(NOVEMBER 1975)

Item	Quantity		Percentage of requirement	
	Requirement	In-theatre	Specific item On hand	Specific item including substitute
deleted				

a/Includes two items which are used in the same weapon. One item is being reworked into the other configuration.

b/This is considered the "work horse" fuze. This type fuze in also much cheaper than the proximity fuze listed above—$6.17 ea. vs $45.00 ea.

PRINCIPAL OFFICIALS RESPONSIBLE FOR ADMINISTERING ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office From	To
DEPARTMENT OF DEFENSE		
SECRETARY OF DEFENSE:		
Donald Rumsfeld	Nov. 1975	Present
James R. Schlesinger	July 1973	Nov. 1975
William P. Clements (acting)	May 1973	July 1973
Elliot L. Richardson	Jan. 1973	May 1973
Melvin R. Laird	Jan. 1969	Jan. 1973
DEPUTY SECRETARY OF DEFENSE:		
William P. Clements	Jan. 1973	Present
Kenneth Rush	Feb. 1972	Jan. 1973
Vacant	Jan. 1972	Feb. 1972
David Packard	Jan. 1969	Dec. 1971
ASSISTANT SECRETARY OF DEFENSE (INSTALLATIONS AND LOGISTICS):		
Frank A. Shrontz	Feb. 1976	Present
Dr. John J. Bennett (acting)	Apr. 1975	Feb. 1976
Arthur I. Mendolia	June 1973	Mar. 1975
Barry J. Shillito	Feb. 1969	Feb. 1973
COMMANDER IN CHIEF, U.S. EUROPEAN COMMAND:		
Gen. Alexander M. Haig, Jr.	Nov. 1974	Present
Gen. Andrew J. Goodpaster	May 1969	Nov. 1974
CHAIRMAN, JOINT CHIEFS OF STAFF:		
Gen. George S. Brown	July 1974	Present
Adm. Thomas H. Moorer	July 1970	June 1974
DEPARTMENT OF THE ARMY		
SECRETARY OF THE ARMY:		
Martin R. Hoffmann	Aug. 1975	Present
Howard H. Callaway	June 1973	July 1975
Robert F. Froehlke	July 1971	June 1973

	Tenure of office	
	From	To
UNDER SECRETARY OF THE ARMY:		
Norman R. Augustine	May 1975	Present
Herman R. Standt	Oct. 1973	Apr. 1975
Kenneth E. Belieu	Aug. 1971	Jan. 1973
Thaddeus R. Beal	Mar. 1969	July 1971
ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS AND LOGISTICS):		
Harold L. Brownman	Oct. 1974	Present
Edwin Griener	Aug. 1974	Sept. 1974
Edwin Griener (acting)	May 1974	Aug. 1974
Vincent P. Huggard (acting)	Apr. 1973	Apr. 1974
CHIEF OF STAFF:		
Gen. Frederick C. Weyand	Oct. 1974	Present
Gen. Creighton W. Abrams	Oct. 1972	Oct. 1974
Gen. Bruce Palmer, Jr. (acting)	June 1972	Oct. 1972
Gen. William C. Westmoreland	July 1968	June 1972
COMMANDER IN CHIEF, U.S. ARMY, EUROPE:		
Gen. George S. Blanchard	July 1975	Present
Gen. Michael S. Davidson	May 1971	July 1975

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Senator PROXMIRE. Would you discuss some of the principal readiness problems and explain how they are related to mobility plans?

Mr. STOLAROW. Without getting into classified data, I think it is fair to say that the JCS study itself, the one that we have been discussing, points out that in the time frame of this study that many of the units that would be scheduled to be moved would not be in a combat-ready status and, therefore, there is some question as to whether they would be moved or what the resolution of that problem would be.

Senator PROXMIRE. Now, yesterday, we had quite a discussion on the utilization rates, and GAO's challenge to what seemed to be to me rosy and optimistic estimates as to how many hours per day the equipment could be used.

As I recall, the best record achieved at any time under any circumstance was about 7 hours a day. I think it is now about 4 hours. On the C-5, they are below 2 hours and they are not much better than that in other respects. But they set 10 to 12 hours as to what they thought they could do.

They said that these estimates were reasonable, because the commercial airlines have achieved such rates and better.

How do you respond to that motion that the commercial airlines have had utilization rates of 14 hours and more?

Mr. STOLAROW. Certainly the operation of a commercial airliner is quite a bit different than a military cargo aircraft, and certainly the emphasis that goes into turn around times because of the fact that commercial airliners sitting on the ground lose money for the airline makes a big difference. But I think——

Senator PROXMIRE. One of the points raised in the statement by Mr. Staats was the availability of crews as I understand it. You said there just were not enough personnel.

Mr. STOLAROW. Yes. We have looked very carefully at those projected utilization rates and they are possibly based on all of a number of very optimistic assumptions being effective at the same time.

In other words, availability of crews, availability of spare parts, many factors, all of which seem to be optimistic. We do not think it is realistic to believe that all of those could be accomplished during an emergency period.

Senator PROXMIRE. Now, can you explain the relevance of the GAO report of October 21, to the utilization rate issue and also give us details or examples that would help us understand what you are saying in that report?

Mr. STOLAROW. Well, the maintenance base for supporting Air Force aircraft does not seem to be adequate at this point in time to support a very large increase in utilization rates. Certainly, with increased aircraft utilization, your maintenance problems go way up.

Senator PROXMIRE. Can you give us some details on that?

Mr. STOLAROW. Those are classified, sir.

Senator PROXMIRE. Give us a hypothetical example so we can see what you are talking about, not specific numbers, not the specific situation but so that we have some understanding of how the maintenance relates to the ability to keep the planes in operation.

Mr. STOLAROW. Just the very simple fact that parts wear out. They have a life that is based on the number of hours an aircraft is flown. An engine, for example, will——

Senator PROXMIRE. Why should an engine be any different in a military plane when the commercials are operating now at more than the military is projecting. They have the same problem of parts wearing out, same problem of maintenance, same problem of parts being replaced.

Mr. STOLAROW. I am not sure I understand.

Senator PROXMIRE. Well, from the maintenance standpoint, if it is possible for the commercial planes, as you say, to keep operating, why isn't it possible for the military planes in an emergency when we have to settle for half the commercial rate when Europe's life is at stake, why isn't it possible under those circumstances for us to keep our military planes flying on the same basis?

Mr. STOLAROW. As I mentioned earlier, it is a completely different environment that——

Senator PROXMIRE. That is what I want to get at. How is it different?

Mr. STOLAROW. The airlines, to my understanding, do a lot of maintenance overnight.

Senator PROXMIRE. Why can't these fellows work at night in an emergency?

Mr. STOLAROW. Well, they are talking about flying a lot more hours and at different times of the day. The airliners are put into scheduled maintenance on a rotating basis. In an emergency situation, you would be pushing everything you could in a military operation into the air and keeping it operating as best you could.

Senator PROXMIRE. Well, I must say that it is hard for me to understand why they couldn't do this if they had to. For one thing, I think we could use, commandeer, if necessary, if we are desperate enough, the commercial planes themselves for some kind of work.

Mr. STOLAROW. That is true.

Senator PROXMIRE. I appreciate it is very limited, but, nevertheless, it would be important, especially the personnel carrying aspect of it.

Mr. STOLAROW. That is the basis for the civil reserve air fleet program.

Senator PROXMIRE. You could keep them going on the basis of their own experience, their own record, at least 10 or 12 hours.

Mr. STOLAROW. Yes.

Senator PROXMIRE. As to the military planes, you say you are very skeptical about the maintenance problems there?

Mr. STOLAROW. That is right. And another problem is the availability of spare parts. At the present time, the stockage of spare parts to support increased utilization of military aircraft is not available.

Senator PROXMIRE. Why is that? Why aren't those parts available?

Mr. STOLAROW. That is primarily budget constraints that are in effect, they are stocking for peacetime utilization, and as we point out in our statement——

Senator PROXMIRE. We are talking about a multibillion-dollar program, $10 to $12 billion over a period of years, it seems to me they ought to be able to stock the parts.

Mr. STOLAROW. They would have to, yes, that is——

Senator PROXMIRE. That is one of the things they would have to do.

Mr. STOLAROW. They have not done it yet.

Senator PROXMIRE. Yesterday, the witnesses conceded that they had not considered the alternative of pre-positioning of ships.

Is this another possible alternative to the present mix of proposals?

Mr. STOLAROW. That is one alternative that has been discussed extensively over the years.

Senator PROXMIRE. But not in the JCS report?

Mr. STOLAROW. No, sir.

Senator PROXMIRE. They admitted that. They missed it.

There is one critical fact in your 1975 report on the airlift to Israel which has not received much attention. That is that Israel used only 8 of its commercial aircraft to move 5,500 tons from the United States while we needed 228 aircraft to move 22,500 tons.

They had been moving 5,500 or about 700 tons per commercial aircraft and we have 228 which figures out to be about one-seventh of that. We moved 22,500, one-seventh on a per aircraft basis.

How could Israel move so much with so few? Are they that much more efficient than we are? How do you explain that?

Mr. STOLAROW. I am not familiar with those statistics but I don't know how many missions or how many trips each aircraft made. It is very possible or likely that each one of the Israeli aircraft may have made more trips than the ones we used.

Senator PROXMIRE. This was in a period, as you know, of relatively limited time.

Now, this is from the GAO report, page 8, dated April 16, 1975, "Airlift Operations of Military Aircraft During the 1973 Mideast War."

I will read a portion of that:

> The airlift began on October 13, was completed on November 14, except for two flights; 51 C–5's and 177 C–141's delivered 22,000 tons of material to Israel. Only 39 percent of the material was delivered before the ceasefire agreement on October 24.
>
> Also, Israel used eight of its commercial B-707 and B-747 aircraft, only two of which were cargo configured, to move 5,500 tons from onloading points in the United States.

That is a remarkable disparity. They were at least seven or eight times more efficient than we were.

Mr. STOLAROW. As I say, I am not completely familiar with all of those figures but the only rationale——

Senator PROXMIRE. Would you look into that and let us know for the record?

Mr. STOLAROW. Yes, sir, we will look into that.

[The following information was subsequently supplied for the record:]

The GAO report (LCD 75–204, dated April 16, 1975) showed that 51 C–5's and 177 C–141's delivered 22,497 tons of material to Israel; whereas, the Israelis used only 8 aircraft to deliver 5,500 tons. From these facts alone, it would seem that the Israeli aircraft had carried much more cargo per aircraft than MAC aircraft.

Actually, the average tonnage carried per flight was roughly the same for both MAC and Israeli aircraft as shown by the following table:

	Total tonnage	Total flights	Average tonnage per flight
Israeli	5,500	140	39
MAC	22,497	569	39

The differences in the number of aircraft used—8 by the Israelis and 228 by MAC—was the result of the Israelis dedicating 8 specific aircraft to the airlift; whereas, MAC used aircraft as they became available from other missions.

Even though the MAC and Israeli aircraft achieved the same average tonnage per flight, this is no basis for comparing the relative efficiency of the MAC and Israeli airlift. In assessing the relative efficiency it would be necessary to consider such things as the types of aircraft available and used; the types and mix of cargo lifted by the aircraft; the amounts of fuel used; the cost and time of loading and unloading, the operating constraints, such as safety restrictions, flying hours per crew, and route restrictions; and indeed the relative personal interests of the Americans and Israelis in the outcome of the operations they were supporting.

In our opinion, because of the differences in the above factors between the MAC and Israelis operations, there is no valid basis for comparing the relative efficiency in this particular instance.

Senator PROXMIRE. Now, that seems to me to raise two interesting situations here with respect to the European area. It demonstrates, first, it is feasible to use commercial carriers in a military situation.

It is feasible, it worked and it worked to a very great extent.

Second, it is reasonable to expect an ally to take part in an airlift that is to its benefit. Do you agree with that?

Mr. STOLAROW. Yes, sir.

Senator PROXMIRE. That is why I am concerned why we are not using the commercial aircraft available to the European countries as part of the mix, part of the solution to the airlift.

After all, their countries lives would be at stake and they could commandeer every aircraft they could and help out.

Mr. STOLAROW. We happen to know that every one of the El Al Israel commercial airliner planes has been modified in order to be able to be converted very quickly into a cargo carrying aircraft.

This is not true of most aircraft fleets around the world.

Senator PROXMIRE. Have you looked into the cost of that kind of a modification and its practicality for us to do that to some extent?

Mr. STOLAROW. Yes, sir; as Mr. Staats mentioned in his statement, we have looked at the civil reserve air fleet program and he previously commented that it appears to be a relatively cost-effective program.

Senator PROXMIRE. To what extent is the JCS report including that?

Mr. STOLAROW. They do include capability for that.

Senator PROXMIRE. They include it; do they include it sufficiently so that it is a viable component?

Mr. STAATS. This gets back to our central point of, again, what is the tradeoff among the various options they have.

Senator PROXMIRE. They have not given that enough consideration?

Mr. STAATS. I would say that that is our position.

Senator PROXMIRE. Yesterday I read into the record some figures that show the cost-effectiveness of using commercial aircraft. Yet, Congress has been slow to approve the current proposals and I understand that some of the airlines are also reluctant.

Will you discuss the issues causing concern in the committees and, also, what seems to be bothering the airlines?

Mr. STOLAROW. Well, one thing that appears to be bothering the committees is the method of paying the airline for the increased operating expenses, modification of the aircraft will reduce their profitability.

It adds to the weight and increases fuel consumption. So the method of reimbursing the airlines for this has been a matter of concern to the committees.

The proposal that was made at one point in time, and that has been rejected by the committees, is a continuing payment over the life of the aircraft and I suspect the committees are looking for some alternatives.

Senator PROXMIRE. Offhand, it seems to me that whatever modification is necessary as a part of our military defense, then, the airlines would be right in asking for compensation and it seems to me the committees would go along with it if it is an economic and feasible action.

Mr. STOLAROW. I feel that it is fair, if you are doing to do that——

Senator PROXMIRE. Are the committees troubled with the cost? What is the problem?

Mr. STOLAROW. It is just the mechanics of how this would work. To me it appears the mechanics of it—the Armed Services Committees appear to believe that the civil reserve air fleet program is a good program and I would suspect that within the next year or two that they will find a method of making those payments that is acceptable to the committees.

Mr. STAATS. The principle that you are talking about here has been adopted in the maritime field, as you know, for ships that are modified in order to be able to be used.

Senator PROXMIRE. The maritime field, we really have leverage. The poor old taxpayer has to pay practically the whole cost of the ship.

Mr. STOLAROW. But I mean the principle of it, that it's a defense cost, has been accepted for many years in the maritime field. The principle would be the same as you suggest here in the CRAF.

Senator PROXMIRE. Now, will you undertake a review of the CRAF program with special emphasis on the current proposals and make a report to go with recommendations for improvement of DOD's proposals. We would welcome that.

Mr. STOLAROW. Yes, sir.

Senator PROXMIRE. You question the C–141 stretch program. As I understand the way the staff explains it to mean you take a C–141 and you cut it at a certain point and spread it out the way you do a dining room table, and you insert a section to make it bigger. Apparently it works.

But you question the C–141 stretch program, although Defense officials say it is cost-effective because it will increase the oversize cargo capability by 30 percent without increasing operating costs.

What is your response to that argument?

Mr. STOLAROW. Thirty percent for such aircraft sounds like a lot but if you put it into terms of total tonnage, that would be airlifted during the critical period that we are talking about, as we said in our statement, it amounts to only 21,000 tons.

We question whether 21,000-ton capability is worthwhile in terms of a $700 million cost.

The 21,000 tons is a 30-percent increase over what the C–141 could carry in the critical period of time. But it is still a relatively small——

Senator PROXMIRE. There may be cheaper and better ways of providing that additional capacity?

Mr. STOLAROW. That is correct, sir.

Senator PROXMIRE. You suggest that the C–5 rewinging proposal is not the most cost-effective solution to the problem of outsized cargo. Would you discuss other possible solutions? What other alternatives are better?

Mr. STOLAROW. In the previous report we made to you some time ago, Mr. Chairman, we raised the possibility of buying new cargo aircraft instead and using the C–5 only in an emergency for the very few items that cannot be carried in other aircraft.

The answer that came back from the Department of Defense was that they had looked at the options and had decided that the C–5 rewinging was the most cost-effective alternative.

We still have some reservations about that, as you know.

Senator PROXMIRE. What are your reservations?

Mr. STOLAROW. Well, potentially, we could buy, for example, a 747 that is a proven cargo airliner being used by many cargo airlines around the world, and provide, together with having the C–5's in reserve, in total a greater lift capability than would be given by just rewinging of the C–5A's for the same amount of money.

Senator PROXMIRE. Can you give us the data on that? We would like to have it so that we will have a basis for comparison. We discussed that with the witnesses yesterday and that information will permit us to compare it.

This is the data that would establish the point that in your view the purchasing of the large commercial planes and modifying them is a cheaper alternative than rewinging the C-5A's.

Mr. STAATS. We outlined this proposal in the report we made about a year ago.

Senator PROXMIRE. We would like the data that would back it up.

[The following information was subsequently supplied for the record:]

The $1.3 billion planned to be spent on the C–5A wing modification could be used to purchase about 20 Boeing 747 class aircraft. This would provide an additional capability of about 65,000 tons during the critical period.

Senator PROXMIRE. The Air Force wants to build more capability along these lines, the AMST, advanced medium short takeoff and landing transport to haul tanks around the battlefield; that is, move them around Europe.

Would you discuss that proposal as to feasibility and cost-effectiveness? Incidentally, yesterday, for your information, I pointed out that it might be more logical to use the railroads and highways and the trucking capacity and railroad capacity far more efficiently.

What is your response?

Mr. STOLAROW. We have been looking into the AMST program. We have recently just informally heard that the Army says it does not have a requirement for this type of aircraft.

Now, in our work on major weapons systems, we will be getting much more thoroughly into the need and the requirement for this particular aircraft.

Senator PROXMIRE. Let me see if I understand that.

The JCS is recommending it, the Air Force seems to be pushing it, the argument you make is that there is no requirement for it—I am not sure I am aware of where that came from.

Mr. STOLAROW. As I said, informally we have heard that the Army has done a study and we have not seen it yet, which indicates that they do not have a requirement for this particular type of aircraft.

Senator PROXMIRE. The Army says that?

Mr. STOLAROW. They would be the users of the AMST; the Air Force would fly the plane but it is to move Army cargo.

Senator PROXMIRE. Would you give us a copy of that?

Mr. STOLAROW. As soon as we can find it we will get it to you, yes, sir.

[The following information was subsequently supplied for the record:]

The unclassified Executive Summary of this Army study follows. The study concluded that "The tank carrier AMST offers the Army the most flexible and efficient tactical airlift system." Army and Air Force officials that have briefed GAO on the AMST study appear convinced of the requirement for the aircraft.

UNCLASSIFIED

AUGUST 1977 ACN 27542 AD

ADVANCED MEDIUM STOL TRANSPORT (AMST) STUDY

CAC

EXECUTIVE SUMMARY

UNITED STATES ARMY COMBINED ARMS CENTER

COMBINED ARMS
COMBAT DEVELOPMENTS ACTIVITY
FORT LEAVENWORTH, KANSAS 66027

UNCLASSIFIED

7-2615

EXECUTIVE SUMMARY

1. PURPOSE. The purpose of the TRADOC study is to determine the tactical intratheater airlift requirements for the Army during the mid-1980 period. Candidates considered were the C-130H, C-130IV (Stretch, Short Takeoff and Landing (STOL)), Advanced Medium STOL Transport (AMST) (Required Operational Capability (ROC)), AMST (tank-carrier options 1, 2, and 3) and the C-5.

2. CONCLUSION. The study's primary conclusion is that:

> THE TANK CARRIER AMST OFFERS THE ARMY THE MOST FLEXIBLE AND EFFICIENT TACTICAL AIRLIFT SYSTEM.

3. INSIGHTS. This conclusion was derived after developing these insights:

- C-130 PERFORMED SATISFACTORILY IN EVENTS REQUIRING MOVEMENT OF BULK SUPPLIES AND LIGHT UNITS; HOWEVER, THE C-130 LACKED SUFFICIENT BOX SIZE TO TRANSPORT THE ARMY'S PRIMARY COMBAT VEHICLES, I.E. MAIN BATTLE TANK (MBT), MECHANIZED INFANTRY COMBAT VEHICLE, SELF-PROPELLED ARTILLERY, DIVISION AIR DEFENSE GUN (DIVAD GUN), AND NUMEROUS COMBAT SERVICE SUPPORT (CSS) VEHICLES.

- AMST PERFORMED SATISFACTORILY IN THE MOVEMENT OF SUPPLIES AND UNITS IN ALL EVENTS WITH THE EXCEPTION

OF THE MOVEMENT OF THE DIVAD GUN* AND CERTAIN CSS VEHICLES.

- C-5 PERFORMED SATISFACTORILY IN MOVEMENT OF SUPPLIES AND MOST UNIT MOVES BUT ITS LACK OF AIRDROP CAPABILITY REQUIRED DEVIATION OF CRITERIA IN ABN EVENTS. THE C-5 IS ALSO LIMITED BY ITS TRADITIONALLY STRATEGIC ROLE, SMALL FLEET SIZE, AND LACK OF STOL CAPABILITY.

*The DIVAD Gun is currently in the early developmental stages and its final configuration may allow it to be loaded in the AMST.

4. METHODOLOGY.

a. After reviewing numerous approved battle models, scenarios, and operation/contingency plans, seven events were selected which represent a cross-section of missions, theaters, and type units. Each of the tactical airlift candidates was then wargamed against the seven events.

b. The results of the airlift model wargame simulation were then grouped, weighted, and prioritized to determine a total requirement.

5. STUDY EXCURSIONS.

a. Several excursions were conducted during the study. The two excursions having the most impact were:

(1) The requirement for tactical airlift to carry the MBT.

(2) The requirement for STOL.

b. TANK CARRIER FINDING: IT IS ESSENTIAL THAT TACTICAL AIRLIFT HAVE THE CAPABILITY TO CARRY THE MBT.

c. STOL FINDINGS: STOL IS A HIGHLY DESIRABLE CAPABILITY DURING THE COMBAT PHASE OF OPERATIONS IN DEVELOPED COUNTRIES AND IN ALL PHASES, TO INCLUDE THE BUILD-UP, IN UNDER-DEVELOPED COUNTRIES.

6. DATA.

a. Computer model simulation of the six unit move events resulted in the following overall capability:*

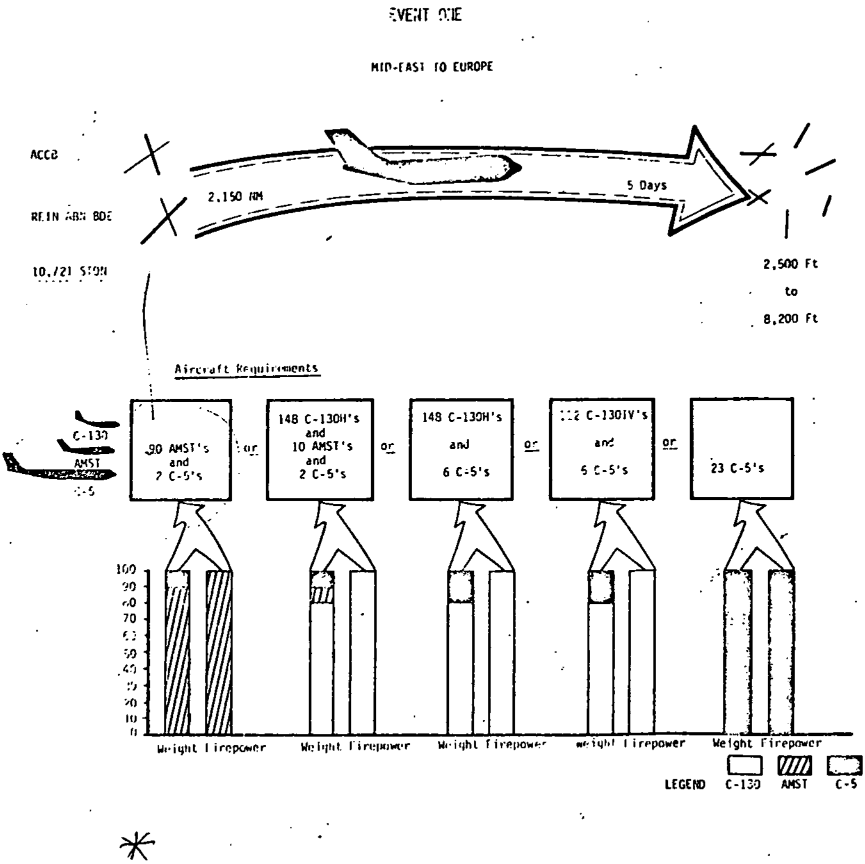
	Weight Delivered	Firepower Delivered
C-130	54%	52%
AMST	94%	98%**
C-5	96%***	92%***

*AMST tank carrier (opt 1) is depicted in the executive summary. Other AMST data is in Chapter 5.

**The 2% firepower not carried is the DIVAD Gun.

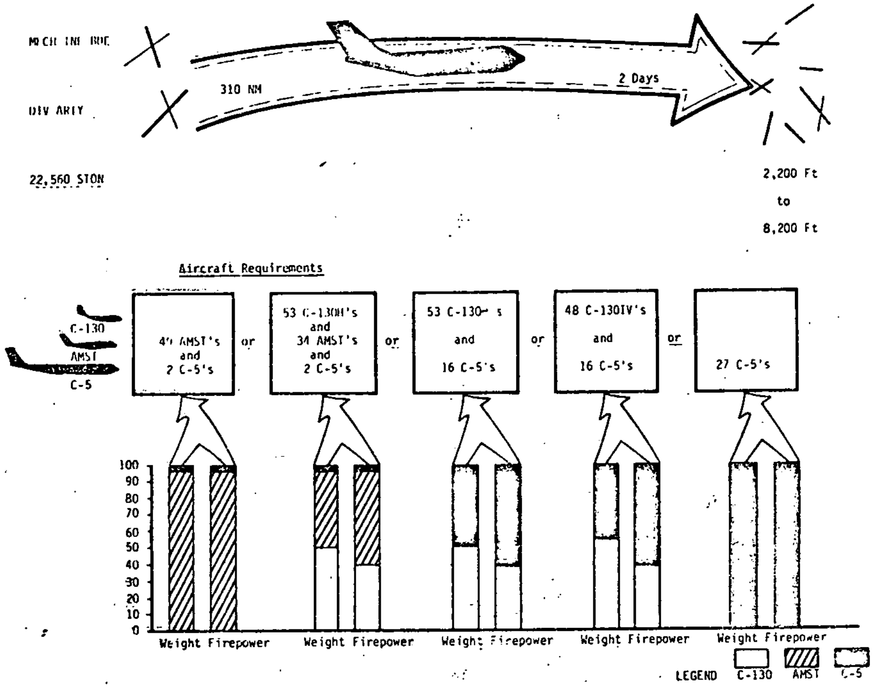
***The 4% weight and 8% firepower not delivered is the "airdrop" portion. When the scenarios were modified to "airland", both categories rose to 100%.

b. Model simulations loading and transporting results of the seven events are depicted in the following tables:


EVENT ONE
MID-EAST TO EUROPE
ACCB
REIN ABN BDE
10,721 STON
2,150 NM
5 Days
2,500 Ft
to
8,200 Ft
Aircraft Requirements
C-130
AMST
C-5
90 AMST's and 2 C-5's
or
148 C-130H's and 10 AMST's and 2 C-5's
or
148 C-130H's and 6 C-5's
or
112 C-130IV's and 5 C-5's
or
23 C-5's
100
90
80
70
50
10
Weight Firepower
LEGEND
C-130
AMST
C-5

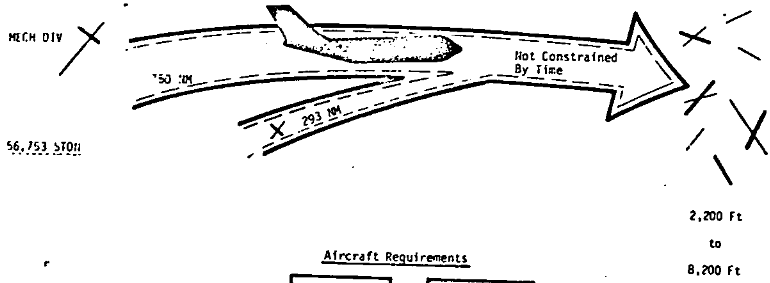
EVENT TWO

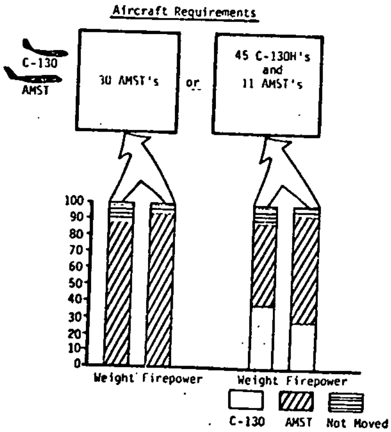
EUROPE



EVENT THREE

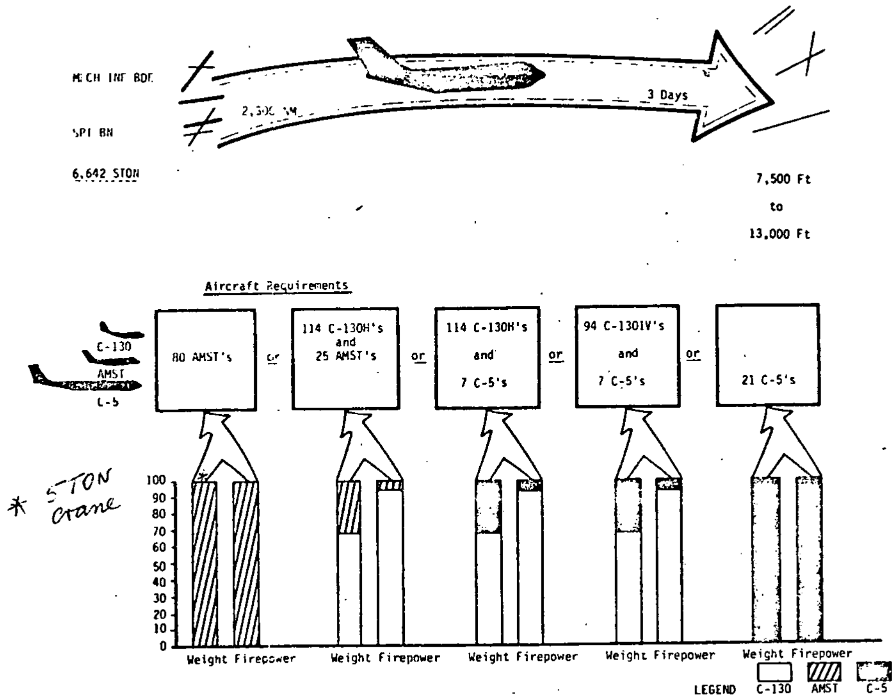
EUROPE





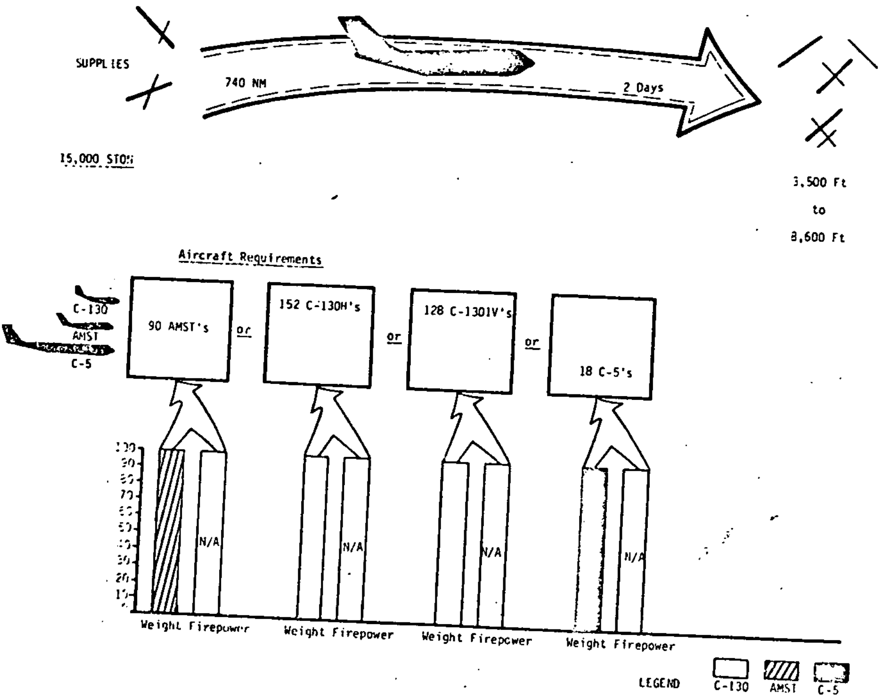
EVENT FOUR

EUROPE TO IRAN



EVENT FIVE

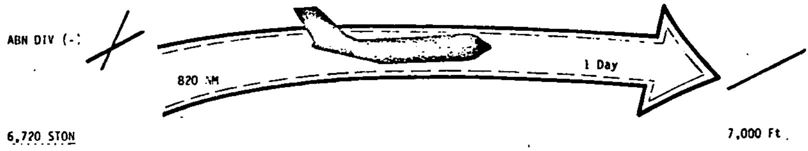
KOREA

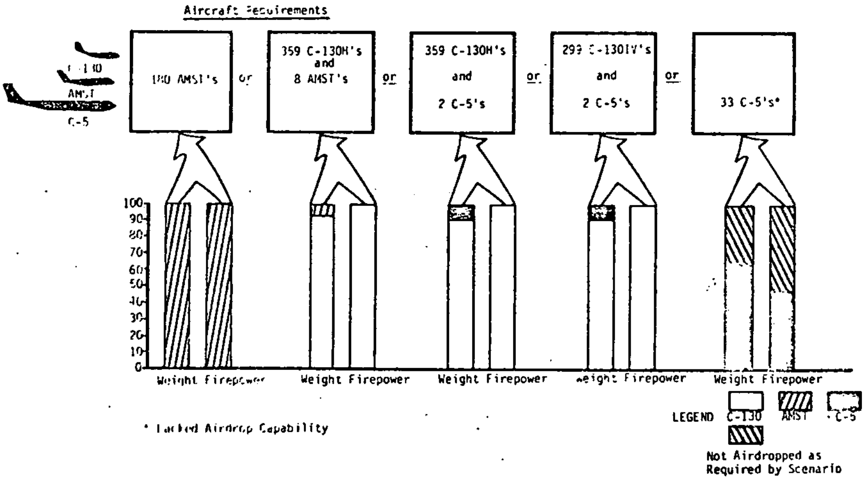


8

EVENT SIX

CARIBBEAN



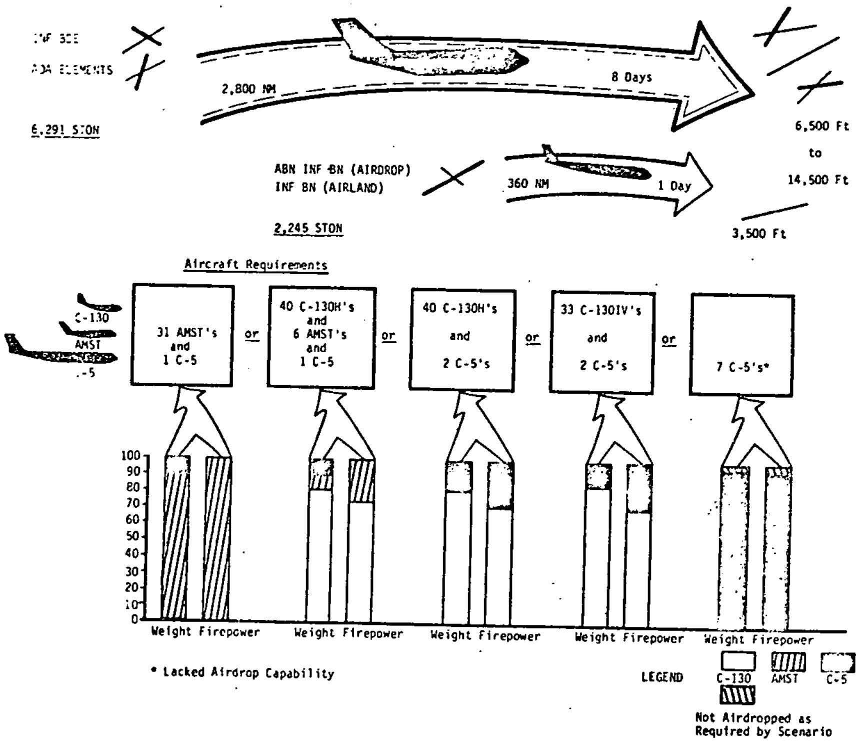


* Lacked Airdrop Capability

EVENT SEVEN

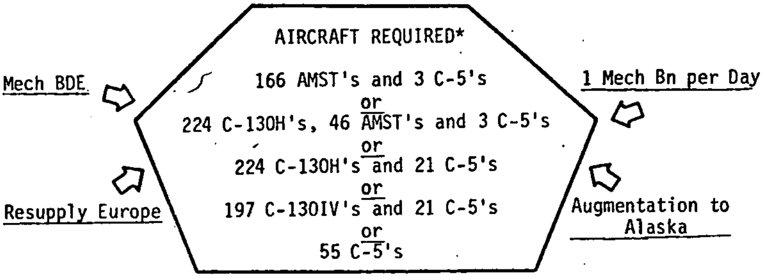
CONUS TO ALASKA

ALASKA



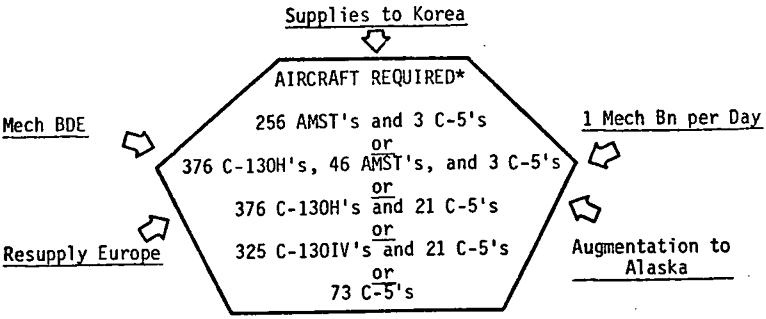
7. ARMY TACTICAL AIRLIFT REQUIREMENT. The result of the study's evaluation of the Army Worldwide Surge requirement is --

1 DAY ARMY SURGE TACTICAL AIRLIFT REQUIREMENT



The above requirement takes the calculated risk that war in Korea will not occur in the same time frame as the other events. If this does occur the Surge condition would be --

1 DAY ARMY SURGE TACTICAL AIRLIFT REQUIREMENT
(with Korea)

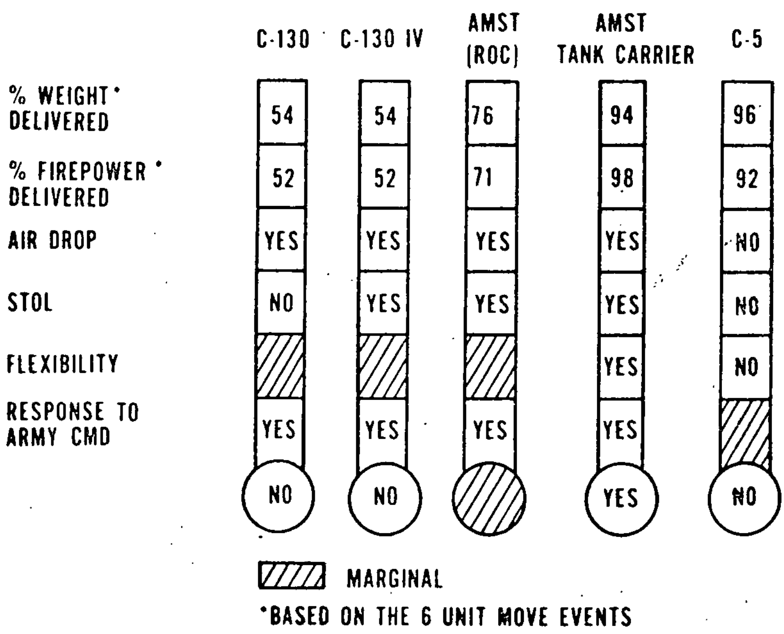


*C-130IV, AMST, and C-5 requirement represent new aircraft procurement (i.e., current C-5 fleet is fully committed to strategic lift). C-130H requirements represent modification of current fleet plus procurement of additional aircraft.

8. COSTS. The development and validation of costs pertaining to the procurement and life-cycle maintenance of the alternative candidates were not an objective of this study. However, candidate aircraft costs as developed by the Air Force are portrayed in appendix K. These costs as they pertain to the various aircraft requirements for each of the seven events are shown in chapter 9.

9. SUMMARY.

a. **EVALUATION SUMMARY**



b. The Army requires tactical airlift for unit moves and logistics in order to capitalize on mobility and concentration of forces in order to fight, outnumbered, and win. The tactical airlift aircraft that performs most efficiently in these roles is the tank-carrying AMST (opt 1).

Senator PROXMIRE. Is it correct that neither the AMST or AT–CA, advanced tanker-cargo aircraft, were considered as alternatives in the JCS study, although both have strategic mobility capabilities?

Mr. STOLAROW. That is correct.

Senator PROXMIRE. I want to thank you very, very much, Mr. Staats, Mr. Stolarow, and Mr. Chemery for a very, very helpful analysis and most responsive answers to my questions.

I will just close by saying that last year Congress asked the Pentagon to do its homework and to demonstrate the justification for these strategic mobility proposals.

The upshot of this hearing is that the Pentagon has not done its homework.

The JCS study issued in February according to GAO, by the Pentagon's own admission, is incomplete. The Comptroller General, after reviewing the JCS study has issued a clear unmistakable warning, to wit; the study should not be relied upon by Congress as a justification for major airlift programs.

In my view, Congress ought to heed that warning and suspend funding for some of these programs or issue labels to be pasted on the Pentagon's new program, "Warning: This product may be dangerous to the Nation's military and economic health."

I intend to do everything I can to bring that message to my colleagues and the public.

I want to thank you very much for your appearance here this morning.

Mr. STAATS. Thank you very much, Mr. Chairman, for having us here this morning.

Senator PROXMIRE. The subcommittee stands adjourned.

[Whereupon, at 11:12 a.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

ECONOMICS OF DEFENSE PROCUREMENT: THE C-5A AND STRATEGIC MOBILITY

MONDAY, AUGUST 25, 1980

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON PRIORITIES AND
ECONOMY IN GOVERNMENT OF THE
JOINT ECONOMIC COMMITTEE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10 a.m., in room 5302, Dirksen Senate Office Building, Hon. William Proxmire (chairman of the subcommittee) presiding.

Present: Senator Proxmire and Representative Wylie.

Also present: Richard F. Kaufman, assistant director-general counsel.

OPENING STATEMENT OF SENATOR PROXMIRE, CHAIRMAN

Senator PROXMIRE. The subcommittee will come to order.

The C-5A cargo aircraft program has become the most publicized example of Government waste in modern history.

This subcommittee first revealed the cost overrun problems on the C-5A in 1968. Followup hearings in 1969 and throughout the decade of the 1970's examined the management of the program by both the Air Force and Lockheed, and inquired into the problems of structural defects and readiness.

The taxpayer has already paid approximately $2 billion in cost overruns for the C-5A above and beyond inflation—above and beyond inflation, $2 billion.

The total cost for the 81 aircraft purchased by the Air Force was about $4.5 billion. In return for that expense, the taxpayer has received an aircraft that is so defective it cannot adequately perform its intended mission. Its utilization rate and load capacity has been seriously impaired.

The taxpayer is now being asked to spend an additional $1.4 billion, according to Air Force estimates, to repair the defective wings of the C-5A.

New evidence, brought to light in recent weeks, raises serious questions about the origins and the extent of the wing defect. This information raises the possibility that the defects in the wings were known by both the Air Force and Lockheed at the time the decision was made to award the contract to Lockheed.

Further, there is evidence that, although the wings are unquestionably defective, the Air Force and Lockheed may be exaggerating the seriousness of the problem in order to justify the plan to replace rather than to simply repair the wings. The cost difference, of course, is very, very great.

The purpose of this hearing is to complete what has become one of the most significant case studies on record of the management of high cost Government contracts and the allocation of resources for support and maintenance of major weapon systems.

I should add that I have already asked the Office of Technology Assessment to do an independent study of the wing problem and the options for correcting it. My request is now under active consideration by OTA and I am hopeful of receiving a positive response.

The subcommittee has invited testimony from all sides. We will hear this morning from Paul C. Paris, director of the Center for Fracture Mechanics of Washington University, a leading specialist in the areas of metal fatigue and stress. Mr. Paris will be followed by David Keating of the National Taxpayers Union, and our final witness will be Mr. R. B. Ormsby, Jr., president of the Lockheed-Georgia Co.

The Secretary of the Air Force is scheduled to appear on September 16, of this year.

Mr. Paris, will you come forward, sir, and before you're seated will you raise your right hand? Do you swear the testimony you are about to give will be the truth, the whole truth, and nothing but the truth?

Mr. Paris. I so swear.

Senator Proxmire. All right. Be seated. You have a prepared statement, Mr. Paris. If you would like to abbreviate that statement in any way we would appreciate it. It's a rather long statement and we have other witnesses here. We have it available. You were very good to make it available to us. Go right ahead.

STATEMENT OF PAUL C. PARIS, DIRECTOR, CENTER FOR FRACTURE MECHANICS, UNIVERSITY OF WASHINGTON, SEATTLE, WASH.

Mr. Paris. I have a prepared statement, but I will not follow it during my presentation other than it will be background material. Other background material includes the Rand report and especially volume 3, their document No. 1941 dated March 1977, the U.S. Air Force Scientific Advisory Report on the C–5A structural information and enhancement program of November 1979, and attachments to my prepared statement, and also my letter to you about 1 month ago.

Senator Proxmire. Very good.

Mr. Paris. Now I'd like to begin with a summary of what I'm recommending to you and that is, first of all, that a genuinely independent study of the C–5A wing problem be done and that, of course, would be done if OTA proceeds with your recommendation.

Indeed, the second recommendation is that the new study group should have the authority to get the data. Considerable difficulty was incurred at the Rand Corp. in trying to do the Rand study in getting source data and I have had my own difficulties as a member of the structural information enhancement program steering group.

I'd like to point out that the study should begin with the hard evidence at hand. It is very difficult to go through all of the data which is available on the C–5A and sort out that which you can expect to use without error and that which might have some bias in it. The hard data at hand is really the evidence from the teardown of the wing on the C–5A airplane. From that information you can imply the status of the fleet and that needs to be done quickly.

The study should go on to address realistic options to the 30,000-hour wing replacement as indicated in the Rand report and the study should be an in-depth technical study. It should go back into the safe life. It should compare that with other aircraft and criteria for other aircraft and look at options for rewinging the airplane and it should look at historical perspectives to the problem.

Let me now illustrate why I'm making a plea for a genuinely independent study. In the development of the well-known 8,000 wing life number, the Division Advisory Group of the Aeronautical Systems Division put together a safety limit scenario which produced that number and it's apparent that Lockheed or other Air Force people misled Mr. Tiffany about some of the data.

For example, Mr. Tiffany in his presentations referred to mean crack growth data as being used in the calculation of the 8,000-hour number. Indeed, it was not mean crack growth data but a data factor of 1.3 on the average slower than the calculation curve used which means that the 8,000-hour number approximately times 1.3 is really 11,000 hours. That was known in 1976.

Mr. Tiffany had been told that the 1–G stress levels in the C–5A were higher than those in the KC–135 and so on and the Rand study showed that was not true. Indeed, in presentations made by Air Force people in late 1977, after the Rand report was published, people were still saying the 1–G stress levels in the C–5A were higher than other aircraft, which they weren't; and indeed, the SAB report in November of 1979 refers to high 1–G stress levels in the C–5A.

Indeed, in a meeting at the Rand Corp. in late 1976 with cognizant Air Force and Lockheed people present, when confronted with the fact that this was not mean crack growth data and that there were also additional effects of a system called ALDCS which were not included in the 8,000-hour number, a conclusion of the meeting was that everybody thought that the airplane as it currently was constituted with perhaps some minor changes could make it to 12,000 or 14,000 hours and thereby open other options.

In my letter to you I spoke of the independence of the SIEP steering group from Air Force and Lockheed influence, and all I can say is what was in that letter, and I must admit that I don't believe any of the studies on the C–5 were ever truly independent.

Finally, I would like to point to the SAB report and bring up an issue which they seem to feel is important; that is, the fail safety of the C–5A airplane. Now they say on page 4, "With regard to the C–5A wing structure, it was originally designed to be fail-safe for single member failure, for example, single wing panel spar, cap spar, web, etc." Indeed, they go in their report and mention single panel fail safety on pages 7, 8, 9, 10, and 11 they say, "As previously indicated, the committee feels that maintenance of design fail safety for single panel failures is a key factor in achieving continued safe structural performance until wing-mod."

Now in April of 1979 at a meeting of the steering group of the structural information enhancement program, I was admonished for asking questions about the fail safety. In particular, it was task 7 of that program that was being presented and my notes say that the presentation was being made by Mr. Fred Conley who is in this room, I believe. When I questioned the dual panel failure strength in the rear beam area if panels one and two failed which gave a number of 13,000 k.s.i.—that is an indication of the relative load number—and said that seemed indicative of a panel failure strength when a single panel failed of someplace around 20, Mr. Conley, I believe, gave me the figure of 21.

Would you verify the figure? Is that correct?

Mr. CONLEY. Would you ask the question again?

Mr. PARIS. For single panel failure in the rear beam area, I believe you gave me a single panel failure strength of 21.

Senator PROXMIRE. Would you rise, sir, and state your name and position so we can have it for the record?

Mr. CONLEY. I'm Fred Conley from Lockheed.

Senator PROXMIRE. Thank you. Go right ahead.

Mr. CONLEY. I would expect it to be somewhere in that neighborhood, yes.

Senator PROXMIRE. Thank you.

Mr. PARIS. Now, in order to be fail-safe against single panel failure under the current flying conditions, that is peacetime flying conditions, that number would have to be in the order of 27,000 k.s.i. That is a load level of 27 instead of being able to sustain a load level of 21.

So, accordingly, in that area of the airplane it is not fail-safe. Indeed, if the NATO mission is considered, then in order to be single panel fail-safe it must be able to sustain a stress of 34,000 k.s.i. and indeed, as indicated by Mr. Conley, the number is in the area of 21. So the airplane is not single panel fail-safe and, again, I read from the SAB report, that they regard it as a "key factor in achieving continued safe structural performance until wing-mod." Apparently nobody told the SAB those numbers.

Now somebody must have read that SAB report who knew the numbers, and didn't correct them. So I submit that a genuinely independent study of the numbers should be done, all of the numbers, and that concludes my statement, sir.

[The prepared statement of Mr. Paris, together with attachments, follows:]

PREPARED STATEMENT OF PAUL C. PARIS

THE C5A WING LIFE AND REMEDIAL OPTIONS

In the spring of 1975 I was called by the Rand Corporation to assist them in an evaluation of the (then current) "8000 hour safety limit" for the C5A wing. The Rand Corporation was doing a study of airlift capability in which the wing life of the C5A was key to several options. The 8,000-hour safety limit had been determined by the Division Advisory Group (DAG) of the Aeronautical Systems Divisions of the U.S. Air Force under Mr. Charles F. Tiffany's leadership in January 1975. Mr. Tiffany and his group had developed a rational "safety-limit-scenario" for cracking of the most critical location in the C5A wing, based on Lockheed data. Mr. Tiffany gave many briefings on this scenario throughout the Air Force (including Rand) and the "8,000-hour" result was adopted as the C5A safety limit from 1975 to 1979.

At Rand, during development of their report,[1] it was found that many airlift options were opened by even modest increases in the 8,000-hour C5A wing life. Hence, an intensive effort was made by a team led by Dr. Jean Gebman of Rand to assess the uncertainties in the 8,000-hour life number and other factors limiting the C5A wing life. (No number, such as the 8,000 hours, which is the result of a highly complex engineering calculation, is exact; uncertainties exist and a balance is sought.) The Rand team poured through virtually thousands of pages of Lockheed documents (and some others) to verify the data, assumptions and analysis of the 8,000-hour safety limit. It was found that if one accepts the data and detailed analysis methods on which the development of the safety limit is based, then Mr. Tiffany's DAG group had provided a very reasonable result. However, it was found that misleading data and obscure detailed analysis methods were given to the group. For example, in two clear instances Lockheed (or other Air Force people) "misrepresented" the data to Mr. Tiffany. They are:

(1) The fatigue crack growth rates used directly in the safety limit life calculation were not mean data, but a curve of 1.3 faster growth rates was used. (See Rand report, vol. III, p. D–24.)

(2) The 1g stress levels in the C5A wing were not as great as those in the KC135, nor where they much greater than the C141. (See Rand report, vol. III, p. E–42.).

Moreover, it later became clear that other factors, neglected as insignificant in the 8,000-hour safety limit calculation, such as the effects of the "Active Lift Distribution Control System" (ALDCS)[2] did indeed extend the wing life significantly. (For the critical point in the wing where the 8,000-hour calculation was made the late life improvement factor is 2.69, significantly more than the 1.25 as given to Mr. Tiffany's DAG group.) Hence, by mid-1977, if the 8,000-hour number had been recomputed under its agreed ground rules, but correcting the data which was "misrepresented," the result would have been in excess of 11,000 hours for the safety limit for the C5A wing. In acknowledgement of this fact and others, at a meeting at the Rand Corporation with many cognizant representatives of both Lockheed and the Air Force present in late 1976, it was concluded that "The C5A wing might last to 12,000 to 14,0000 hours without replacement." The Rand report clearly illustrates that such a life improvement could enable the C5A to get to the end of the century without significant modifications or would open the options to less expensive modifications than the currently suggested H-mod.[3]

Therefore, for reasons which seem self-evident, the Air Force in mid-1977 decided to begin a "Structural Information Enhancement Program" (S.I.E.P.) (See Rand report, Vol. III, p. F–1.) Mr. Tiffany became Chairman of the S.I.E.P. Steering Group which I was invited to join (along with becoming an Air Force consultant to Mr. Tiffany). By this time, Rand had completed its study so accepting this assignment caused no conflict. I was the only member of the Steering Group who was not a regular Air Force or Lockheed employee. In August 1977 at the first meeting of the Steering Group, the Lockheed-Georgia people outlined the tasks and in each case the tacit assumption was made that since the H-mod of the wing was going to be done other less expensive options were not to be considered. As a member of the Steering Group I responded to this tactic by preparing a memo and giving it to Mr. Tiffany. It is included here as "Attachment A".

Subsequently, in September 1977, the Air Force Scientific Advisory Board (S.A.B.) met at Lockheed-Georgia to review the S.I.E.P. tasks and objectives. By the end of the first day it was noted again that it was a tacit assumption that H-mod was going to be done and that other less expensive options should not be considered by the S.I.E.P. Hence, "Attachment A" was given to the S.A.B. at the end of the first day for consideration in their second day's meeting, especially to point out that they were suggesting the possible foreclosure of less expensive options than H-mod which were recommended for study in the Rand report. Later, upon receiving a copy of the S.A.B. report of that meeting

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[1] "Strategic Mobility Alternatives for the 1980's" (3 volumes) The Rand Corporation R–1941, March 1977.

[2] The ALDCS is a computer controlled uprig of ailerons to reduce bending moments or stress in the inner wing.

[3] H-mod is a planned replacement of virtually the whole C5A wing, which has grown from a plan to rework the wing as suggested as early as 1972.

just a few days before the deadline for comments, I sent some comments, "Attachment B," to the Air Staff to reiterate, among other matters, my concern about foreclosing less expensive options to H-mod of the C5A wing.

The memo's, "Attachment A" and "Attachment B", and for that matter, the Rand report as well, received no response except from Mr. Tiffany personally. By early 1978 Mr. Tiffany became so busy with other urgent Air Force problems that the S.I.E.P. studies proceeded on without exploring other options. The justification became that "the Air Force had decided" it needed a 30,000-hour life for the C5A which in turn made H-mod of the wing a requirement. The fact, so clearly pointed out in the Rand study, that the 30,000-hour life objective had no rational basis and that invoking it precluded other options, was simply ignored.

During the remainder of the S.I.E.P. program, the matter of the actual life of the current C5A wing became more obscure rather than less obscure. The critical cracking location in the wing was changed to the outer wing, then finally back to a different point in the inner wing. No new full "safety-limit-scenario" such as that presented by Mr. Tiffany's D.A.G. study (paragraph 1 herein) was given to the Steering Group (it was assumed we should believe Lockheed's final numbers and judgments). No final ALDCS benefit numbers were given to the Steering Group, although they were urgently requested by the D.A.G. in January 1975 and in spite of the 1977 S.A.B. recommendation of "close scrutiny of these calculations by the Steering Committee."

Other important technical factors in a final assessment of the current C5A life remained missing while approaching the end of the S.I.E.P. studies. I missed the last S.I.E.P. Steering Group meeting at Lockheed-Georgia only because the Air Force "forgot" to prepare my travel orders (and you can't get in without them). At the immediately subsequent final S.A.B. meeting in August 1979, I found that many of the previously calculated (by Lockheed) S.I.E.P. results known to me had changed and especially that a new safety limit for the current C5A wing was given as 7100 hours. Mr. Tiffany, having moved to Boeing in early 1979, also indicated surprise with the new numbers.

Therefore, as a specialist in this field I can assure you that no one outside of a small Lockheed-Air Force group has a full knowledge of how these numbers were developed nor has anyone had sufficient access to the raw data. The S.A.B. saw presentation charts which were results of complex calculations which they could not possibly have checked. And recall that there is a past history of misrepresentation of data here. Therefore, unless you are willing to put blind trust in Lockheed's numbers, there are compelling reasons to initiate an independent study of the C5A wing life and the possible options to H-mod.

Moreover, if H-mod is considered one of the options in such a study, i.e. to obtain a 30,000-hour wing, then the study should include the fuselage and empennage as well. The D.A.G. group, the S.I.E.P. group and various S.A.B. groups have relied on studies made in or prior to 1972 as a means of assuring the fuselage and empennage life. In all of the meetings attended and documentation read by me, any question about fuselage and empennage life was dismissed (and no data provided) by saying that earlier studies had determined their life to be at least 30,000 hours. Meanwhile the wing life numbers have been changed several times and it is argued by some that studies as late as 1977 are obsolete. Therefore if there are firm new ground rules for determination of the wing life they should be also imposed on the fuselage and empennage.

It may be argued that there is too little time left to produce a new study prior to H-mod. However, that argument has been used before. It is my impression that at one time it was suggested that H-mod be opened to bidding by other airframe manufacturers. Estimates at that time showed that the new wing would be absolutely required by 1979, which foreclosed the bidding option since only Lockheed could meet that schedule. (The estimates had grossly overestimated aircraft usage!) A timely study can produce interim results quickly enough if the correct initial evidence is addressed promptly.

In particular, during the S.I.E.P. a wing from one of the high time C5A airplanes was disassembled and examined in great detail for cracks. This is hard evidence of the life-status of all C5A wings. Now, all aircraft contain cracks. but small cracks do not impair safety. Such a teardown inspection on a KC-135 wing revealed thousands of cracks some years ago. The teardown of the C5A wing revealed only a few hundred actual cracks, the vast majority of which were so small as to be of no consequence. On the other hand, the larger cracks should be examined with close scrutiny. By knowing a larger crack's precise size and shape, its exact location in a fastener hole (etc.), the precise location in the wing and with stress and material property information, its future growth may be accurately predicted and hence the danger to flight safety assessed. Such an assessment should be done for each of the larger cracks found in the teardown of the C5A wing. With such assessments available for each of many cracks and knowing their precise locations, the implications with regard to the life status of the whole C5A force (fleet) may be evaluated directly from the hard evidence at hand. This information alone would do much to clarify the existence of possible options.

Subsequently, more detailed studies would of course be required to assess actual safety limits. The detailed studies would require more time and would depend more heavily on sorting out the data available (from Lockheed). For example, during the Rand study,[3a] the source data reports received often were marked "superseded and outdated," whereas update versions were not available. As a consequence of this and other factors cited above, it is recommended here that such a study be done by a group who is empowered to obtain all of the data and who can proceed to do a genuinely independent evaluation.

PUTTING THE ORIGINAL C5A WING DESIGN IN PERSPECTIVE

In light of the current conclusions of the S.I.E.P. studies and data, it is of interest for reasons of perspectives in the C5A wing problem to consider the implications. The current result is given as a safety limit of 7,100 hours R.M.P. (i.e. representative mission profile hours for 1973 missions flown and for the 1974 configuration with PLDCS included). The original design goal for the aircraft was 30,000 hours of flight much more severe than the actual 1973 flying missions, e.g. the aircraft was supposed to be designed to land and take off from unimproved runways. Thus if one accepts the 1,100 hours R.M.P., then by implication the aircraft, if flown according to its design missions, would have lasted less than 3,000 flight hours before reaching its safety limit (my actual estimate from unpublished data of the Rand study is 2,130 hours). To have a major aircraft corporation miss the fatigue life goal of an aircraft wing designed in the 1960's by a factor of more than 10 is absolutely incredible! Indeed, since aircraft are rented, leased and otherwise valued in general by the hour, this can be regarded as a cost increase of a factor of more than 10.

Moreover, in the recent (November 1979) U.S.A.F. Scientific Advisory Report on the C5A S.I.E.P. studies, it says (p. 4) "With regard to the C5A wing structure, it was originally designed to be fail safe for a single member failure (e.g. single wing panel, spar cap, spar web, etc.)". The original design limit-load stress was 52 ksi[4] and the fail safe load (80% of limit-load) was 42 ksi. On the other hand, the S.I.E.P. reported the strength with a single panel failed (no adjacent panel damage) (at location IWBRS147) of 21 ksi. Hence, if you accept the S.I.E.P. results, contrary to the S.A.B. contention, the original design missed being fail safe by a factor of 2 on load. Now, even with the current restrictions on the airplane for peacetime and N.A.T.O. mission flying, the fail safe (2g) loads give stresses greated than 27 ksi and 34 ksi respectively. These both exceed the S.I.E.P. reported strength of 21 ksi. Consequently, the S.A.B. in reviewing the S.I.E.P. results failed to discover that the airplane was proported to be not only not fail safe as originally designed, but that it is also not fail safe for a single wing panel failure under currently restricted flying conditions.

Further, when I first noticed the implications of the S.I.E.P. results with respect to fail safety with single panels failed, I asked some further questions at the meeting and was admonished for my "untimely questioning of results". In order to dispel any further questions from me as a Steering Group member, Lockheed-Georgia and the cognizant local Air Force representative subsequently held a meeting at the Lockheed California Company and reviewed their results with Mr. T. Smith of McDonnell-Douglas and Mr. D. P. Wilhem of Northrup. Reportedly, they concur with the method used for calculation and the results.

[3a] "Strategic Mobility Alternatives for the 1980's" (3 volumes) The Rand Corporation R-1941, March 1977.

[4] ksi (kilo pounds per square inch) as used here are stresses or tension loads per unit area in the wing lower surface structure induced by wing bending and may be regarded as directly proportional to the apparent gravity (g) loads experience by a passenger due to gravity, maneuvers, turbulence, etc.

But apparently they failed somehow to communicate these facts to the S.A.B. Moreover, this is not unimportant to the S.A.B., since they go on into their report (page 11) to say "As previously indicated the committee feels that the maintenance of design fail safety for single panel failure is a key factor in achieving continued safe structural performance until wing-mod * * *" (refer also to S.A.B. emphasis at oher points in their report).

Therefore, if the 1977 Rand report or this author are wrong in raising hopes that a less expensive option to H-mod exists, then consider the implications with respect to the original design goals of C5A aircraft and what it actually has achieved. A secondary benefit of the above recommended independent study can be gained by reviewing the original procurement and putting it into proper perspective. Can the wing really be as bad as the current numbers imply? And if so, do you accept the 1972 result that the fuselage and empennage are good for 30,000 more hours without even reviewing the data (none was given to the S.I.E.P. Steering Group)? And finally, if the numbers are this bad, do you reward the producer of such a product a profit making contract for a new wing? Etc. * * * My own expertise is fracture mechanics analysis, so I do not wish to answer such questions, but a future intensive study could also provide such further perspective to the C5A wing problem.

COMPARISON OF THE ORIGINAL DESIGN WITH OTHER AIRCRAFT AND THE NEW H-MOD WING DESIGN

In "Attachment A" it was suggested that life comparison be made between the C5A and other aircraft, and this suggestion would apply to the new wing as well. If the methodology that was used to develop the current 7100 hour life number for the C5A wing is appropriate, then it could be directly applied equally well to other aircraft and the new wing. (Other differing detailed methodology is used by other groups to evaluate other aircraft.) Hence, the analysis method for the C5A could be calibrated and verified against other aircraft experience. This has not been done in the S.I.E.P. studies, even though the 1975 D.A.G. Group attached significance to more simplistic comparisons such as 1g stress levels (also noted in later, 1978, Air Staff briefings). It was disregarded due to some opinions that each airplane is vitally different. However, it is suggested here again for future studies. Indeed, if we cannot relate past, current and expected future experience through analysis methods used to predict life, we couldn't design any aircraft.

The new H-mod wing design was not addressed by the S.I.E.P. program in any way. However, other sources indicate the new design incorporates about 25 percent more cross-sectional area in the wings lower surface (with a resulting proportional reduction in stresses) and that the gross structural arrangement and details are much the same. Presumably, it is a better aluminum alloy but will be subjected to higher loads if current weight restrictions are removed. All high strength alloys have about the same fatigue crack growth rates and characteristics. All of them vary with about the 4th power of applied stress. Therefore the apparent life increase due to additional cross-sectional area to the wing lower surface is about $(1.25) = 2.44$. This would take the current projection of 7100 hours for the old wing and increase it (times 2.44) to over 17,000-hours.[5] The balance of the increment to 30,000-hours for the new wing remains unexplained. Such a balance of an additional factor of about 2 might be gained by improvements in production quality, special fasteners, etc. but only if such measures were not taken in the original wing. On the other hand, an old wing with a little over 12,000 hours life, times 2.44 would net a new wing of 30,000 hours, other factors equalized. Either way it would be informative to compare the new wing with the old using the full computational method on both to learn the truth of this matter.

Direct comparisons with the C141, KC–135, B52 and other aircraft would be equally informative.

Finally, if the S.I.E.P. results on fail safety of the current wing (as discussed on p. 10 herein) are correct, then it appears that the new H-mod wing will not be fail safe either. If the S.A.B. is as adamant about fail safety as they state in their report, this point should be checked as well.

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[5] This is an oversimplified approach providing good trend numbers, but must be replaced by full safety limit calculations to identify causes of change in comparative numbers.

FINAL STATEMENT AND SUMMARY RECOMMENDATIONS

For 4 of the past 5 years I have quite intensively studied the C5A wing. One year ago, after the last S.A.B. meeting on the C5A, I gave up on trying to answer the questions posed on these pages. There was no way open to get the information required to obtain the answers. I had participated with the Rand Corporation and watched them put forth a report on the C5A wing with utmost integrity, effort, and care, knowing it would be unpopular with the Air Force and thereby risking their main source of support. Moreover, I had the pleasure of working with an old and valued friend in the fracture mechanics field, Mr. Tiffany, and watched the pain as he learned that data he was given and had used in presentations to the Air Force General had been "misrepresented." His hard work for the U.S. Air Force and his absolute integrity remained in spite of the C5A. And finally, I have read an S.A.B. report by fellow professors and other knowledgable men with achievements to be admired, where they are used to review a program and have obviously not been told some facts they regard as a "key factor."

Their report has been published without others, who are knowledgable and who must have read the draft, coming forward to point out their lack of knowledge of all the results.

Recently the Survey's and Investigation Staff of the House Appropriations Committee produced a report on the C5A. "The Air Force" responded to the S & I Staff report's suggestion of an independent study stating "Each factor in the rogue flaw safety limit was reviewed with the Steering Committee to their full satisfaction and agreement" and by stating they had "the advice and council of the best fracture mechanics and structural experts available in the nation. Therefore, I have felt compelled to come forward and explain why I do not wish to be counted as a Steering Committee member or a fracture mechanics expert in their implied claims of concurrence.

Indeed, I wonder how the S.A.B. members will accept the fact that some of the S.I.E.P. program data shows the structure not to be single wing panel fail safe by a factor of about 2 on load in the light of the statements of safety requirements in their report. If the S.I.E.P. results are correct and the S.A.B. fail safe requirements are also valid, would the S.A.B. members wish to be counted if they knew these results? The system tends to put some of us in rather compromising positions, on projects such as the C5A wing, and it is with regret that I realize that pointing out such discrepancies will not be thanked by anyone involved.

However, when a group such as the Survey's and Investigation Staff produces a report which "hits the nail on the head," and the system attempts to smother it, sometimes one who feels the most compromised must come forward or no one will. After diligence within the system it is a last (if often fatal) resort.

Therefore, in concert with the S & I Staff report, the following recommendations are put forward:

(1) A genuinely independent study of the current C5A wing should be made.

(2) The study should be done by a group with the authority to obtain data (such as O.T.A.).

(3) The study should begin and be keyed on a timely evaluation of the hard data produced by the C5A wing teardown (available from the S.I.E.P. program) in order to assess options as soon as possible.

(4) Alternatives to a 30,000-hour life objective for H-mod should be carefully evaluated for more realistic options.

(5) The study should later include an in-depth and completely detailed evaluation of all the factors in the current C5A safety limit life.

(6) Consistent evaluations with other aircraft experience should be compared to the C5A life calculations and any potential modifications of the C5A wing should also be consistently evaluated.

Finally, though I have in this discussion brought up questions and suggested re-evaluation of the dsirability of H-mod of the C5A wing, it is only because I am yet to be convinced that such an expenditure will definitively increase the real critical air lift capability for wartime contingencies in the next 20 years. After participation in the Rand airlift study and being privileged to have been made aware of results or other such studies pointing out the needs for outsized airlift capability in contingencies, my suggestions here should not be misconstrued as questioning such needs. On the contrary, it is suggested that approving expenditures for programs such as the C-X absolutely assures increased capability, whereas C5A expenditures for H-mod may still be in doubt. It is left to you to evaluate these needs and attempt to optimize the expenditures.

ATTACHMENT A—GENERAL COMMENTS ON 1ST S.I.E.P. MEETING AT LOCKHEED-GEORGIA 8/29/77 BY PAUL C. PARIS

1. Throughout the presentations, it was assumed that H-mod will be performed. That approach leads to an inadequate program for preserving the options other than H-mod.

Rand studies indicate that the current C5 might be managed to a life approaching 15,000 hours. If so, several alternatives to H-mod exist and must be studied. If not this must be shown in a manner consistent with other aircraft by comparisons.

Information enhancement programs must include life-enhancement studies of the current configuration done in a timely fashion to answer the question of should H-mod be done?

2. If it is found (eventually) that H-mod must be done, then it would be prudent to assure that other portions of the airframe are adequate to accommodate H-mod. More specifically, the fuselage, empennage, etc., should be subject to the same criteria as the wing in motivating H-mod and should be shown adequate for 30,000 hours.

At the same time that people currently discount the I.R.T. conclusions on the wing, we are asked to accept without detailed information that the I.R.T. evaluations of fuselage, empennage, etc., were adequate. This is a grossly inconsistent position.

Therefore, it would be prudent to require safety limit and economic limit calculations on the whole airframe prior to commitment to H-mod.

3. The current program as suggested by the presentations is in the right direction but appears to lack coordination and balance, i.e. adequate planning. It gives the appearance of bolstering previously drawn conclusions without a full reassessment of the program. Most of the effort is associated with "assuring" the 8,000-hour safety limit number. The task seems aimed at reducing certain uncertainties without being able to address others such as rogue flaw probabilities) and thus give some impressions of futility. Thus the proposed program cannot be condemned but it should be asked where is it really leading?

Thus fresh approaches and coordinated well-planned studies are needed to assure that useful results will be forthcoming of a balanced nature.

4. As emphasized by Colonel Newsom and Major Montulli, the studies should be independent of C5 project management. On the other hand, those responsible should be given full access to all C5 information. All judgments and assumptions and interpretations of raw data should be in the hands and the responsibility of the studies management (and perhaps the S.I.E.P.).

The Rand studies noted inconsistencies in data interpretations (e.g. upper bound crack growth data stated as mean data, etc.) and generally misleading judgments about comparisons between aircraft (e.g. for relative 1g stress levels, etc.).

It appears to be vital that someone or some group have responsibility and authority to get the data and to have people available for an independent interpretation of the data in all detail.

5. The January 1975 D.A.G. meeting identified certain areas where more information was vitally needed. Most significantly A.L.D.C.S. "Benefits need to be further qualified"! Other matters such as residual strength were identified where data was lacking. It is now 2½ years later and there is virtually no change in the information available on such items. Isn't it appropriate to inquire on why no information has been forthcoming?

It is suggested that at a S.I.E.P. meeting in the near future that a review of progress since January 1975 should be the specific subject. The specific items affecting the 8,000–8,750 hour R.M.P. safety limit should be a major part of such a review.

6. Much of the information presented on the C5 safety limit to date has been purportedly compared to similar studies on other aircraft. Nevertheless, it seems the actual comparisons on a one to one basis do not exist or have not been made

available. For example, the C5 and C141 structural configurations are very similar. In current usage, C5 and C141 1g stress levels are similar. Yet their respective safety limits are widely different (reportedly 8,000 vs. 46,000 hours). This strongly suggests that one to one comparisons of safety limit calculations for these two, if not other, aircraft should be made available.

Moreover, other Air Force aircraft, which have been subject of modification, have experienced extensive cracking prior to modification. This is of course not desirable and involves unacceptable risks. However, the C5 has not yet shown signs of such extensive cracking, yet it is scheduled for modification. Though modification may be prudent, it has not been shown necessary in the same way as with previous aircraft.

Again, this suggests that comparative studies should be made to establish the comparative risks with other aircraft. One to one comparisons are lacking.

Thus as part of the information enhancement studies on the C5, one to one comparisons of safety limit and economic limit calculations with other aircraft are suggested, especially with the C141 but also with the KC135, B–52, etc.

7. To date no information has been presented on the new H-mod redesign, in particular the safety limit analysis of the new design. Presumably the safety limit calculations, residual strength analysis (one and two panels failed) and other details could be a comparative basis for judging the pre-H-mod as well as the H-mod wing. This information would assist the S.I.E.P. in making judgments.

Thus as part of the information enhancements studies, the H-mod wing design consideration should be the subject of review.

8. Another seemingly relevant item, which has not yet received direct attention in safety analysis is the failure mode at the end of crack growth life. Multiple load path, i.e. "fail-safe", designs lead to more passive failure modes than the catastrophic results of failure in single load path structures. Specifically, in safety limit calculations it is reasonable to base life limit calculations on the assumption that reaching a crack size where limit load will fail a panel is end of life. That produces a good estimate of the life, but it does not produce a good estimate of actual probable failure modes or crack sizes at the end of life.

Recent studies of the C5 (Rand Draft Report R–2238RC) indicate that there is only about one chance in 37 that a double panel failure will cause catastrophic loss of the wing, at the most unfavorable location in the wing. Since single panel failure is much more likely than double panel failure and also since "rogue flaws" are randomly located in a structure (not necessarily at the most unfavorable location), it is estimated that the probability that a panel failure implies catastrophic failure is one chance in thousands.

First, it is of interest to pursue such calculations in greater detail in the information enhancement program. But immediately some initial conclusions may be drawn:

(1) Panel failure detection is important to continued C5 service. (Especially so if rogue flaws larger than 0.05" should be present or other circumstances causing panel failure prior to reaching the safety limit are present in any one of the C5's.)

(2) Since probable crack lengths in a panel failure are large, in-service inspections should take advantage of this fact. Fast scanning NDT equipment could be used along the critical splice joints to reduce the actual risk of losing a C5. Fuel leaks, etc., at critical joints should receive immediate attention (however, the wing center section which is a dry bay and hard to inspect should receive additional special attention).

In summary, assuming reaching limit load for safety limit calculations should not be used for assessing the relevance of in-service inspection requirement to reduce risks of catastrophic failure.

Attention should be given to end of life failure conditions and their probabilities by the information enhancement program and in service inspections should be modified accordingly.

Attachment B

Comments on: "Special Report of the Aerospace Vehicles Panel Committee on C5A Structure Information", October 1977, Scientific Advisory Board, United States Air Force.

Comments by: Dr. Paul C. Paris, Professor of Mechanics, Washington University (also Consultant to the U.S.A.F./A.S.D. and consultant to the Rand Corporation).

At the S.A.B. public meetings at the Lockheed Georgia Company in early September 1977, this author presented to the S.A.B. Committee (through Dr. J. Mar) written statements entitled "General Comments on 1st S.I.E.P. Meeting." Many of the points to be made here stem from concerns presented at that time, hence, they are not new but bear reiteration in view of the subject S.A.B. report. These topics will be enumerated here with reference to S.A.B. suggestions.

1. THE 8,000 R.M.P. HOUR SAFETY LIMIT NUMBER

(a) The S.A.B. meeting, as well as the S.A.B. report presume that the H-mod of the C5A will be done on the schedule as currently anticipated. They have specifically avoided the question of whether the current configuration of the C5A can be managed safely to significantly greater hours under an appropriately revised safety limit. But indeed, to date there is no compelling data to the contrary.

The S.A.B. admits in its report that it "finds it difficult to understand the life improvement factors attributed to the use of the A.L.D.C.S.", but the matter was not pursued further by them. This was ignored in spite of the current use of a 1.25 factor on life improvement with A.L.D.C.S. (over the 8000 R.M.P. hour number), when actual A.L.D.C.S. effectiveness for the point in the wing where the 8,000 hours was computed is the 2.6 factor which they acknowledege. This alone might imply a potential for about doubling the hours to the safety limit. Other factors are of course present which might influence the situation.

Indeed, the S.A.B. draws attention to reports of high aerial refueling stresses, which implies acknowledgement that the point at which the 8,000-hour number was computed in the inner wing might not be the critical point. This diverts attention to the outer wing where no thorough safety limit scenario exists. Nor was any note made that aerial refueling takes place only at high altitudes where environmental influences on crack growth are substantially reduced, thereby perhaps mitigating any problem.

In any event, these statements in the S.A.B. report (specifically the last two paragraphs on page 6, etc.) acknowledge the possibility of a significantly increased safety limit. Therefore, this author disagrees with the tenor and conclusions of the 3rd paragraph of the section "Overriding Considerations" (page 2) of the S.A.B. report. Indeed, there seems to be no evidence that H-mod must proceed on schedule. On the contrary, evidence seems to this author to be developing that it can be put off for many years.

(b) If the case is made that aerial refueling is a damaging and thus controlling factor, but one which is somewhat mitigated by other factors, then the point made by the S.A.B. report in the first paragraph of "Overriding Considerations" (page 2) is weak. It actually appears that A.L.D.C.S. benefits in the inner wing would permit flying higher payloads, perhaps 50 tons, without a substantial penalty. The higher payloads would only significantly increase the damage rate of the inner wing, which in this case would not be critical, whereas aerial refueling damage is due to asymmetrical (aileron) loads which are proportional to rolling moment of inertia which is unaffected by the cargo.

In any event, if the S.A.B. Committee had considered the implications, then this author finds it difficult to understand that they did not recommend further study and revisions of the peacetime management plan and other options as alternatives.

(c) However, under Item G, "Other Considerations" (page 11) the S.B.A. finally does acknowledge this problem, and this author concurs with their point. Indeed, an important option is to consider the C5A as a strategic weapons system, in which case, if husbanded properly, it may be possible to put it to better current use and yet also safely fly to updated safety limits, perhaps well beyond the current schedule for H-mod.

But the S.I.E.P. as seen by the S.A.B. (last paragraph on page 2) does not acknowledge this option. In the opinion of this author, the S.I.E.P. should also develop any information necessary to defer H-mod safely if that option is both prudent and desirable. (Although the abstract of the S.A.B. report might be interpreted to be stating this point, the substance of the report does not do so.)

(d) Summary: Though the S.B.A. report acknowledges facts which indicate that the current safety limit might increase substantially with more information, it recommends against its further study. In doing so, it may be foreclosing the option of safely delaying H-mod because of lack of information on its safety. It is the opinion of this author that foreclosing such a possible option should be avoided and left for higher authority.

Senator PROXMIRE. All right, sir. Before we go into your statement, Mr. Paris, I'd like to discuss your background and qualifications as an expert in these matters.

Tell us briefly about your education, your professional training, the courses you teach at Washington University, the professional publications in the center you head.

Mr. PARIS. I received a bachelor's degree in engineering mechanics from the University of Michigan in 1953 and an M.S. degree and Ph. D. in applied mechanics from Lehigh University in 1962. During the 1950's I worked off and on for the Boeing Corp., as a summer faculty employee and consultant in the fracture mechanics area and at that time I was the first person to develop the use of fracture mechanics in fatigue life computations. I have been a specialist in that area ever since that time.

I have written someplace in the neighborhood of 80 to 90 publications in the fracture mechanics area, not all of them directed exactly at that, but most of them.

The Center for Fracture Mechanics at Washington University is a group of people who work with me to do research and develop further methods in areas like this.

Senator PROXMIRE. Now have you also been hired as a consultant by the Air Force, Rand Corp., and various private firms in the aeronautical industry?

Mr. PARIS. Yes. I would say perhaps over the years I have been consultant to at least 10 airplane corporations and others that you spoke of and to many other companies in other industries.

Senator PROXMIRE. Also the Air Force?

Mr. PARIS. The Air Force included. That's correct. As far as I know, I'm still an Air Force consultant. I was a consultant to the Air Force as a steering group member for the structural information enhancement program.

Senator PROXMIRE. What part have you played in the development of the methodology currently employed to analyze fractures or cracks in aircraft wings?

Mr. PARIS. Well, I think I was one of the pioneers. I was certainly one of the people who encouraged people to adopt it. The Air Force indeed was slower to adopt it than some other people, but in 1970 I consulted for General Dynamics on the F–111, when they had the F–111 wing problem, and indeed helped them, through fracture mechanics, to solve their wing problem, and it was at that time and because of that solution I think that the Air Force adopted fracture mechanics widely.

Senator PROXMIRE. By the way, you say in your prepared statement that all wings have cracks. Does that mean all commercial and military aircraft have cracks in the wings? Does the 747, the DC–10, the L–1011, the B–52, the F–14, all the aircraft, have wing cracks?

Mr. PARIS. That's correct. When I get on the airplane to fly home I'm well aware there may be some cracks in the airplane, but——

Senator PROXMIRE. Now you're saying "may be." You said before that they all have them.

Mr. PARIS. They are there. The gliders I fly I know have cracks in them, because one of the gliders I fly, I go and inspect the crack in the aileron each time I fly. So there can be cracks there and they may not be consequential.

Senator PROXMIRE. Does that mean they are unsafe and should be repaired or replaced eventually?

Mr. PARIS. No; not if the cracks are growing so slowly that they do not cause failures of the components of the aircraft or if the aircraft is fail-safe, indeed a component failure can be caused by cracking and still the whole vehicle is not lost. It simply has to be repaired.

Senator PROXMIRE. So the fact that the C–5A wings were cracked by itself does not necessarily mean that they would have to be replaced or even repaired?

Mr. PARIS. Well, the fact that there are cracks there and there have been observations of the growth means that at some time the life will be limited by those cracks. The question is, how long there is until it becomes unsafe to fly.

Senator PROXMIRE. When were you first consulted by the Air Force concerning the C–5A wing problem and which studies were you involved in?

Mr. PARIS. It was after the end of the Rand study, so it was sometime after March 1977, I believe, that I was consulted by the Air Force. I recall receiving a telephone call from Mr. Tiffany and he asked me to become his consultant on the C–5 problem as well as other problems.

Senator PROXMIRE. Did you and the other groups that were involved in studying the C–5 wing problems get full cooperation from Lockheed?

Mr. PARIS. My answer to that is that as a steering group member I very often asked questions to which I did not get full answers or full backup data. I don't want to put the blame entirely on Lockheed, but the procedures of a program like that in releasing data of Lockheed through the Air Force, someplace along the line——

Senator PROXMIRE. Was it partly Lockheed's lack of cooperation?

Mr. PARIS. I don't know, but there was a breakdown someplace there.

Senator PROXMIRE. Either by Lockheed or by the Air Force or by both?

Mr. PARIS. Yes.

Senator PROXMIRE. Now when did you first suspect that the Air Force and Lockheed were exaggerating the seriousness of the wing problem and why?

Mr. PARIS. Well, that was during the Rand study and indeed the Rand people felt that. I told them at first that I looked over the calculation of the 8,000-hour number and thought it was correct. It was when they started pointing out to me that there was misleading data involved and things of that nature that I became convinced that there was something awry.

Senator PROXMIRE. Now do you question whether there is a wing problem at all or do you only question the seriousness of it?

Mr. PARIS. There indeed is a wing problem. Of course, the airplane does not meet its original design goals, but the question is whether there are options to replacing the whole wing; whether indeed, as the Rand report purports, the fleet could be husbanded for many years, for example, beyond the turn of the century, without complete replacement of the wings.

Senator PROXMIRE. Is it correct to say that, if the problem is not as serious as Lockheed and the Air Force say it is, that less drastic corrective measures are available and hundreds of millions of dollars can be saved for the taxpayer?

Mr. PARIS. I believe that's correct, yes. That might be possible.

Senator PROXMIRE. Now the C–5A was supposed to last 30,000 hours?

Mr. PARIS. Yes, sir.

Senator PROXMIRE. Do you agree that the wings will not last that long?

Mr. PARIS. Yes, indeed. I did a calculation at one time and that's in my prepared statement that if the airplane were flown to its original design missions—that includes things like air drops, landing and takeoff on unimproved runways and some other maneuvers which have been since deleted from the requirements—that the aircraft would last less than 3,000 hours under those conditions.

Senator PROXMIRE. Less than 3,000 hours instead of 30,000, one-tenth of its design goal?

Mr. PARIS. That's correct.

Senator PROXMIRE. Now the Air Force and Lockheed say the wings will last only 7,100 hours. What's your answer to that?

Mr. PARIS. Well, under the restricted flying, keeping the payloads down, keeping the maneuvers and other loads to below 2–G, there is some intermediate level between 3,000 and 30,000 hours to which the airplane could be flown safely. I intensely studied the 8,000-hour number before and indeed found factors with the help of the Rand Corp. which said it was more than that. I believe with the 7,100-hour number that it is the result of a calculation and I don't know enough about the background of that calculation, even though I was one of the steering group members on the structural information enhancement program, to know whether there are things in that number like the 8,000-hour number which might be misleading. I have indeed, though, illustrated that there was structural information enhancement program data which apparently the SAB committee did not see. So things look suspicious I would say. Perhaps the aircraft could last considerably longer than 7,100 hours.

Senator PROXMIRE. How long did the Rand report conclude that the wings can last and what is your belief? You say 3,000 or maybe it would be longer than that, possibly 7,000. What's your estimate?

Mr. PARIS. It did not come to a final conclusion, but the best estimate that we had at the Rand Corp. was that, let's say someplace above 10,000 hours, perhaps as high as 14,000 hours.

Senator PROXMIRE. Now that would take it under ordinary circumstances to the extent we can tell? We don't know what's going to happen and what kind of military situation may develop that may make emergency demands on the C–5A, but you indicate that that might carry the C–5A through the year 2000?

Mr. PARIS. If the number is in the higher range, 12,000 to 14,000 hours, the Rand report concluded that. I didn't conclude that.

Senator PROXMIRE. The Rand report concluded under those circumstances that the plane, without repair——

Mr. PARIS. Without substantial repair, that's correct. Perhaps some fastener changes would have to be made and some things would have to be done. For example, if somebody were to do a new study on the aircraft, what might be looked at is if new fasteners were put in the wing, increasing the hole size, they would drill out many of the cracks.

Senator PROXMIRE. Can you give us a dollar estimate that might be useful? For instance, the Air Force and Lockheed are asking for $1.4 billion for repair. What would be the cost of repairing the wings in a less expensive way that would permit the plane to last through the century?

Mr. PARIS. The Rand report indicated many of the options were less than half of that cost.

Senator PROXMIRE. Less than half of that?

Mr. PARIS. Yes.

Senator PROXMIRE. So it would be $600 million or something like that?

Mr. PARIS. There were also some options called "do nothing" options where the cost would be negligible.

Senator PROXMIRE. You say in your prepared statement that Lockheed gave misleading data to the study group. Why didn't the study groups obtain their own data? Why did they rely on Leekheed?

Mr. PARIS. I don't know of any data produced which could be appropriately used which was not produced by Lockheed, so they had to rely on Lockheed's data. All of the data on the structural information enhancement program basically which led to the 7,100 hour number was Lockheed data.

Senator PROXMIRE. Are you saying that all wing tests, the analyses and the calculations concerning the cracks, were done by Lockheed? Didn't the Air Force perform any of its own tests or analyses?

Mr. PARIS. There may be some very minor amounts of testing which are really inconsquential compared to the backup tests which are done by the results, so 99 percent at least were done by Lockheed.

Senator PROXMIRE. Is it correct to say that the most recent major study of the structural information enhancement program, known as SIEP, was done by a contract from the Air Force to Lockheed?

Mr. PARIS. That's correct. The contract was to Lockheed. They did have the Air Force materials lab look over some of the cracks in the teardown airplane, but as far as the numbers which led to the 7,100 hour number, it was entirely done by Lockheed.

Senator PROXMIRE. That's one of the studies you worked on as a member of the study group?

Mr. PARIS. That's correct.

Senator PROXMIRE. My time is up. I have some more questions. Congressman Wylie.

Representative WYLIE. Thank you very much, Mr. Chairman.

Do you think the C–5A is worth saving?

Mr. PARIS. Yes. Indeed, after being part of the Rand team, there are very definitive needs in our airlift for NATO contingencies and other compelling needs, and so we do need the C–5 and we need it critically and there are dangers in suggesting that one fly it longer than some of these numbers, but we have not adequately assessed for the cost of that program what those dangers are, and it's about time we do make that assessment.

Representative WYLIE. Well, wouldn't it be better to be safe than sorry?

Mr. PARIS. Yes, but if, for example, our money is limited, if we invested money in the CX program, we can be assured of increasing our capability. When we invest it in the C–5, if it happens to be unneeded, we don't know that we are increasing our capability for certain.

Representative WYLIE. Well, I'm being the devil's advocate a little because I'm not a structural engineer and I'm not really certain where I'm coming from, but I do think that if we agree—and you agree that we do need to have the C–5—that we have to be right. You have also indicated there's a wing problem. So there is a judgmental factor involved here.

Did you testify before either of the Armed Services Committees?

Mr. PARIS. No; I did not.

Representative WYLIE. Did they not ask you to testify or you didn't volunteer to testify?

Mr. PARIS. They did not ask me to testify.

Representative WYLIE. I guess my question is how you happened to come before the Joint Economic Committee if you have not appeared before one of these authorizing committees?

Mr. PARIS. All right. The surveys and investigation staff of the House committee wrote a report on the airlift, including some things on the C–5. The Air Force responded to that report and in the Air Force response they claimed independence and that all of the data, for example, was available to the steering committee in making that determination.

Representative WYLIE. When you say the steering committee, are you talking about the structural information and enhancement program?

Mr. PARIS. Yes, of which I was a member.

Representative WYLIE. Of which you were a member?

Mr. PARIS. Yes, so I felt compelled, upon reading that material, to write to Representative Addabbo and point out that I did not feel as a member of the steering committee that I knew all the information that the Air Force purported me to know and that I couldn't attest to those answers.

Representative WYLIE. Well, why would the Air Force recommend these changes recommended by the structural information enhancement program steering committee? This has been going on since about 1969 and there have been different chiefs of staff of the Air Force and they have all recommended the changes which Lockheed wants to make.

Mr. PARIS. Well, if you would like to know my belief, I'll state it.

Representative WYLIE. That's why I asked the question.

Mr. PARIS. I think that having an airplane on which there are flight restrictions imposed makes that airplane harder to manage for the Air Force and is not quite as much fun to fly and that it creates problems.

Representative WYLIE. I don't understand when you say "not quite as much fun to fly."

Mr. PARIS. I'm a pilot so I guess I'm an expert about the fun of flying.

Representative WYLIE. But we're not manufacturing this plane for fun.

Mr. PARIS. That's right. It should be—indeed, its most critical use is for contingencies, and what I believe is that if it were carefully husbanded for those contingencies, then it would be OK, but I don't think the Air Force's motivation is completely connected with that sort of usage.

Representative WYLIE. You think they might be including in their consideration, flying for fun? I'm not sure that I follow.

Mr. PARIS. Well, I think from a point of view of retaining pilots that they have talked about morale problems and it's a matter of personal satisfaction, let's call it, then of the pilots themselves if there's a morale problem.

Representative WYLIE. Well, now, would you say that the membership of the structural information enhancement program steering committee was relatively an objective membership?

Mr. PARIS. I believe these people are reasonably objective as scientific people. I believe that indeed Mr. Tiffany is an exceptionally objective and honest man. On the other hand, during the structural Air Force problems. The F–100 engine is one example—that he was information enhancement program he had other compelling urgent not able to go to the steering committee meetings and become completely apprised of all the information. So I think it's a matter of how much study the people could put into the problem and how much diligence they had in doing that. They tried. I think they honestly tried.

Representative WYLIE. You think the people on the panel were too busy and therefore they didn't take the time on it?

Mr. PARIS. Yes.

Representative WYLIE. But the panel, except for you, was unanimous in recommending what Lockheed now wants to do.

Mr. PARIS. Perhaps so. I don't know about their recommendations or findings.

Representative WYLIE. I don't have any further questions. Thank you, Mr. Paris.

Senator PROXMIRE. Mr. Paris, did the members of the group have adequate access to Lockheed information during the structural information enhancement program?

Mr. PARIS. That's a very difficult question to answer because it depends on the psychology of the issue. I think that because I had participated earlier in the Rand study and that that study was somewhat unpopular with Lockheed and the Air Force, that when I asked for information there was some hesitance to give me information. I think other people had easier access to information than I did, but most of them didn't ask.

Senator PROXMIRE. Did members of the steering group fully take part in the SIEP study or was it controlled by Lockheed?

Mr. PARIS. Well, it was done at the Lockheed-Georgia Co. by Lockheed people. There was a cognizant Air Force man there, a man named

Howard Wood, who I believe is also in this room, who was supposed to be cognizant of all details.

Senator PROXMIRE. Did you complain about the lack of information and about other matters during the SIEP study and, if so, what was the reaction?

Mr. PARIS. Well, there were some times that I exchanged letters with Howard Wood requesting information and I don't think I received back adequate information.

Senator PROXMIRE. Were you ever prevented from attending any of the final SIEP meetings?

Mr. PARIS. Well, there were meetings in January, in April, and I believe in July of 1979 and for the January and July meetings I believe I did not receive Air Force travel orders. That's my recollection and you have to hand in the travel orders to get in the door at Lockheed. So I regarded that as preventing me from getting to the meeting, yes.

Senator PROXMIRE. Earlier we discussed the lack of access to Lockheed data. Did Lockheed ever provide misleading information or actually lie to the study group you worked with and, if so, give us some examples?

Mr. PARIS. No; I don't know of any case where they lied to us. I still question the results which I alluded to with respect to the dual panel and single panel failure residual strengths that I referred to Mr. Conley, but even though I question those figures, I don't know that they have lied about any of the data.

Senator PROXMIRE. Did any Air Force officials privately agree with your complaints about the lack of access to raw data or to Lockheed information and about misrepresentations?

Mr. PARIS. No, not that I know of.

Senator PROXMIRE. Were any Air Force officials sympathetic with your suspicions that the wing could last 12,000 to 14,000 hours?

Mr. PARIS. Well, at times I believe Mr. Tiffany was sympathetic. He wanted to really get to the bottom of things and dig more deeply into the problem, but as I said, by 1978 he was so busy I don't believe he had the time to do the digging.

Senator PROXMIRE. Now in providing conclusions about the wing life, did Lockheed employ accepted methods or did they use methods not accepted by your profession?

Mr. PARIS. No; they employed methods that I would generally characterize as accepted methods, but what they did was employ new methods which had not had the, let's say, oversight and endorsement of the full academic community in some cases when it came down to the detailed way they did things.

Senator PROXMIRE. Would you consider them unsound in their new methods?

Mr. PARIS. I don't know. I can't testify to that because I did not know the details of many of the methods and I wanted to know them.

Senator PROXMIRE. Since then have you been able to establish to your satisfaction whether the new methods employed were adequate?

Mr. PARIS. No; I haven't, since that final SAB meeting. Indeed, what happened was at that time I gave up and walked away and forgot about the problem.

Senator PROXMIRE. Do you consider it irregular or improper that the Air Force studies and analyses of the C–5A wing problems have been so much under the control of Lockheed who had the contract to build the C–5A?

Mr. PARIS. I don't regard it as improper. I regard it as dangerous for anybody to purchase something like a large aircraft or weapons system where they rely solely on the——

Senator PROXMIRE. Why isn't that improper?

Mr. PARIS. Well, it could be construed to be improper, but I think that's a judgment for you gentlemen to make. I would say it's dangerous to do that.

Senator PROXMIRE. It certainly gives the appearance of a conflict of interest; does it not?

Mr. PARIS. Yes, indeed.

Senator PROXMIRE. At least I understand the wings of the C–5A were torn down and examined for cracks during the SIEP study.

Mr. PARIS That's correct.

Senator PROXMIRE. Were you given access to the results of the teardown while you were a member of the steering group?

Mr. PARIS. I was given access to some results, yes, but those results which I received were in a form that I could not really make any judgments from them.

Senator PROXMIRE. Now I asked myself for some of the data from the wing teardown and you have been shown that data.

Mr. PARIS That's correct.

Senator PROXMIRE. How many major cracks were evident in this data and what do they mean to you?

Mr. PARIS. Well, I believe there was a list there in that information of about 930 cracks which were regarded as significant from a point of view of being cracks which might grow. Of those, the vast majority of them were so small that they're really quite inconsequential. If you did a fastener change on the airplane, for example, they would be gone because they would be drilled out with the change in the fasteners. There may be a few of those which are consequential and I took a rough look and decided that there are at least seven that are important because of their large size and shape and so on, but the information did not tell me exactly where in the airplane those cracks were and if they are in the lowly stressed area of the airplane they are also inconsequential. So I don't know, in that set of cracks as listed, if there is any great consequence whatsoever.

Senator PROXMIRE. Having seen that, do you still believe the wings can have 12,000 to 14,000 hours of life remaining?

Mr. PARIS. Perhaps they can, yes. I believe that that's still a possibility with cracks like that present.

Senator PROXMIRE. In one part of your prepared statement you question the validity of the SIEP calculations. You discuss the fail-safe problem. What do you mean by fail-safe?

Mr. PARIS. Well, the fail-safe airplane is an airplane designed with many structural components carrying the same load. For example, the wing of the airplane is made of in the critical area of 10 spanwise planks and if one of those planks break the other 9 planks can carry the load. That's called fail-safe when the other nine planks are capable of carrying that load.

Senator PROXMIRE. Well, that's one example. Would it always be to have a backup of nine?

Mr. PARIS. You would have a backup at least so there would not be catastrophic failure of the system with the failure of one component. That applies also to other things like electronic gear and so on as well as structures.

Senator PROXMIRE. Are you saying if the SIEP calculations are correct, the C-5A is not safe to fly at the present time, that the entire fleet should be grounded?

Mr. PARIS. I didn't say that. I believe that the SAB report says that, though.

Senator PROXMIRE. What do you say? Is that true? Do you agree with it or not?

Mr. PARIS. Well, as I said, I'm not sure Mr. Conley's results were correct, so I don't know what the truth is about whether it's safe to fly now or not.

Senator PROXMIRE. Supposing the results are correct. What do you believe?

Mr. PARIS. It's risky to fly, yes. I would not like to fly on it—if those results are true, I wouldn't like to ride in the airplane.

Senator PROXMIRE. Well, supposing you had the decision. You believe the C-5A should be grounded right now?

Mr. PARIS. I cannot form an opinion about that. I think that has to be taken up by higher authority.

Senator PROXMIRE. Well, we're asking you. You're the high authority.

Mr. PARIS. No; I'm not an authority on——

Senator PROXMIRE. What's your advice? You're an expert. There are few people in the world who have the background you have in this area. We're asking you for advice. You don't have to make a decision, but if you were asked your advice what would you say? Ground it or don't ground it, assuming the calculations are correct?

Mr. PARIS. Assuming all the calculations are correct, well, what I would do is actually defer that decision. If I had to make a decision, I would say with what it says in the SAB report, I would say if I had to make the judgment, I would say ground the thing.

Senator PROXMIRE. You would say ground it?

Mr. PARIS. Yes.

Senator PROXMIRE. In your prepared statement you asked whether the fuselage and empennage are good for 30,000 hours. Did any of the study groups you worked on examine those questions? Do you know of any study that looked at this?

Mr. PARIS. Well, no. Whenever the question was asked, and I asked it frequently, it was said that the 1972 IRT program on the C-5 had studied that question and resolved that the life was over 30,000 hours and I kept requesting further clarification on that. Nothing was really forthcoming, but near the end of the structural information enhancement program they did indeed acknowledge that they were going to make calculations and perhaps they made some calculations at this time. But even if they have made those calculations and have a number at this time, it takes a judgment about that number. It takes looking at how it was calculated, where in the airplane it was calculated and so on, as to its significance and whether it's really valid. So far as I'm concerned, although I made requests, there was no adequate data available. I was simply asked to believe the IRT results.

Senator PROXMIRE. You're saying you have an opinion on this yourself? The fuselage—I understand the empennage is the tail section, right?

Mr. PARIS. My opinion is that it's worthy of further study. I don't know what the answer will be, but if there are great problems in the wings in the aircraft and the number for the safe life of the wing of the aircraft keeps coming down historically, then I don't believe we should believe a number like 30,000 hours safe fuselage and empennage life that is an early number in the studies of the C–5A.

Senator PROXMIRE. Congressman Wylie.

Representative WYLIE. Thank you, Mr. Chairman.

I lost track somewhere along the line from the moment I came in until right now. As I understood your first statement when you came this morning, you said that you thought it was not necessary to fix the C–5A plane, that it had a certain number of hours of life expectancy without repairing the wing. Is that correct or not?

Mr. PARIS. That's correct, that there's that possibility, yes, and I believe it might be a real one.

Representative WYLIE. Well. you were questioning the wisdom of the Air Force and the Armed Services Committee and of this SIEP committee in recommending that the plane be fixed; is that right?

Mr. PARIS. That's right. Well, and how it's fixed.

Representative WYLIE. Just a little while ago you thought that the plane should be grounded.

Mr. PARIS. No. I really deferred to the SAB committee and said that if the results for single panel failure strength of the SIEP program are correct and given the SAB report, I believe the SAB report then would say the airplane has to be grounded and I base my answer on their opinions, not my own.

Representative WYLIE. It has to be grounded unless the wing is fixed?

Mr. PARIS. I think that's what they're saying.

Representative WYLIE. You're not suggesting that it be grounded? I asked you if you thought it should be moth-balled and you said you didn't think it should be grounded. Correct?

Mr. PARIS. Well, that's because I don't think that the single panel failure strengths are as bad as they have been purported to be in the SIEP studies, but I don't know the answer to that. I don't have enough information.

Representative WYLIE. But you had information enough to say that there were some 930 cracks found in the airplane which is a little discombobulating I might say.

Mr. PARIS. Yes.

Representative WYLIE. Then you said perhaps they're not consequential.

Mr. PARIS. That's right.

Representative WYLIE. Perhaps they are?

Mr. PARIS. In transport aircraft, for example, the airplane I expect to fly home on, I honestly can say to you I believe there are 930 cracks in that airplane too and I will get on it and fly because I know it's fail-safe and that those cracks aren't consequential.

Representative WYLIE. I have made about 1,400 trips between here and Columbus and I must say that shakes me up a little bit. Do you think all airplines have cracks in them? All airplane wings have cracks in them?

Mr. PARIS. That's right.

Representative WYLIE. And you said there are 930 cracks in the C–5A but perhaps they are not consequential?

Mr. PARIS. That's right.

Representative WYLIE. Could you also say perhaps they are consequential?

Mr. PARIS. Yes, but that hasn't been determined as far as I know. At least I haven't had access to the information to make the determination. I don't know if anybody else has really determined it.

Representative WYLIE. But the Chief of Staff of the Air Force thinks they are consequential and both the Armed Services Committees, the SIEP committee, and so forth, all think they are consequential, and I go back—what you're saying is you really haven't made up your mind?

Mr. PARIS. Well, I have made up my mind in this respect and that is that I have today presented before you evidence that there was an instance of the key man in the Air Force, Mr. Tiffany, being misled by the data. That we don't know—at least I don't know whether we have been misled with respect to some of these other things; and conclusions were drawn from Mr. Tiffany's being misled which are, I believe, incorrect, and I don't know what the situation is here and now. That's why I'm recommending further study and an independent study so we can get to the bottom of it.

Representative WYLIE. I know we have other witnesses that will take a different position, but I say again, we have to be right on this. Thank you very much.

Senator PROXMIRE. I want to make sure we understand this. Are you saying if the calculations in the final justification for the H-mod wing fix are correct, then the figures show the plane is not fail-safe? If this is correct, the plane should be grounded, right?

Mr. PARIS. Well, I'm saying that the Scientific Advisory Board appears to be saying that the plane should be grounded.

Senator PROXMIRE. Well, if the plane should be grounded, if you say it should be grounded and Lockheed says it should be grounded and the Air Force says it should be grounded, do they incidentally say that?

Mr. PARIS. They don't talk about grounding. They just say that's a key factor in the——

Senator PROXMIRE. Are they grounded now?

Mr. PARIS. No; not as far as I know.

Senator PROXMIRE. At any rate, even if you all agreed that it should be grounded, the difference is that you say it can be fixed at a far lesser cost and secure in all likelihood the hours that would be necessary to continue the plane flying until the year 2000 at which time we could reasonably expect that plane might be obsolete. It would be a 30-year-old plane—more than 30 years old.

Mr. PARIS. Yes, indeed.

Representative WYLIE. But, Mr. Chairman, the question is a little bit misleading.

Senator PROXMIRE. I lead all the time.

Representative WYLIE. He said a little while ago that he didn't know what the consequences—how consequential these 930 cracks are.

Mr. PARIS. I think all of that has to be determined and basically my recommendation is a further study to be sure.

Senator PROXMIRE. Well, now, I want to clear this up. What difference does it make how long the fuselage and empennage will last?

Mr. PARIS. Well, it would seem a bad idea to put on a new H-mod wing that will last 30,000 hours and designed to last 30,000 hours if the fuselage and empennage won't last 30,000 hours. You may be asked for a new program to replace them.

Senator PROXMIRE. How long will they last? 15,000 hours maybe?

Mr. PARIS. I don't know. There's not adequate information.

Senator PROXMIRE. The prospect is it would not last 30,000 hours?

Mr. PARIS. It's possible.

Senator PROXMIRE. Is it your view that a group such as the Office of Technology Assessment should do an independent study?

Mr. PARIS. I believe it's a group with that kind of power that is needed to get access to the data and provided they employ the proper technical people, then they could do a study.

Senator PROXMIRE. What issues should they examine and how long should such a study take?

Mr. PARIS. I think the first thing is to take a very careful look at the cracks in the teardown wing to determine feasibility of various options. Indeed, they may determine from that that there are no options to wing replacement. Then what they should do is to look at the options to a 30,000 hour life requirement, especially as pointed out by the Rand Corp. They can very well start with the Rand report and I don't want to recommend the Rand report as the last word. They should form their own opinion and they should then do recalculations of the safety limit and economic limit of the airplane and indeed come to final conclusions about the real options for the airplane.

Senator PROXMIRE. Now our staff has been informed that in Lockheed's efforts to reduce the weight of the plane that, in addition to taking the weight out of the wings, weight was taken out elsewhere. Among the items removed was an electric motor and jackscrew intended as a backup to the hydraulic actuator and tail stabilizers. If that's true, could the absence of such a backup device result in a safety hazard under certain circumstances?

Mr. PARIS. Well, you're asking me for an area of expertise where I'm not using my fracture mechanics expertise. My reaction is, as a pilot, if you have less backup available for an emergency, yes, it could be dangerous.

Senator PROXMIRE. Let me give you a specific example. If the hydraulics were dried as it was in the crash in Saigon, could the absence of such a backup make the pilot not make an emergency landing?

Mr. PARIS. That depends on the reactions with the trim in the wrong position. I don't know the answer to that. I suspect you could ask a C–5 pilot or you could read the flight manual and find out the answers to that, but it sounds to me like it's a very dangerous situation for a pilot to be in and it could be the contributing cause.

Senator PROXMIRE. Thank you very much, Mr. Paris, for an excellent presentation. You have made a fine record. We are in your debt. You're obviously an expert in this area and I think you have made very useful comments.

Our next witness is David Keating, director of legislative policy, National Taxpayers Union. Mr. Keating, we're happy to have you. Mr. Keating, you have a rather substantial prepared statement here and we would be delighted to have it for the record.

TESTIMONY OF DAVID KEATING, DIRECTOR OF LEGISLATIVE POLICY, NATIONAL TAXPAYERS UNION, WASHINGTON, D.C., ACCOMPANIED BY DINA RASOR, STAFF ASSISTANT

Mr. KEATING. Mr. Chairman and members of the subcommittee, I'd like to thank you for the opportunity to appear today.

Senator PROXMIRE. Thank you very much, Mr. Keating.

Mr. Keating, it's unusual when we have a representative of the taxpayer appear before congressional committees. The overwhelming majority of witnesses are for approving programs, getting us to spend more money for programs or approval and expert witnesses like the preceding witness. You come not as a professional or expert in this particular area but as one who is deeply concerned with excessive spending and waste in government and, of course, this subcommittee has that as its principal purpose—to prevent waste, especially waste in procurement—and therefore, we are in your debt and I think you have done a remarkably fine job. You have obviously put in many, many hours of work on this subject and I think it shows very well in your presentation and also in your detailed backup.

In your prepared statement, you say that the original contract awarded to Lockheed was the result of pressure from the Georgia congressional delegation. Do you have any facts to substantiate that conclusion or is it just an assertion?

Mr. KEATING. Well, it's from what we understand. Quite frequently, as you see in many spending programs, including this one, pressures aren't necessarily documented by paper and such, but there's a general understanding of how things work. I couldn't produce any piece of paper where the Georgia congressional delegation would say who they applied pressure to or what political trades were promised. First of all, none of the politics of——

Senator PROXMIRE. You know the Senators from Georgia and the Congressmen have had great expertise in this area and we all look to them for advice because they have made themselves highly competent and they are very highly respected, and I presume, like all the rest of us, that we are interested in getting Federal funds in our State. Is that what you're saying? In this case you had highly influential people who Congress looked to for advice and, of course, as could be expected and predicted, they were interested in having the work done in their State—in this case, Georgia.

Mr. KEATING. That's a fundamental problem. We see this in all Government spending. It's not limited solely to this.

Senator PROXMIRE. Now will you briefly discuss the study reports on the C-5 structural problems you have had a chance to examine?

Mr. KEATING. Well, I think the best one that we have had a chance to examine is the Rand study done in 1977. That one is the most technical and thorough report that I've seen. Basically, I have examined what I have given to the subcommittee today—the Rand report, the Apex Engineering report, and the S. & I. staff report, but it's clear from the evidence we see that there are a lot of questions on the H-mod proposal and that alternatives exist.

Senator PROXMIRE. Do any of those reports report C-5 structural problems other than the wings and do you have any reason to believe the fuselage areas other than the wings will not last 30,000 hours?

Mr. KEATING. The Apex report refers to corrosion problems in the plane and although I'm not an expert on corrosion control, I wonder what sort of corrosion control programs have been implemented. Mr. Paris mentioned today and I guess the IRT study came up with the 30,000-hour figure. Did they consider corrosion control? Does it matter whether the plane is on the east coast or west coast, for that matter? Perhaps that would have some bearing. But corrosion problems may indicate the fuselage may not last 30,000 hours. According to the Apex report, corrosion control seemed to be the most serious problem.

Senator PROXMIRE. Now you're not an engineer or a technical expert in any of these highly technical subjects. On what do you base your conclusions that the technical experts in the Air Force are wrong and why should the Congress or the subcommittee believe you rather than the Air Force?

Mr. KEATING. Well, basically, I do it from examining the data we have seen publicly from the Air Force and House committees. We were not impressed that the questions previously raised by the S. & I. staff, the Rand report, and the GAO report, had been adequately addressed. We were not impressed with the Defense Department's answers. For example, one of their public answers was the simple assertion thta the rest of the plane could last 30,000 hours without statements of where that figure came from—and those types of things concern me.

Senator PROXMIRE. To the best of your information, was the contract to fix the wings awarded to Lockheed on the basis of competitive bids or was it a sole source award?

Mr. KEATING. Well, this is a bit confusing. It apparently was open to some sort of competitive bid but as it turned out—and I'm not sure of the details on this and we could submit a written answer in greater detail if you would like—but it seems that other companies were not interested, for various reasons, in doing this wing modification.

Senator PROXMIRE. Did you discuss the so-called simulated competitive bids that were performed by the Air Force?

Mr. KEATING. I think we have a long document that we could submit to the committee for the record. From examining that document, it would become clear as to how it was done. Evidently, the other corporations were not interestd but the Air Force took a guess-estimate or simulated what a bid would be to do this project.

Senator PROXMIRE. Is Dina Rasor here? Would you come forward? I understand you have done some work on this. Would you state your name for the record?

Mr. KEATING. Dina Rasor is a member of the staff of the National Taxpayers Union.

Senator PROXMIRE. Can you tell us about the simulated competitive bids?

Ms. RASOR. I talked to a Colonel Felmley at Wright-Patterson Air Force Base who evidently did a C–5A feasibility study. A GAO report—I think it was the 1976 GAO report on airlift—said that although the design and the research and development of the wing modification would be sole source to Lockheed, that the actual implementation of the wing modification would be open to competitive bidding. I saw no example of that, so I called up Colonel Felmley and he told me nobody wanted to bid on the project. He sent me a very large document which I have gone through. It showed several letters from Boeing, McDonnell Douglas and I think Rockwell which showed initial interest in bidding, but because of what they called a disadvantaged learing curve, they did not want to bid. He explained to me that the Air Force then went and took Lockheed's costs of doing the plane along with what they pay their employees, their overhead, the plant and whatever, and they took the cost of Boeing and McDonnell Douglas, which they considered two contractors that could possibly do this one modification, and the Air Force calculated their own bids. He called it—I forgot what he called it, but we sort of agreed it was a sort of simulated bidding in the sense the Air Force made simulated bids for this final phase because nobody bid on it. Lockheed had the lowest bid because of this learning curve disability, as they call it.

I can supply all this to the subcommittee.

Senator PROXMIRE. Did the other companies say that they didn't want to bid because Lockheed already had the R. & D. contract?

Ms. RASOR. Well, that was implied. This was just in my conversation with him. He said that the other companies wanted to do—also, this was brought up in the NBS report—the other companies expressed interest in doing the entire wing modification program but were not interested in just doing the implementation. Obviously if you don't do the research and development and you're using other people's information, you do have a learning curve disability. So that's what is meant by simulating bidding.

I was surprised to find that the Air Force had done this. I don't know if this is standard practice or not.

Senator PROXMIRE. Thank you very much, Ms. Rasor. Why don't you stay there. We might have further questions for you.

I'm almost through with my questioning, but it might relate to this. Mr. Keating, Lockheed says the SIEP study was done in response to the Rand report. Why, then, do you conclude that the Rand recommendations were not followed up? Wasn't SIEP a followup to Rand?

Mr. KEATING. Well, if it was, it didn't take up one of the fundamental recommendations of Rand, and that was to thoroughly study the alternatives. As I point out, part of the charter of the SIEP was to justify the H-mod. The S. & I. staff report pointed out that one of the basic goals of SIEP was to help sell the H-mod.

Senator PROXMIRE. So the SIEP report followed the Rand report but it wasn't responsive to the issues raised in the Rand report. Is that right?

Mr. KEATING. I don't think it was responsive at all.

Senator PROXMIRE. Now, Mr. Keating, Lockheed argues there have been numerous independent studies of the wing problem. Do you agree with that and, if not, why not?

Mr. KEATING. Well, that may be the truth. I'm not sure how many studies have been done, but I think the committee should evaluate these studies. The mere existence of a study doesn't really prove anything. The fundamental question that has to be asked is, What was studied? For example, the SIEP was a study after the Rand recommendations, yet it didn't even study what should have been studied.

The second question that should be asked about any study is, Who did it and what sort of interest did they have in the outcome?

Another question that I would put to any study is, How thorough was it? What were the qualifications of the people who did the study? And evidently the S. & I. staff, which I presume had access to all the studies, were not satisfied that an independent study had been done and this was as of January 1980.

The studies that we have seen haven't addressed the alternatives and the questions that have been raised by the GAO in 1976 and Rand in 1977. So even though there may be studies that exist, I don't know if they meet all the qualifications for an independent and thoroughly done study that would answer all these questions. That's the sort of study that needs to be done and that's the sort of study that the Congress needs to make these decisions.

Senator PROXMIRE. How do you respond to the argument that yet another study will simply waste taxpayers' money and possibly cause delay in repairing the defective wings?

Mr. KEATING. I think the Air Force should have done the study properly in the first place 3 or 4 years ago when it was called for by the GAO and then asked for by the Rand report. All I can say is that the Air Force has already wasted money on studies. If they had done a study right in the first place, we would have saved that money too, and perhaps even saved more money on the program by implementing lower cost alternatives. By letting the plane fly for these 3 or 4 years after the other studies were called for, who know how much money was wasted. These planes are getting older. The longer we wait, the more likely it is that a full modification will be necessary.

So I don't see how somebody could say, well, we have wasted plenty of money already; the fundamental answer to that is that if an independent study is done, it's quite possible and likely that we can still save money, even though plenty of money has already been wasted, unfortunately.

Senator PROXMIRE. Congressman Wylie.

Representative WYLIE. Thank you very much, Mr. Chairman, and Mr. Keating.

I think it's fair to say that everybody here wants to save money and I certainly do and I'm committed to the balanced budget proposition, and so forth, and I don't feel that the defense budget is sacrosanct really and I think I have indicated that in my votes and I would also say that the National Taxpayers Union has given me a good rating so you have pretty good judgment in one regard. But I think we do have to——

Senator PROXMIRE. I support that view.

Representative WYLIE. But I do think we have an obligation here to be right, and I think it's very important that we are right. You would agree with that, I assume?

Mr. KEATING. No; I wouldn't.

Representative WYLIE. You wouldn't?

Mr. KEATING. I wouldn't disagree that you have an obligation.

Representative WYLIE. OK. Well, the suggestion that the decision might have been made or engineered by the Georgia delegation to have this modification it seems to me is a little bit serious and I would assume that the President is for the modification since Secretary Brown is also for it and also Secretary Marcus. Do you think that their decision about it is a little bit more objective than the congressional delegation of Georgia? I can understand why they might want the program.

Senator PROXMIRE. Would the Congressman yield? I hate to interrupt but I can't resist. I ignored the fact that part of the Georgia delegation in Washington is President Carter. He doesn't come from Madison, Wis. He comes from Plains, Ga.

Representative WYLIE. You did ignore it. Well, I guess what I'm saying here is that they have certainly been objective in their analysis of it, haven't they? I mean, they have no particular ax to grind as far as our defense posture is concerned.

Mr. KEATING. Well, one can be as objective as one wants and perhaps they have been. I'm not saying they have or haven't been. The fundamental thing we're bringing up here is, how can they be objective when they don't have the proper information to make the decision? That's why we're recommending that a further study be done—to get the information so as to make the proper decision so more money is not wasted. If they have some other study that they are hiding or they have some other material about this, I wish they'd let everybody know about it. But I don't see how they could make a good decision based on the studies that we have seen.

Representative WYLIE. Your information is based on the studies that you have seen. You don't have any structural engineers on your staff?

Mr. KEATING. No.

Representative WYLIE. An interesting suggestion was made here a little while ago that the modification ought to be put out to competitive bid. Are you suggesting that maybe Boeing could do it better?

Mr. KEATING. Well, that's perhaps the case. It seems that—I'm not thoroughly familiar with the history of it, but it seems from—and Dina can correct me if I'm wrong——

Representative WYLIE. I shouldn't have referred to Boeing. I should have referred to Rockwell since Rockwell is in my district. Are you suggesting that Rockwell could do it better?

Mr. KEATING. Based on the past performance, it's hard to see how the plane could be much worse.

Representative WYLIE. You just don't like the plane?

Mr. KEATING. We don't like the idea that a lot of money has been wasted and it looks like if we go ahead with the H-mod a lot more money will be wasted. That's what we don't like.

Representative WYLIE. You would think the bottom line is put the plane in mothballs?

Mr. KEATING. Well, I'm not—evidently there is a need for this plane. You can't put it in total mothballs, but one of the options of Rand was do nothing. One of the options is fly it less, take special care of it. Maybe you can, by storing it out West, control the corrosion problem and maybe the planes will last longer in Texas. There are alternatives. Putting it in the reserves so that it is used less, but ready to fly, may be one solution.

Representative WYLIE. Well, you're not saying that we put it in mothballs. We have to do something, either use it less or modify the wing. If we do modify the wing, if we make that decision, it seems to me as if it would just—just off the top, and I'm going to have to look into this a little more—it might cost more if some other company were brought into the fray right now, and I think you suggested that, Ms. Rasor, that there's a learning——

Ms. RASOR. There's a learning curve disability. I'm not suggesting that the Air Force miscalculated. What I'm suggesting is that the two other companies wanted to bid at an earlier time, the research and development stage, but the Air Force decided to go sole source until the actual wing fix, until you actually bought the kit to put them on the plane. Therefore, that created a learning curve disability. I can provide that contract document to you.

Senator PROXMIRE. Yes; I would like to have that.

Mr. KEATING. That's another interesting question, why it was done sole source originally. It would seem to give the other potential contractors a fundamental disadvantage for the expensive part of the contract.

Representative WYLIE. I think the question comes down to two considerations here: (1) Whether the SIEP report is objective; and (2) whether it's credible; isn't that right?

Mr. KEATING. And (3) were all things studied as recommended in the Rand report?

Representative WYLIE. That would be included in the first one, whether it was completely objective.

Mr. KEATING. OK.

Representative WYLIE. Well. thank you very much, Mr. Chairman.

Senator PROXMIRE. The SIEP report was done by Lockheed under a contract to Lockheed?

Mr. KEATING. Well, my understanding was that it was done by a committee of people, composed of both the Air Force and Lockheed members.

Representative WYLIE. Mr. Paris was on it.

Senator PROXMIRE. It was done under an Air Force contract to Lockheed. Did you know that?

Mr. KEATING. No.

Senator PROXMIRE. That's my understanding. The staff assures me that's the case. We will confirm that with the next witness who's the president of Lockheed. He should be an authority on that, among other things.

Thank you very, very much, both of you, for excellent testimony and a fine record and all the tremendous work you have done on this. We are certainly in your debt. It was very helpful.

[The prepared statement of Mr. Keating, together with appendixes, follows:]

Prepared Statement of David Keating

Summary

NTU has found that the C-5 cargo airplane may have many technical and maintenance problems other than the wing cracks. Several studies have pointed out that the Air Force has not adequetely addressed these problems before going ahead with the plan for a full wing modification. The House Survey and Investigation (S&I) staff report and a 1977 Rand report questions the need and desirability of a total wing fix compared to other alternatives.

NTU recommends that the 1977 Rand report recommendations for an independent panel of specialists to study the wing modification be followed. We suggest funding be stopped for the full wing modification and recommend that Congress request the Office of Technology Assessment to conduct an impartial review of the C-5 wing modification outside the Air Force.

Mr. Chairman and Members of the Committee, thank you for the opportunity to appear before the Joint Economic Committee.

The National Taxpayers Union represents 450,000 family members in all 50 states interested in reducing the burden of the taxpayer. We are concerned with all areas of federal spending and the military is no exception.

President Carter and many Members of Congress would like to increase defense spending in real terms. Military spending is one of the few areas scheduled for spending increases this year.

The National Taxpayers Union strongly supports a strong national defense, but we are also concerned that the American taxpayer is not getting a good return on his defense dollar. Since 1969, the Department of Defense has underestimated the costs of all major weapons systems by more than 50 percent according to hearings before the House Committee on Government Operations.[1]

One area that we are especially concerned about is the C-5A wing modification, known as H-Mod. We have serious questions concerning the C-5A and we believe the taxpayer has a right to bear some straight answers. We commend this committee for holding hearings on he proposed C-5A wing modification. We are hopeful that these hearings will shed some light on this program.

Before we raise our concerns about the wing modification let us briefly go back through the painful history of the C-5A cargo plane.

In the early 1960's, the Department of Defense developed an operational concept of a huge airlift capability that could give the United States a remote presence anywhere in the world. In 1964, the decision was made to build a C-5A cargo plane. Although Air Force engineers highly recommended Boeing's design for the new plane, Lockheed underbid Boeing in the initial contract by about 400 million dollars. It was generally known that the bid was too low, but because of pressure from the Georgia Congressional Delegation, Lockheed got the contract. (Boeing went on to revise their design for commercial use and produced the 747—one of the safest planes in history.)[2]

From that point the trouble began. For several years the cost overruns were kept quiet by Lockheed and the Air Force. The Air Force repeatedly claimed that only slight cost overruns were occurring, but justified the costs by claiming the plane exceeded its technical requirements. In late 1968, before Senator Proxmire's Subcommittee on Economy in Government, Ernest Fitzgerald, (who at the time was Deputy for Management Systems in the Air Force) told the committee the truth—the C-5A program had a $2 billion cost overrun. Despite these serious problems, and hours before Ernest Fitzgerald was scheduled to testify again, the Air Force quietly bought a second run of the C-5A without even knowing the real cost of the first run.

For the next several years Lockheed and the Air Force repeatedly dodged any type of accountability on the cost overruns to the taxpayer and the Congress. (We have included a chronology of the C-5A's history as Appendix I.)

The main argument for the C-5A, despite its cost overruns, was that it would be a technological marvel.

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[1] Inaccuracy of Department of Defense Weapon Acquisition Cost Estimates—Hearings before the House Legislation and National Security Subcommitee of the Committee on Government Operations, June 25, 1979.

[2] Rice, Berkeley; the "C-5A Scandal," Houghton Miflin Co., 1971, pp. 15-27.

During this same time period Henry Durham, department manager for Lockheed in charge of production control activities for the C–5A, began to notice serious problems in the flight production line of the C–5A. Planes with thousands of undocumented parts missing were being delivered to flight line areas. One of the reasons for the cost overruns became clear—quality and production control was grossly inadequate and rows of expensive unused parts lay rusting at the Georgia plant.[3]

Mr. Durham, unable to get any cooperation from the highest Lockheed management, quit in disgust and went public. These quality and production control problems were the first hints that the C–5A might not have been the technical marvel that justified the cost overruns. Lockheed had apparently manipulated the contract by deliberately running up the price of the first run of planes so as to make more money on the second run. The Air Force continued to look the other way, make the payments and accept faulty planes. This was a case of very poor accountability for the taxpayer.

The cracking of the wings in a stress test in July 1969, dispelled the myth that the C–5A Galaxy was a great technological achievement. Other problems began to appear as the planes were flown. One blew up on the runway and killed a Lockheed employee, an engine took off without the plane, wheels fell off during landing, but the most tragic failure of all was the cargo door failure during the Vietnam evacuation that killed more than 200 people including Vietnamese war orphans. Two years before this tragedy, an Air Force engineer pointed out the serious cargo door problem.[4]

From Jack Anderson's column:

"Among the mechanical problems known to Lockheed and the Air Force were faulty latching and locking mechanisms on the pressure doors and self contained cargo-loading ramps. In a confidential report dated June 23, 1971, a senior Air Force safety expert noted that there had been five cases of pressure door "loss" including one in flight.

"In uncharacteristically dramatic prose for a military report, he described the complex aft-cargo door mechanism as a "monster system" that caused the Saigon crash . . ."

Anyone wanting more details on the C–5A need only consult Congressional testimony. The failures of the plane are well documented.

So far we have spent $65 million per plane before the H–Mod. What did the taxpayer get for his investment? A plane with chronic design, quality and production control problems, produced and maintained at a high cost, that is unable to meet the specifications that was supposed to make it useful in the first place.

NTU has learned that the Air Force has awarded the Lockheed-Georgia Company a $1.4 billion contract for a full C–5A cargo plane wing modification program or H–Mod. This program's objective is to provide a 30,000-hour wing service life. We believe that the expenditure for a full wing modification is unjustified for the following reasons:

(1) An independent review of the project still needs to be done.
(2) A 30,000 hour flight goal may be unnecesary, unrealistic or unattainable at reasonable cost.
(3) Other lower cost options for the wing modification exist.
(4) The contract for the H–Mod has incentives for inefficiency.

Let's examine each of these reasons in detail.

1. AN INDEPENDENT REVIEW OF THE PROJECT STILL NEEDS TO BE DONE

As early as 1976 the General Accounting Office advised the Air Force to ". . . firmly establish and present to the Congress the total costs associated with modifying and correcting all defects."[5]

A 1977 Rand report which thoroughly studied C–5A wing modification proposals recommended ". . . that a panel of independent specialists be constituted to define and carry out the program of initiatives." We have recently obtained the declassification of this report and have included its pertinent references to the C–5A as Appendix II.

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[3] The Acquisition of Weapons Systems—Hearings before the Subcommittee on Priorities and Economy in Government of the Joint Economic Committee, Sept. 28 and 29, 1971, pp. 1280–1301.

[4] Washington Post, July 27, 1979, p. c–17.

[5] GAO PSAD–76–148 Information on the Requirement for Strategic Airlift, June 8, 1976, pp. 19 & 20.

A January 1980 report by the House Appropriations Survey and Investigation staff concluded that a ". . . panel of independent specialists needs to thoroughly evaluate the entire C-5A wing modification program . . ." A full copy of this report's discussion of the C-5A can be found in Appendix III.

The Air Force claims that the Air Force Scientific Advisory Board (a report was released in November 1979) (USAFSAB) and the Structural Information Enhancement Program (SIEP) steering committee "in effect" did do an independent review of the wing modifiation.

However, the S & I report doubts the objectivity of the SIEP because the makeup of the committee was largely composed of representatives from Air Force organizations, with Lockheed providing technical support.

The S & I report says "The SIEP in no way accomplishes these goals. One of the basic objectives of SIEP was to 'help sell wing mod' according to MAC."

We commend Dr. Paul Paris, Director of the Center for Fracture Mechanics of Washington University in St. Louis and noted fracture mechanics expert, for testifying before the committee today. Dr. Paris confirms the S & I staff's conclusion that the SIEP was not independent. He was co-author of the Rand Report and was a non Air Force member of the SIEP committee and was present at the final S.A.B. review of the SIEP program. He has written that the SIEP steering committee ". . . cannot be claimed to lack Air Force or Lockheed bias . . ." He also explained that ". . . U.S.A.F. Scientific Advisory Board, in their final review of the work, listened to one day of presentations from Lockheed-Georgia staff and drew their conclusions . . . In one day the S.A.B. members, no matter how eminent, could not examine the background of the data given at the briefing. They simply had to accept what they heard and base judgments on those numbers."

We were shocked to discover that recommendations made as early as four years ago for full fiscal disclosure of all alternatives has yet to be done.

2. A 30,000-HOUR FLIGHT GOAL MAY BE UNNECESSARY, UNREALISTIC OR UNATTAINABLE AT REASONABLE COST

The Air Force claims that the C-5A fuselage can last 30,000 flight hours. Therefore, the H-Mod is necessary to extend the life of the wings to match the life of the plane.

But we question this 30,000-hour fuselage life figure. When was this estimate calculated? How was it calculated? We don't doubt it could last 30,000 hours, but how much will it cost in maintenance and repair to make it last that long?

No independent evidence proves that the fuselage will last beyond 30,000 hours. In fact, an internal Air Force engineering report, known as APEX, on the safety of the C-5A pointed out other startling problems with the plane.

The following are the recommendations by the APEX study on what needed to be done on the C-5A to make it safe:

Provide additional simulator capability.

Eliminate fire sources and provide an extensive fire detection and suppression system.

Install electronic aids to prevent inadvertent collision with the ground.

Implement an effective corrosion control program.

Increase the spares and parts inventories to reduce cannibalization.

Improve the management system for implementing corrective actions.

Replace avionics systems with off the shelf equipment.

Install a lift distribution control system to reduce wing fatigue damage.

Return the aft cargo door complex to full operational use.

We have included the engineering part of the APEX report that we were able to obtain as Appendix IV. We apologize for the condition of the report, but very few of these reports are in circulation. The APEX group did not put a price tag on these repairs. However, a 1976 GAO report concluded:

"The total cost to implement the APEX recommended improvements is unknown at this time. We believe, however, a substantial cost will be incurred for additional work resulting from the study." [6]

Were these costs of the other documented problems considered by the Air Force before they claimed that the wing fix was the most cost effective solution? We have not seen any evidence that they were.

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[6] GAO PSAD-76-148 Information on the Requirement for Strategic Airlift, June 8, 1976, p. 20.

NBC News has found more recent evidence that the C–5A has other problems beyond the wing. They recently reported that the complicated nose gear has malfunctioned frequently and failed upon landing last August at Rhine-Mein Air Force Base in Germany. The commander of the C–5A at Dover Air Force Base admitted to NBC that the C–5A had more shutdowns than normal due to engine problems. According to NBC, in 1978 a C–5A blew an engine upon takeoff and in January 1979 another C–5A engine failed while leaving a base in Hawaii.[7]

How many of the APEX repairs or modifications have been implemented? At what cost? How much is being spent on fixing the most recent failures of the C–5A? These are basic questions that the Air Force has not publicly addressed.

The 1976 GAO report also concluded:

"If the C–5As are to be available for airlift through the 1980's, the wing modification and other modifications such as the aft cargo door, installation of a fire suppression system, and a lift distribution control system are apparently essential. The Air Force should firmly establish and present to the Congress the total costs associated with modifying and correcting all defects. That cost should then be compared with the cost of alternative methods of achieving the mission now assigned to the C–5A, such as prepositioning material utilizing fast sealift capability or procuring outsize versions of the 747 (or equivalent) freighter."[8]

Both the Rand report and the S & I staff report question the need for extending the flight hours to 30,000. At projected utilization rates a 30,000-hour service limit would enable the plane to last until 2019. It would then be 46 years old and probably obsolete. A choice of a 30,000-hour service limit eliminates low cost options. The Rand report concludes that these options have not been thoroughly examined. Even though the Air Force had the results of the Rand report, the charter for the SIEP review did not include any study of alternatives of the H-Mod. Again, in 1980, the S & I staff report brought up the need to study low cost options.

The Rand report states:

"The 30,000 hour requirement, a fundamental tenet on which past judgments and decisions have been based, needs to be re-examined by the Air Force . . . If the 30,000-hour service life goal is not a constraint, then there is no overwhelming technical reason to foreclose consideration of a number of alternatives . . . Neither the predicted fatigue problems nor the justification the possibility that the service life might easily be extended to 12,000 to 15,000 hours, providing the opportunity for service to the end of the century without significantly impairing the aircraft performance capabilities . . . An aggressive near term pursuit of additional information could . . . possibly lead to long term savings in the costs of wing modification."

The S & I report states:

"It is apparent that a 30,000-hour service life is not necesary . . . At projected operating rates (and allowing 2,000 flying hours per aircraft reserve for contingency operations), only 14,400 to 16,400 flying hours are needed to sustain the C–5A to the year 2000."

3. OTHER LOWER COST OPTIONS FOR THE WING MODIFICATION EXIST

The Air Force has chosen the most expensive option for fixing the wings of the C–5A—the H-Mod. The 1977 Rand report repeatedly questions this approach:

"Option H represents a high confidence but expensive way to meet this design goal. Lesser options involving more modest structural modifications and extending present constraints on operational use conceivably could extend the service life of the C–5A through the balance of this century for significantly less than the Option H will cost, and could avoid the crtical reduction of outsize capability during 1983–86.

The Rand report discusses other options and their costs. Other viable options do exist.

However, a later review by the Structural Information Enhancement Program (SIEP) steering committee was limited by charter to discussing only the H-Mod. We would like to know why the other options were eliminated in favor of the

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[7] NBC News, Prime Time Saturday, 3/29/80.

[8] GAO PSAD–76–148 Information on the Requirement for Strategic Airlift, June 8, 1976, p. 11.

H-Mod. These decisions on the part of the Air Force convince us that an independent review of the H-Mod and other possible options is essential. The taxpayer deserves a closer look at lower cost options to the H-Mod.

4. THE CONTRACT FOR THE H-MOD HAS INCENTIVES FOR INEFFICIENCY

Lockheed now has the contract for the H-Mod wing fix. How much profit and general and administrative expenses are being paid to Lockheed? If any profit is being paid to Lockheed for the H-Mod, we are setting up a terrible incentive system. We will be rewarding Lockheed to repair a part that is clearly deficient. What type of example will we be setting for other defense contractors? The message is clear. The more inefficient you are—the more profit you make. Build failures into the system and you'll be rewarded. By rewarding failure such a system encourages waste and inefficiency.

We have been informed that Lockheed has a fixed price/incentive contract for the wing modification construction. This means the taxpayer will pay a certain percentage of any cost overruns. What percentage is unknown to us. But on the basis of Lockheed's past performance on this plane, the likelihood of large cost overruns is very real. We find it incredible that the taxpayer would have to pay any more cost overruns on this plane.

Finally, because the H-Mod wing fix may very well be unnecessary, could it be that H-Mod was intended to be a multi-million dollar bailout for Lockheed?

CAN WE RELY ON THE C–5A?

Beyond the question of the cost effective problem of the wing fix is another pressing question. Is this plane reliable in a national emergency? The plane has had unexplained random failures such as landing gear malfunctions, engine failures, and other problems beyond its wing flaws. The C–5A played a significant role in the 1973 Mideast Airlift. Although the 1975 GAO Mideast Airlift report stated that the C–5A performed well, a significant problem occurred that placed doubt on the plane in case of a more massive airlift need.

Sixty percent of the C–5As were inoperable because they needed maintenance or parts. Only 35% of the C–141 aircraft were inoperable for the same reasons. Although this did not hinder the Mideast Airlift effort, it seriously raises doubts that the C–5A can be used for a massive airlift effort.[9]

We seriously question the reliability of a weapons system where only 40% of the planes were operational in an emergency. We believe this problem relates back to the quality control disaster during the manufacturing stage.

LACK OF CREDIBILITY

We see a chronic lack of credibility on the part of the Air Force on the C–5A. The less than full disclosure on the part of Lockheed and the Air Force of the cost overruns and technical failures of the C–5A are well documented. We have not seen any change in the basic attitude in the Air Force since the first C–5A fiscal disaster.

Who will watch the taxpayers' money in this new C–5A investment?

There are no more Ernest Fitzgeralds to watch for the abuses by the Air Force—his job was eliminated. How can the taxpayers believe their figures in light of their horrendous past performance? Who is watching for the soldier whose life may depend on this equipment?

The fiscal marriage between the Air Force and Lockheed continues. The Air Force glossed over Lockheed's abuses on the C–5A so as not to "hurt" the company. The drain of tax money by the Air Force and Lockheed on the C–5A may not be over yet.

NTU RECOMMENDATIONS

NTU urges Congress to stop funding on this project until a thorough review is made. Spending money on the H-Mod could be wasted. This should be stopped before it is too late to implement cost saving recommendations.

To prevent waste, it is Congress' duty to see that an independent review of the H-Mod is done. Because the Air Force has been unable or unwilling to follow the several recommendations for an independent study of alternatives, we recom-

[9] GAO LCD–75–204 Airlift Operations of the Military Airlift Command During the 1973 Middle East War, Apr. 16, 1975, p. 12.

mend that Congress request the Office of Technology Assessment (OTA) to conduct such a study. The OTA is best suited to do the study because of the highly technical nature of the subject. OTA also has the statutory power to get the information that is needed and would not have any vested interest in the outcome of the study.

Lockheed's contract for any C–5A wing modification should be renegotiated to exclude any profit or general and administrative expenses. This is necessary if we are to send a message to Air Force contractors that taxpayers will not pay for failure and mistakes. We should not set up an incentive system that rewards contractors for faulty products. To do so would encourage failure and mismanagement on the part of all contractors.

The H-Mod is at best a questionable investment for the taxpayer. Congress is about to make the final investment without a full study of alternatives. The C–5A fiasco is a system of a larger fiscal disease. We feel that it is high time for the Congress to put some kind of restraints on such spending by the Department of Defense. NTU Research Director Sid Taylor has formulated the "Fitzgerald's Law of Cost Overruns"—"First it's too early to tell what it will cost; and second, it's too late to do anything about it."

Fortunately, it is not too late for Congress to do something about the C–5A wing modification proposal. The taxpayer is counting on it.

Appendix I

1965 Air Force awards contract to Lockheed over Boeing to build C–5A's.

Jan. 1966 Ernest Fitzgerald visits Lockheed and learns that overhead rates for the program were well above those estimated in the contract; he reports it to his superiors via Office Financial Management's Weekly Staff Digest Report.

Oct. 1966 Lockheed has an overrun of $18 million but solves that by increasing its budget for August–Oct. period.

Nov. 1966 Rising costs show up on System Program papers, but when confronted with it Lockheed denies there is any overrun, but refeuses to supply any figures.

Dec. 1966 Overrun now up to $122 million. Cols. L. Killpack and J. Warren report the overrun to Ass't Secretary L. Marks of the USAF. Col. Killpack is transferred to Vietnam and Col. Warren a computer manager, somewhere in the Pentagon.

Jan. 1967 The Comptroller of the DOD requests a cost summary from the Air Force. The report shows no overrun at all, makes no mention of Lockheed's $212 million 'budget increase' and fails to supply most of the data requested. The Comptroller returns it for "reaccomplishment." Lt. Gen. D. Crow, Comptroller of the Air Force Systems Command deletes the $212 million overrun from a management summary report because the figures have not been reviewed by proper USAF authorities.

Jan. 1967 Lockheed requests $79 million in additional funding.

Sum. 1967 A USAF study group states the Lockheed budgets submitted to the Air Force were "so unrealistic one wonders if they were developed for government consumption."

Nov. 15, 1967 Air Force Chief of Staff Gen. J. McConnell reports to Sect. of Defense McNamara the Air Force has been successful in controlling cost growth in the C–5A program as a result of changes. DOD Comptroller R. Anthony reports an overrun of $351 million. Estimate for completion cost is nearly $500 million over original estimated cost.

Feb. 1968 Lockheed submits a year-end report to the USAF showing no serious cost problems. A C–5 system Program Office report estimates Lockheed having a potential loss of $316 million. Lockheed protests that the estimates are too high.

Mar. 1968 Ass't Sect. of the Air Force for Res. and Development A. Flax tells the House Subcommittee on Defense Appropriations that current estimates of C–5A costs are "within range" of the original target & ceiling costs.

Spring 1968 USAF Systems Command finds an overrun of $570 million. This is covered up by a program change which increases Lockheed's budget requirements by $570 million above earlier estimates.

Summer 1968 DOD Comptroller R. Anthony attempts an audit but is told by the AF Systems Command and the C–5 System Program Office that the overrun information has been deleted from their reports per direction of higher headquarters. System Program officers tell GAO audit that orders from Ass't Sec. of the AF for Installations and Logistics said the overrun on the C–5A program should not be reflected in routine management type reports.

Nov. 13, 1968 In testimony before the Senate Subcommittee on Economy in Government E. Fitzgerald testifies the projected overrun for the entire C–5A program will reach at least $2 billion due to initial underestimation of costs, ineffective cost controls, and corporate strategy. The AF immediately denies the $2 billion estimate, but puts the figure at $1 billion.

Nov./Dec. 1968 GAO requests cost data and is told it is classified on the grounds that such data might compromise negotiations with Lockheed for a second run of 57 planes.

Jan. 1969 AF agrees to release cost data if GAO agrees not to make them public. GAO does not agree. Ass't Sec. Charles sends GAO a brief and incomplete cost summary explaining that circumstances of the negotiations make it possible to release the data. The summary and subsequent GAO report relied almost completely on cost figures supplied by the AF or Lockheed.

Jan. 16, 1969 The AF places its order for 57 more planes just hours before Ernest Fitzgerald was to testify again before Proxmire's committee.

Jan. 1969 Air Force claims C–5A will exceed the contractor's proposed performance.

Apr. 1969 Defense Secretary Laird declares that in the future, "full and accurate information on the C–5A and other procurement matters."

June 1969 Ernest Fitzgerald testified that the C–5 requirements had been relaxed, such as 15% reduction in its gross weight for takeoff and landing on substandard airfields and a 10% decrease in allowable "sink rate" on landing.

July 13, 1969 Wing crack occurs during static ground tests. Air Force Colonel remarks: "The reason the wing came off this aircraft is because we meant for it to come off."

Sept. 1969 Wing fix by Lockheed failed in ground test at only 83% of the plane's load limit. The Air Force did not make it public.

Dec. 1969 GAO finds 25 defects in C–5.

Dec. 17, 1969 Air Force accepted first C–5 from Lockheed with defects.

Jan. 1970 Second wing crack occurs.

Jan. 1970 Air Force announces wing fix would cost $6.5 million. Six months later the estimate rose to $15 million.

March/Oct. 1970 C–5 continues to have sporatic failures.

Oct. 18. 1970 First C–5 plane explodes on runway.

Sept. 1971 Former Lockheed employee Henry Durham testifies before Senator Proxmire's Subcommittee on Priorities and Economy in Government. He accuses Lockheed of serious lack of production controls and collusion between Lockheed and the Air Force.

Mar. 1972 GAO confirms Durham's charges and charges the Air Force with $1 billion dollar overpayment to Lockheed.

Apr. 7, 1972 Air Force Secretary Seamans voices disappointment in C–5 and is forced to limit the plane to crisis use due to wing failure.

July 1973 Shortly after the delivery of the last C–5, Lockheed recommended a new wing design.

Apr. 1975 C–5 crashes in Vietnam killing over 200 people including war orphans. A 1971 Air Force study reveals that the Air Force knew about a severe cargo door problem that caused the crash.

Apr. 1975 GAO evaluates 1973 Mideast Airlift and found that 60% of the C–5 planes were grounded for repair or maintenance.

Apr. 1975 Air Force study group (APEX) points out serious defects other than the wing in the C–5. The report was not widely circulated.

Apr. 1975 Defense Systems Acquisition Review Council reviewed wing modification for the C–5 by Air Force and asked the Air Force to consider alternatives. Air Force did not respond.

Dec. 1975 Air Force awarded a contract to Lockheed for $28.5 million to initiate design efforts.

June 8. 1976 GAO releases Airlift report and claimed that the Air Force has not provided sufficient data to the Congress to properly consider the needs for new/alternative airlift programs. The Air Force made no response.

Jan. 1980 Final phase of wing fix contract awarded to Lockheed.

Feb. 1980 Air Force asks Congress for new cargo plane—C–X. The program will cost (according to the Air Force) $6 billion dollars.

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Strategic Mobility Alternatives for the 1980s: Vol. 2, Analysis and Conclusions (U)

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Rand
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V. SERVICE LIFE OF THE C-5A: PROBLEMS AND STRATEGIES[1]

The C-5A is the only U.S. aircraft capable of carrying outsize equipment over transoceanic ranges. Eight to ten years would be needed to procure a fleet of supplemental--or substitute--aircraft. In the near term there appears to be no reasonable alternative to doing whatever is necessary to ensure that the C-5A remains a useful element of the airlift force.[2]

Choosing the most appropriate strategy for preserving C-5A capability is potentially of great significance because: (1) the $1.267 billion wing repair program is the largest single item of cost (except for ATCA) in the current strategic airlift program; (2) the critical problem for rapid Army deployments by air is the shortfall of outsize capacity; (3) there could be as much as 17 percent reduction in outsize airlift capacity during the four years required for serial modification; (4) the cost burden of replacing the C-5A wing may hinder future efforts to procure additional outsize airlifters; and (5) the C-5A continues to draw the attention of Congress. A basic issue is, how urgent *is* the C-5A wing problem?

The Air Force's assessment of the current service life limit, means to extend the years of service, and wing modification options have been based on analyses prompted by the fatigue test results (summarized in Appendix C in Vol. 3), which constitute the only empirical evidence that the C-5A may develop serious fatigue problems with the current configuration of the wing. In response to these concerns, fracture

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[1]This section has benefited from personal communication and discussions with C. F. Tiffany of the Aeronautical Systems Division, members of the Division Advisory Group, the former C-5A System Program Office (Col. W. A. Newsome, Jr., G. F. Purkey, L. Smythers), and the Lockheed-Georgia Company (A. P. Shewmaker and R. L. Circle). This support is gratefully acknowledged; however, the interpretations presented are those of the authors, who are wholly responsible for any errors of fact or interpretation. Additional technical detail is contained in Vol. 3 of this study, Appendixes B-H.

[2]See Appendix B, Vol. 3, for a brief discussion of the background on the C-5A service life problems and a summary of previous evaluations and resulting actions.

mechanics methods have been used to make a calculation of what is thought to be a prudent safe service limit for the present wing. An analysis of the uncertainties implicit in this calculation is contained in Appendix D, Vol. 3. Appendix E, Vol. 3, presents an evaluation of the uncertainties that are implicit in the empirical evidence (Appendix C, Vol. 3). The combination of these technical uncertainties raises three important questions:

1. How accurate are the estimates of the remaining life of the present wing?
2. What is the minimum remaining life requirement for the C-5A?
3. What are the alternatives for meeting this minimum remaining life requirement?

The first and third questions are addressed here in terms of the sensitivity of the answers to the major technical uncertainties.

An answer to the second question ultimately involves a value judgment that must be based on a wide spectrum of inputs including, perhaps, a refined analysis of the other questions. In 1965, the answer to the second question was 30,000 flying hours based on a planned utilization rate of 1,800 hours per year (implying a 17-year *calendar service life*). However, the underlying assumptions for this answer have changed: (1) through the first five years of its service life, utilization of the C-5A has only been about one-third of the originally planned rate; (2) the C-5A has thus far been plagued by more than the usual share of problems for a new aircraft; and (3) even with the present problems resolved, the utilization rate for the C-5A is not likely to exceed 700 to 750 hours per year.[1] Thus, a reconsideration of the second question, in conjunction with a narrowing of the technical uncertainties (see Appendix F, Vol. 3, for some possible information enhancement initiatives), may ultimately avoid a 17 percent drawdown in outsize airlift capacity in the mid-1980s, as well as yield a less costly

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[1]After the wing repair and the UTE rate increase, MAC plans for a utilization rate of 2.13 hours per day for 70 aircraft based on a 360-day year. Spread over the entire force of 77 aircraft, the average annual utilization would be 697 hours per aircraft (2.13 × 360 × 70/77).

approach,[1] which would release funds for a more timely acquisition of additional outsize airlift capability.

BACKGROUND

For planning purposes, the Air Force has set the safe service life for the C-5A at 8,000 fatigue equivalent flight hours (based on the 1974 configuration and the 1973 mission use). Since some aircraft have already exceeded 6,000 equivalent hours of service, the repair decision has been viewed as a matter of some urgency.

In addition to curtailing peacetime operations and applying a near-term load-alleviation modification to the C-5A aircraft,[2] the Air Force decided in 1973 that it would be prudent to proceed with the Plan H modification (Option H) rather than lesser modifications, because of the lower risk involved in a wing that would not restrict the design mission use of the aircraft up to the original service life goal of 30,000 operating hours. However, since 1973, the C-5A force has averaged less than 700 flying hours per plane per year,[3] and future operations may only slightly exceed that average even if the UTE rate increase were to become effective. Thus, if Option H provides only an additional 22,000 hours of flying potential for each C-5A, operations averaging 600 to 750 hours a year imply retention of the C-5A in the force until about 2010-2020 (assuming no major contingencies).[4] Such

[1]Potentially less costly wing repair options are discussed subsequently and described in more detail in Appendix G, Vol. 3.

[2]The Active Lift Distribution Control System (ALDCS). For a description of this modification, see Appendix B, Vol. 3.

[3]The difference between the originally planned utilization rate of 1,800 hours per year and the current rates of less than 700 hours per year is probably attributable to: (1) overly optimistic estimates of peacetime requirements for military airlift services, (2) reduction in the demand for peacetime military airlift services due to the rising cost of shipping by air (higher fuel and personnel costs), and (3) efforts to preserve the service life of the current wing configuration.

[4]Several airlift operations, each equivalent to the 1973 Middle East Airlift, would not have a significant influence on this projection. However, a major deployment to Europe, such as was considered earlier in this report, could take one to two years off the projection.

a possibility stimulates questions about whether the costs for other repairs (e.g., for corrosion) or replacement of other components will limit the economic life of the aircraft to less than the safe service life of the wing. Furthermore, technological obsolescence may overtake the C-5A long before such extended calendar service is realized. The Air Force has seldom retained aircraft in service for more than 30 calendar years, yet the initial C-5A deliveries occurred in the late 1960s.

Two questions underlie the consideration of lesser modifications than Option H. Is the extent of the Option H repair necessary? Would the long-term benefit from a new wing be fully realized?

THE TECHNICAL UNCERTAINTIES

Following extensive technical discussions, personnel from Rand and the Air Force's Aeronautical Systems Division (ASD) have agreed that the uncertainties implicit in the service limit calculation and the interpretation of the available empirical evidence may be summarized as follows:

1. The current requirement imposed on ASD is that they modify the wings on the present force of C-5A aircraft to make them capable of meeting the 30,000-hour service life requirement. If the 30,000-hour requirement is still a reasonable objective, then it is likely that no reasonable alternative would be more cost effective than replacing major structural elements in the wing boxes.
2. The 8,000-hour service limit set for the current C-5A wing configuration has been established for programming and planning purposes and is, therefore, based on a number of considerations in addition to the technical evaluation of the structural integrity of the present configuration of the wing structure beyond the 8,000-hour plateau. One of the considerations was that the 30,000-hour requirement imposed on ASD means that the current wing boxes (or substantial portions thereof) eventually will have to be replaced. Given this reality, it was felt that the wing boxes might as well be replaced sooner (e.g., at the 8,000-hour plateau) rather than later. The 8,000-hour plateau should not be viewed as the point at which widespread fatigue cracking is expected; indeed, that is not expected to happen until some time beyond 8,000 hours.

3. Alternative measures to Option H may be more cost effective given an alternative requirement, somewhere less than 30,000 hours and greater than 8,000 hours.

4. More information is required with respect to the structural integrity of the current configuration of the C-5A wing beyond the 8,000-hour plateau. Efforts to obtain some information are already planned. For example, as soon as the first aircraft reaches the 8,000-hour plateau, there may be a detailed inspection of the wing on that aircraft. This could be followed by a reappraisal of the minimum actions required to safely extend the service life of the current configuration of the wing beyond 8,000 hours.

5. The 30,000-hour requirement, the future requirement for outsize capacity, and the alternatives for meeting that capacity all need to be reassessed.

Much of the foregoing uncertainty stems from the fact that the current service limit is not directly supported by either the time at which cracks were observed during the fatigue tests or the experience of the service aircraft to date (see Appendix E, Vol. 3). Rather, the service limit is based on the *possibility* that initial manufacturing damage (equivalent to a propagating quarter circle crack with a .05 inch radius) located at a corner of a fastener hole could have been introduced along a critical spanwise splice in the highly stressed region of the wing lower surface.[1] The initial damage could have been introduced into both overlapping panels[2] at a tapered fastener hole. The fastener that was installed in this dual-flawed hole could have failed to achieve even a partially effective interference fit (which, if achieved, would retard crack growth); and the propagating cracks in both panels could have developed at rates equivalent to those observed under conditions of 95 percent relative humidity.[3] With these assumptions, the Lockheed-Georgia Company has used state-of-the-art fracture

[1]Not all lower surface spanwise splice fastener holes are in the highly stressed region; defects in other regions will not lead to failure as rapidly. See Appendix E, Vol. 3, for additional discussion.

[2]"Panels" is the technical term for the pieces of aluminum that are spliced together to form the wing surface; the initial damage in the second panel may be less extensive (i.e., equivalent to a corner crack with a radius less than .05 inch).

[3]Although crack growth intervals decrease with increases in relative humidity, Lockheed judges that it is appropriate to use the 95

mechanics methods to calculate that after 8,000 hours (1974 configuration and 1973 operational use), an initial .05 inch corner radius crack will have grown to a limit load "critical length" of 0.8 inch. The critical crack length is such that, if the aircraft encountered a "limit load" condition, both panels would fail.[1] It is assumed that this would lead to wing failure and loss of the aircraft because the C-5A was not designed to withstand a double panel failure. Thus, 8,000 hours has been designated as the safe service limit for the current configuration of this aircraft. Relaxation of these analysis assumptions would lead to a higher service life limit. More conservative ground rules (e.g., larger initial damage or the application of a safety factor) would yield a lower service limit.

The technical uncertainty attendant on the 8,000-hour service limit and the limited empirical evidence available to support or refute it make it important to examine increases in service life even as small as 2,000 hours. That increment may open a number of interesting options for preserving the C-5A's wartime capabilities into the 1990s without a major modification of the wing.

THE POSSIBILITIES OF POSTPONING A MAJOR WING MODIFICATION

In his FY 1976 posture statement, the Secretary of Defense said, "At the rate the C-5 aircraft are incurring fatigue damage, the force will begin to reach a damage accumulation point in 1979 at which time some of the aircraft will have to be grounded." ASD made a similar projection in January 1975 in the "Competition Feasibility Study for C-5A Plan 'H' Wing Modification." The ASD projection assumed that high-time aircraft would be flown from 900 to 1,000 hours a year under

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percent relative humidity data to offset "other aspects" of the calculation that would result in an overestimate of the crack growth interval. However, technical documentation of these "other aspects" could not be provided to Rand for the present review.

[1]The stress level for the limit load condition is 50 percent greater than the maximum stress expected in one service lifetime (30,000 hours); it traditionally has been the maximum load (consistent with the operational use limitations imposed on the aircraft's gross weight, payload, speed, and maneuver conditions) that will not permanently deform the structure.

conditions similar to those existing in mid-1973.[1] However, peacetime use of the C-5A has changed since 1973 (e.g., average payloads have been reduced). Figure 4 shows that at the FY 76 utilization rate, the difference between 1973 and 1976 mission use represents a potential 2.5-year extension of the average time at which the 8,000-hour plateau would be encountered.

Illustration of the Useful Service Calculation

The procedure used to construct the curves in Fig. 4 can be illustrated as follows:

1. A per plane average of 3,856 fatigue equivalent flight hours (1974) configuration, 1973 use) had been accumulated by the C-5A force as of December 31, 1975,[2] 4,144 hours then remained to the 8,000-hour limit.

2. The average installation date for the ALDCS was approximately April 1976, so the C-5A SPO's life extension factor of 1.25 for this modification pertains to about 4,000 remaining hours. Thus, there were about 5,000 hours of 1973 mission use remaining (as of about April 1976)[3] in terms of the 1977 configuration (with ALDCS).

3. At 500 hours of 1973 mission use per year, there would be ten years of service available (not accounting for any contingency use).

4. However, data from the first nine months of 1976, a period of reduced cargo use,[4] indicates that nearly 1.3 flying hours (without the ALDCS) were equivalent to one hour of 1973 mission use. Thus, there would be 13 years (1.3 × 10) remaining based on 1976 mission use.

5. Similarly, a more austere use (discussed in Appendix H, Vol. 3), may yield 1.6 flying hours per 1973 mission use hour, in which case there would be 16 years remaining (1.6 × 10) as of April 1976.

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[1] An explicit allowance for contingencies was not included in this projection.

[2] This was the most recent individual aircraft data provided by the C-5A SPO as of early 1977. See Appendix H, Vol. 3, for additional details.

[3] Calculations of remaining life in this example will refer to April 1976.

[4] Because of a misunderstanding during the Congressional appropriations process, this reduced cargo use program was suspended in late 1976. However, it is planned to be reinstated in late 1977.

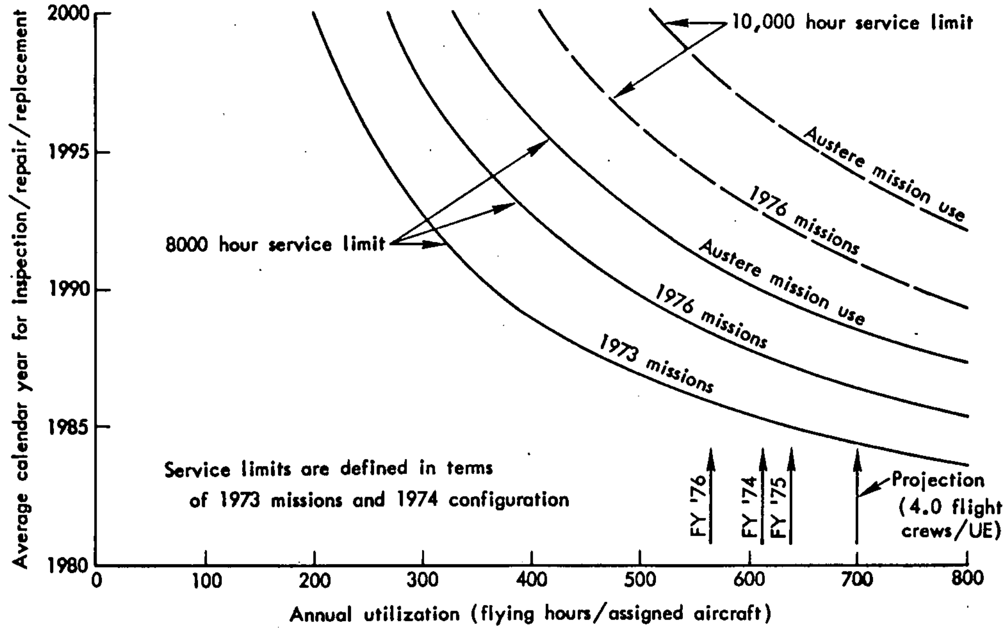

Fig. 4—Time for special inspection/major repair action/replacement for the aircraft in the C-5A force

6. If the service limit were extended by 2,000 hours (1974 configuration, 1973 mission use), this would be equivalent to 4,000 ($2{,}000 \times 1.25 \times 1.6 = 4{,}000$) additional hours based on the ALDCS configuration and austere mission use. Thus, at 500 hours per year, this would add an additional eight years for a total of 24 years remaining as of April 1976. Therefore, with a 2,000-hour service limit extension, utilization of 500 hours per year, austere mission use (assumed to yield 1.6 flying hours per 1973 mission equivalent flying hour), a 1.25 life extension factor for the ALDCS, and no allowance for contingencies, the service life of the C-5A wing could be extended 24 years beyond April 1976. If the use rate is changed to 700 hours per year, the total extension would be 17 years (to 1993). In addition, if the mission use is changed to that of 1976, the total extension would be 14 years (to 1990).

Discussion of Results

The austere mission use[1] curve in Fig. 4 is based on a previous MAC assessment of an austere use of the aircraft that would be consistent with maintenance of wartime capability (see Appendix H, Vol. 3). At a 3.25 crew ratio, the required annual use would be about 550 flying hours per force aircraft[2] and the "inspect or repair or replace" threshold (the 8,000-hour limit) would be the year 1988 for the "average aircraft" in the fleet, based on 1976 mission use. Although that would obligate MAC to operate some 15 to 25 high-time C-5As at a much lower annual rate, enough low-time aircraft now in the inventory could be flown at a higher than average rate to make up the difference. The two dashed curves in Fig. 4 show that if the safe service limit were

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[1]Although the austere mission use, with a ratio of 1.6 flying hours to one 1973 mission use hour, is viewed by MAC and ASD as being possibly overly optimistic at the present time (see Appendix H, Vol. 3), there is reason to believe that the 1.25 life extension factor for ALDCS is low (see Appendix H, Vol. 3). In our view, satisfactory resolution of these uncertainties, as well as whether a service limit extension may be practical, will require better information than currently available (see Appendix F, Vol. 3).

[2]About 600 hours per year on a 70 aircraft unit equipment basis.

10,000 hours, the useful life might be extended to the 1990s without a major modification, and with no operational change more drastic than careful management of peacetime flying. The sensitivity of this finding to contingency use is considered next.

The 8,000-hour service limit is based on the provision that "as individual aircraft attain their safety limit, they must be placed in flyable storage for wartime contingency use."[1] However, the *extent* of wartime service so reserved (at an implicitly higher risk) is not specified. Figure 5 illustrates the effects of *additional* emergency operations on the residual life of the aircraft. Transporting the outsize equipment for eight division equivalents plus 54 TAC squadrons to NATO (the notional contingency examined earlier in this report) represents about 56,500 C-5A flight hours. The effect of providing for a one-contingency reserve (in addition to that available at 8,000 hours) is to shorten the useful life of a C-5A force by one to two years depending upon peacetime mission use (for utilization rates from 500 to 700 hours per year).

Assuming 1976 utilization and mission use and one such notional deployment, the average threshold for inspect or repair or replace would be mid-1986 (corresponding to a modification start date of 1984). Thus, *even given the current Air Force assessment of the safe service life of the aircraft,* the proposed wing replacement program does not appear to be as time-urgent as was previously thought. Moreover, the Air Force's former projection for the 1979 starting date for modification did not include an allowance for a contingency reserve. Even a deferral of modification startup to 1984 may provide some opportunity for additional outsize capacity to offset the loss of C-5As during modification.

The preceding discussion suggests that it may be possible, with austere mission use, to extend the C-5A's safe service life--including at all times a reserve for wartime operations--to the 1990s without a major wing modification. This sets a *lower* bound on options, if Option H is considered as an upper bound. Intermediate options with service

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[1] C. F. Tiffany, *C-5A Wing Structure*, Aeronautical Systems Division, Briefing, January 1975. It is MAC's position that actually placing the C-5A in flyable storage is unacceptable.

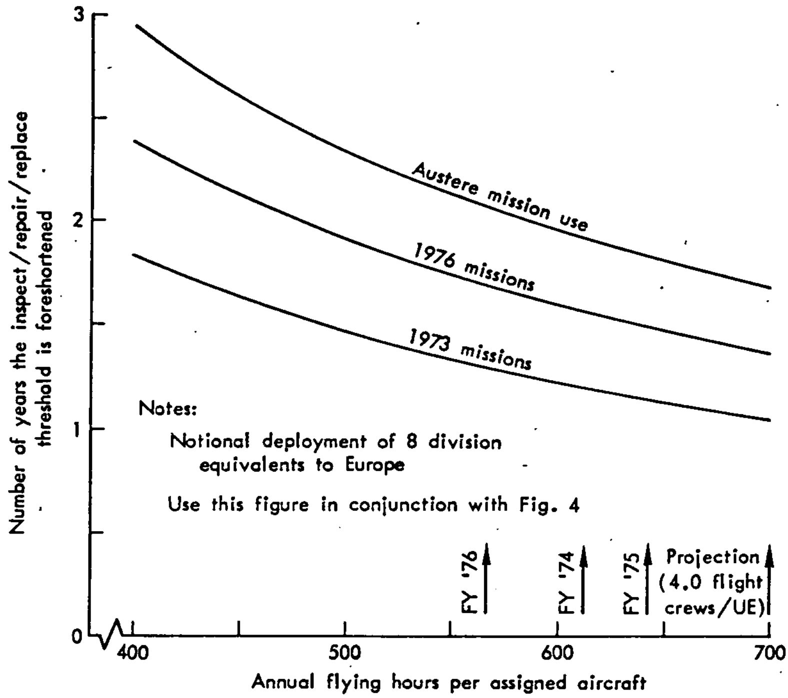

Fig. 5 — Effect of a notional contingency on the special inspection/repair action/replacement threshold

life objectives of less than 30,000 hours may also be technically feasible. Figure 6 displays the same kind of results as Fig. 4 for a range of service limits (up to 15,000 hours) that might be achieved by modifications to the wing structure less extensive than Option H.

ASSESSMENT OF WING STRUCTURE MODIFICATION OPTIONS

The 1972 Independent Review Team (IRT) defined a large number of alternative airframe modification strategies for extending the C-5A

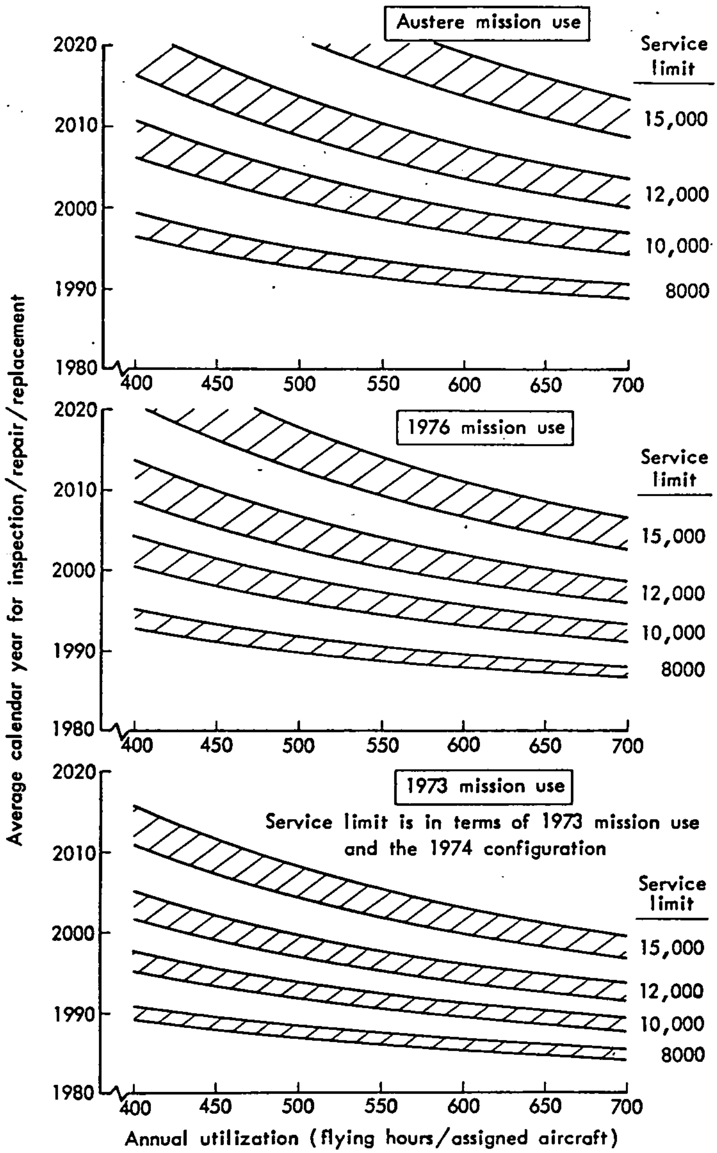

Fig. 6—Sensitivity of calendar year service to mission use, service limit, ALDCS life extension effectiveness (shaded area) and annual utilization

wing life. From these strategies, nine options were developed to provide various degrees of life extension.[1] The Secretary of the Air Force approved the adoption of ALDCS (Plan D) as a near-term means of extending the life of the current wing while development of a longer-term solution (Plan H) proceeded.

The IRT projected that the incorporation of the ALDCS would extend the wing's service life limit to 11,300 to 16,700 hours (depending on the hours already accumulated). The projection assumed mission use slightly different than that of 1973. The difference between this IRT assessment and the present 8,000-hour limit is attributable to the IRT's use of a higher estimate of the life extension effectiveness of the ALDCS, a different procedure to construct the stress spectrum, different crack growth rate data, and the neglect of shear load transfer. The IRT also used a smaller initial crack length (of .03 inch rather than .05 inch); however, this was more than offset by the IRT's use of a safety factor of two because an explicit safety factor has not been used in the 8,000-hour calculation.

The original long-term plan (Plan H) was to satisfy the 30,000-hour life objective through a *rework* of all of the wing boxes (incorporating a change in fasteners and the replacement of some surface panels). An intermediate plan (Plan E) was projected to be capable of providing 22,600 hours by means of a fastener change similar to that performed on the fatigue test article. (The IRT life extension estimates need to be reappraised in the light of new data and analysis procedures.)

By the fall of 1976, the ASD Division Advisory Group had approved a series of modifications to the original Plan H, the cumulative effect of which is the *replacement* of the center, inner, and outer wing boxes with boxes of improved design in order to assure that the wing would not preclude the fulfillment of the original design mission use and 30,000-hour service life goal.

If the 30,000-hour service life goal continues to be a constraint, then there appears to be no overwhelming technical evidence (see

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[1]For a more thorough discussion of these options, see Appendix B, Vol. 3.

Appendixes E and G in Vol. 3) that would foreclose consideration of any one of a number of alternatives--for example: (1) a variation of the IRT Plan E fastener change, (2) a variation of the original Plan H *rework*, or (3) the current wing repair program (Option H). The fastener change[1] alternative might be applicable only to the low-damage aircraft (for the purpose of illustration it is assumed here that 62 aircraft would fall in this category). Reworking wing boxes, with some surface panel replacements, might be required only for the remaining high-damage aircraft (15 aircraft in this illustration). A mixed modification concept (rework on high damage and fastener change on low-damage aircraft) would minimize the C-5A downtime for modification. Moreover, it would avoid the weight penalty associated with the Option H modified wing. The Option H configuration of the C-5A has an empty weight 26,000 lb greater than the current configuration (22,000 lb of additional structure to the wing, 3,500 additional pounds for the engine installation, and 500 more pounds of unusable fuel). This must reduce either the range or the maximum payload for unrefueled missions with a range greater than about 1,900 n mi.[2]

Table 8 provides preliminary life extension and cost estimates for the purpose of illustrating the potential relative costs and benefits associated with alternative structural modification options.[3] The modification start dates are also described in the table. The threshold for inspection, repair, or replacement of the wing[4] is expressed as an average year for the entire force. The results in Table 8 are presented for utilization rates of 500 to 700 hours per year per aircraft (sufficient to support 3.0 to 4.0 crews per UE). The principal assumptions

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[1]New fasteners might provide 8,000 hours of post-installation service life, but other factors may limit a C-5A wing to as little as 12,000 hours; the service life expectanty of the C-5As modified by fastener changes is assumed to be 12,000 hours.

[2]See Appendix A, Vol. 3, for a more thorough discussion.

[3]The tentative nature of these cost estimates must be emphasized; they are for comparative purposes probably accurate only to about ±20 percent. (See Appendix I for the assumptions used in the cost analysis.)

[4]Repair work or replacement action must begin about 2.5 years before this "average date" occurs. To that must be added time for planning, programming, budgeting, engineering design, testing, and mod-kit production.

Table 8

AN OVERVIEW OF OPTIONS FOR EXTENDING THE SAFE SERVICE LIFE OF THE C-5A WING

(Assumes 25 percent life extension for the ALDCS)

Description of Structural Modification Options	Cost in Millions of 1975 $	8,000-Hour Safe Service Limit	With 2,000-Hour Service Limit Extension	With Austere Use[a]	Austere Use[a] Plus 2,000-Hour Extension
Hours/Year Annual Utilization		700[b] 500[b]	700[b] 500[b]	700 500	700 500
1. Do nothing		1983 - 1986[c]	1987 - 1991	1987 - 1992	1993 - 2000
2. Fastener change on 62 low damage aircraft	267	1989 - 1994 (1979 - 1981)[d]	1992 - 1999 (1980 - 1982)	1997 - 2005 (1982 - 1985)	2002 - 2013 (1983 - 1986)
3. Rework current wing boxes on 15 high damage aircraft	239	1986 - 1990 (1980 - 1982)	1990 - 1996 (1984 - 1987)	1992 - 1998 (1983 - 1985)	1999 - 2008 (1988 - 1993)
4. Retrofit with Option H design on 15 high damage aircraft	480	1989 - 1995 (1980 - 1981)	1993 - 2000 (1983 - 1986)	1997 - 2006 (1982 - 1984)	2003 - 2014 (1988 - 1992)
5. Rework current wing boxes on all 77 aircraft	610	1997 - 2006 (1979 - 1981)	2004 - 2016 (1983 - 1986)	2010 - 2024 (1982 - 1985)	2022 - 2040 (1988 - 1993)
6. Retrofit with Option H design on all 77 aircraft	910	2014 - 2030 (1979 - 1981)	2018 - 2035 (1983 - 1986)	2038 - 2063 (1982 - 1985)	2043 - 2071 (1988 - 1993)

[a] Subtract two years for the equivalent life reducing effect of each NATO deployment of eight division equivalents.

[b] Based on 1976 mission use. Subtract 1.5 to 2.0 years for the equivalent life reducing effect of each NATO deployment of eight division equivalents.

[c] Average year for inspection or repair or replacement.

[d] Dates in parentheses are start dates for modification.

are a 25 percent extension of remaining wing service life due to the ALDCS modification, a 1,000-hour cushion between scheduled start of modification and lapse of safe service life limit, operation of each aircraft for at least 100 hours per year, and life extension benefits of an additional 4,000 hours for the fastener change and 8,000 hours for the rework (1974 configuration, 1973 mission use). (See Appendix G, Vol. 3, for the rationale for these assumptions.)

Table 8 indicates that not all 77 aircraft need be modified to extend the C-5A force service life to the end of the century, even if the increased UTE rate is carried out at about 700 hours per year per aircraft. No more than the high-damage aircraft (about 15 in the present analysis) would need a wing box rework to extend the C-5A force service life to the 1990s (nearly 30 calendar years of service from the C-5A). Changing the fasteners on the 62 low-damage aircraft might produce the same effect. Table 8 suggests that it may be possible to extend the availability of the C-5A to the year 2000 at a cost of one-fourth to one-half of the current wing repair program.[1]

Even with no structural modification, the 62 least damaged aircraft might remain in service to the 1990s (with no allowance for contingencies) if they could be operated less than 600 hours per year according to the postulated austere mission use. (See Fig. 7.) However, the 15 most damaged aircraft used in the present analysis would require either modification or some restrictions on use to remain in service into the 1990s. Merely imposing payload and maneuver restrictions might allow the high-time aircraft, unmodified, to fly perhaps

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[1]The cost estimate in Table 8 for the Option H modification ($910 million in 1975 dollars) was derived by means of a cost analysis methodology that was consistently applied to each of the modification options. The estimate may not be completely consistent with the official Air Force estimate ($1.267 million in then-year dollars) used in Sec. III, because the Rand estimate was originally calculated for an earlier version of the Option H modification, which would have involved the rework of the outer wing boxes instead of the current plan to replace them. A revised Rand estimate for the current Option H modification would be somewhat higher than the $480 million (Option 4) and the $910 million (Option 6) indicated in Table 8. The estimates for the other options would not be affected because the outer wing box does not become a problem within the service life extension goals of the other options.

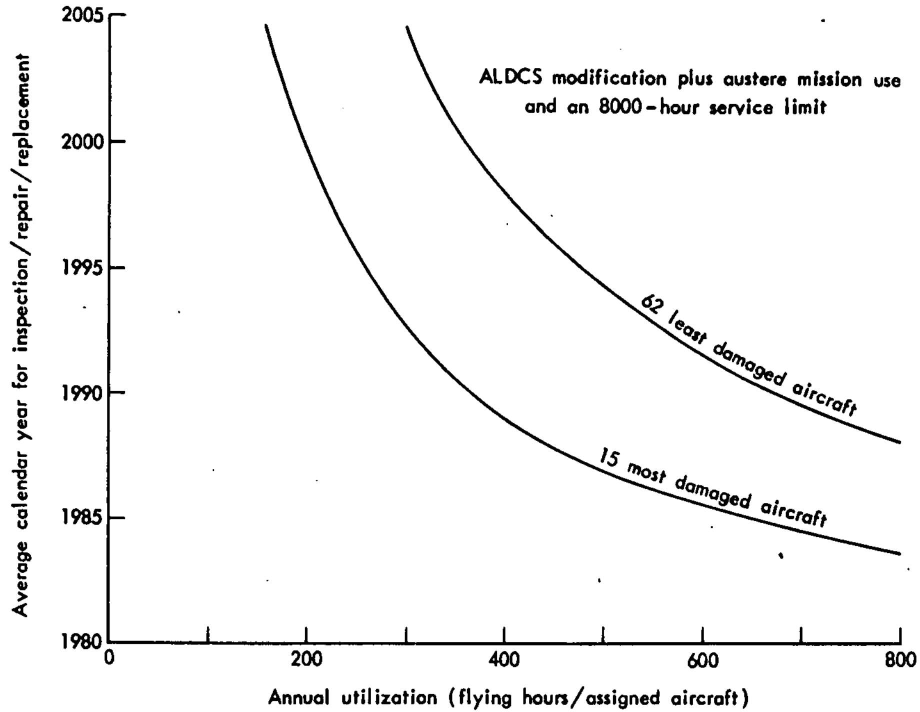

Fig. 7 — Effect of fleet composition on the time for special inspection/repair/replacement

4,000 or more hours beyond the current service limit. During peacetime, they might be used for training and proficiency flying without incurring any more risk than is accepted in current operations;[1] in contingency operations, they might deploy bulky but not heavy equipment (helicopters, for example); ultimately, they might be available for cannibalization to provide ready sources of spares at strategic points in the airlift network.[2]

The foregoing preliminary feasibility analysis of alternatives to the present Option H program, together with the agreed-upon uncertainty that is attendant on both the calculation of the 8,000-hour service limit and the present understanding of expected fatigue problems with the current configuration of the C-5A wing, raises the question: *What actions might be undertaken to more clearly define the problem and the alternatives for dealing with it?*

INFORMATION ENHANCEMENT INITIATIVES

Because time may be running out on some of the potentially less costly modification options, it may be desirable to pursue two sets of initiatives simultaneously to develop a refined assessment of the problem and formulate (and selectively prototype) engineering proposals for a series of wing modifications that could provide for progressively larger increments of service life extension (presumably at increasing costs). The two sets of initiatives would have to be closely coordinated to assure that the first set provides meaningful information on when the alternative modifications in the second set would have to be installed.

Refined Assessment of Prospective Fatigue Problems

Some of the objectives for this set of initiatives (see Appendix F, Vol. 3, for details) would be to refine the assessments of:

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[1] See Appendix F, Vol. 3.

[2] About 2,000 items were cannibalized during October and November 1973 according to *Airlift Operations of the Military Airlift Command During the 1973 Middle East War*, GAO Report LCD-75-204, 16 April 1975, p. 14; MAC Headquarters (DOQA) reports that 2,571 sorties were flown during that period.

1. The point at which the onset of general cracking is expected;
2. The number of austere mission use hours that are equivalent to one hour of 1973 mission use (1974 configuration);
3. The life extension effectiveness of the ALDCS;
4. The procedures that would have to be carried out beyond the current service limit to protect the C-5A from the rogue flaw upon which the current service limit is based;
5. The ability of the adjacent structure to carry the load that is released from the failure of a panel (or two adjacent panels).

Formulation of Modification Alternatives

Engineering proposals should be prepared for a series of modification alternatives at each of several repair levels: The first level modifications could be installed without requiring the removal of the wing; at the second level the wing would have to be removed, but the wing boxes would not be disassembled; and at the third level one or more wing boxes would have to be disassembled. The repair methods considered in the formulation of the alternatives should include: inspection plus on-condition repair, fastener changes in critical areas, and the replacement of surface panels in critical areas. The most cost-effective modification alternatives should be considered for early prototyping.

For each modification alternative (defined here as a specific combination of repair method and repair level), a tradeoff should be prepared that relates the extent of the modification (e.g., number of fasteners to be replaced) and the service life extension. The maximum benefit potential for most modifications will eventually be limited by a "new" fatigue problem other than the ones addressed by the modification. The sensitivity of the maximum benefit to the "new" or benefit limiting fatigue problem should be explored and the basis for determining when the benefit limiting problem is expected to arise should be documented.

If initiatives are to be undertaken, it is recommended that a broadly based and unbiased group of senior members of the aerospace community be convened to organize, monitor, and evaluate the efforts. It is also recommended that a second unbiased panel of experts be constituted to define and carry out the program of initiatives.

MANAGEMENT STRATEGIES FOR COPING WITH UNCERTAINTIES

Commitment to the Option H modification for the entire force of C-5A aircraft is a minimum risk strategy for dealing with the uncertainties about the current wing's structural integrity and the repair options for extending service life. Starting from the opposite end of the risk spectrum, one might consider a strategy where the present service limit is arbitrarily extended by several thousand hours, the benefits of austere mission use are presumed to pertain necessarily to future operations, and the Option H modification program is canceled. If "rogue" manufacturing damage to the current wing should be prevalent across the force, it is conceivable that one or more aircraft may be lost. (However, the evidence suggests that this is not the case.)[1]

If frequent widespread cracking of the wing should suddenly materialize (e.g., after a period of particularly severe operation--perhaps after a NATO deployment),[2] or if widespread "rogue" flawing is discovered, many aircraft could be in imminent danger of catastrophic structural failure if continued in operation. Special inspections and minor repairs might result in the release of some of the aircraft to continued operation; however, a sizable number of aircraft might be grounded pending major repair actions. A major interim repair might take a number of years to complete and require the replacement of numerous structural elements. A "final" repair, such as replacement of the wing boxes, might then be required only shortly thereafter. Even if the present wing box design[3] were to be used for such a final repair, it could take a number of years to carry out. The net outcome could be that a considerable portion of the force would be in inspection or modification status for upward of even a decade in the worst case scenario, where an "interim" plus a "final" modification would be required. The total dollar cost could easily exceed that now planned for the Option H modification. Moreover, the reduction in outsize airlift capacity could easily exceed 17 percent (the reduction due to

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[1]See Appendix E, Vol. 3.

[2]The history of the wing fatigue problems with the B-52D force is a particularly unsettling historical precedent in this regard.

[3]With various pending engineering change proposals incorporated.

the Option modification) and could conceivably persist for many more years than the Option H modification program.

The foregoing catastrophe scenario, although unlikely, is sufficiently ominous that it deserves careful attention in the evaluation of any life management strategy entailing less than the planned incorporation of the Option H modification as *the* final solution. From the standpoint of outsize airlift capacity, the most threatening aspect of the catastrophe scenario is the possibility that two modifications ("interim" plus "final") might be needed. This might occur as the result of some surprise problem for which no "final" solution was available. This aspect of the scenario can be dealt with by continuing with the Option H wing redesign program, along with a modest commitment to incorporate the modification on a few aircraft.

An alternative strategy for coping with the most threatening aspects of the catastrophe scenario would be to: press for immediate determination of a lesser service life objective (e.g., 15,000 hours), develop an engineering definition for a fastener change/rework that may meet that life objective, and prototype the modification on the highest time aircraft to establish modification feasibility. Once feasibility had been established, the Option H design effort might be cut back to a sustaining level of effort. The aforementioned information enhancement initiatives would determine whether the fastener change/rework was going to meet the service life objective and modification incorporation dates for the force. Pending the outcome, the Option H program might be terminated.

A compromise strategy would be to make the Option H modification on several of the high-time aircraft while proceeding with the fastener change/rework on the low-time aircraft. The final decision on the modification mix (high versus low) would not need to be made for a number of years. Meanwhile, either modification program could be canceled if new, compelling information were to become available. However, immediate action would be needed on the fastener change/rework modification because it may prove to be most cost effective if done early. Programming the modification funds now does not necessarily mean a commitment to the modification; it merely preserves the option.

SUMMARY

This section has raised the prospect that technical uncertainties about the service life of the current configuration of the C-5A wing and alternative life extension measures may be sufficiently broad that wing fatigue problems might be coped with to the end of this century at a significantly lower cost than that for the current wing repair program.[1] It is our view that an aggressive, near-term pursuit of additional information, which could better define the C-5A wing fatigue problems and alternatives for dealing with them, may yield a long-term savings in wing repair costs that could be invested in acquisition of additional outsize airlift capability, which may be very important to a strategic deployment of U.S. forces in the crucial early days of a major conflict in Europe.

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[1] Both in dollars and in reduced outsize airlift capacity.

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Strategic Mobility Alternatives for the 1980s: Vol. 3, Technical Appendixes

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A Project AIR FORCE report
prepared for the
United States Air Force

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SANTA MONICA, CA 90406

SUMMARY

Technical issues arising from deficiencies in current information and analysis techniques have to be resolved to sharpen perceptions of how the Air Force can best enhance strategic mobility for the 1980s. The purpose of this volume of technical appendixes is to delineate such issues, summarize the information on which the present study was based, and, where possible, identify ways of improving the available information and analysis methods. Appendix A addresses several cost and benefit-cost issues arising from the straightforward cost-effectiveness calculations presented in Vol. 2; Appendixes B through H address the C-5A life extension issues raised in Sec. V, Vol. 2. This summary provides an overview of these appendixes, which necessarily become deeply involved in technical material.

COST AND BENEFIT-COST RATIO ISSUES

Simplifying assumptions, including Air Force planning factors and ground rules, were invoked in the analysis of the strategic mobility enhancement alternatives as a means of coping with information deficiencies and to focus attention on the primary factors that govern the wide range of computed benefit-cost ratios (see Table S.1, Vol. 2). A refined assessment requires the consideration of secondary factors such as the following:

- The cost-effectiveness preference between stretching the C-141 fuselage and increasing the utilization rate for the C-141A can be influenced by the opportunity cost of forgoing an alternative modification that would reduce drag, and thus fuel consumption, but would not increase the cargo volume.
- Increased C-141A and C-5A utilization rates may cost more than computed here if aerial refueling (not included in the analysis) is needed. Similarly, modification of the C-141A and the C-5A would cost more than assumed here if aerial refueling must be used to offset increases in structural weight.
- Because the Air Force applies escalation (inflation) factors to investment costs but not to personnel costs, alternatives are

biased in favor of personnel and away from investment. Furthermore, because the Air Force does not discount future expenditures when comparing alternative investment programs, deferred expenditures appear more costly than current expenditures.

In many cases, the two Air Force policies (escalation and no discounting) have a cumulative influence. Consider the modification of equipment to avoid such problems as the predicted life limitation of the C-5A wing. Given a 30,000-hour service life goal for the C-5A and the assessment that meeting it will require a major modification, the "least cost" solution supported by Air Force escalation and discounting policies is to modify the aircraft soon before inflation causes the "cost" to increase.[1] Such policies have provided little motivation to explore the possibilities that the aircraft may not be in the inventory for 30,000 hours and that the problem may not be as serious as predicted.

SERVICE LIFE OF THE C-5A: PROBLEMS AND STRATEGIES

When the decision was made in 1973 to rework the primary wing structure and to incorporate design changes in the lower surface of the wing (the original Plan H from which the current Option H wing replacement evolved), the perceived risks (crew safety and maintenance costs) were judged to outweigh the modification costs, because the Air Force then had very little operational experience with the C-5A force (some aircraft were still on the production line), a rear beam lower surface panel had failed on a flight test vehicle,[2] and the projected cost of the

[1] The expenditures in then-year dollars would increase because of inflation if a given modification is deferred. However, if the Air Force's budget keeps up with inflation, the modification expenditures would remain proportionately the same. In terms of real spending power, the costs would not increase. The money could be used in the interim to enhance current capabilities; moreover, a less extensive modification may provide sufficient service life extension.

[2] Another rear beam crack was detected on a different aircraft in January 1974. Neither problem is representative of the current aircraft because both were in areas that have been modified. Moreover, the second crack was occasioned by a manufacturing error that caused a fastener hole to be placed too close to the edge of the panel. The panel failure incident demonstrates the damage-tolerant design concept whereby "if any major structural part fails for any reason, adjoining

modification was modest in dollars[1] and would not appreciably reduce payload.

It is reasonable to reassess the risks and the expected costs, if only because the extent and cost of the modification have since changed. The current Option H modification will result in a 26,000 lb decrease in the maximum payload for unrefueled missions of more than 2400 n mi; for example, the maximum payload for a 3500 n mi range mission will decrease from about 81 tons to 68 tons. This decrease could be compensated for if tankers were assigned to the C-5A force or the maximum allowable take-off weight were increased by installing the current military version of the original C-5A engine.[2] In either case, the cost of new engines or *some share* of the cost of procuring and operating the tankers assigned to the C-5A would be associated with the Option H design.

Another reason for reassessing the situation is that more information has been developed that may now be used to better define the risks. The force has accumulated four more years of service, the structural details that developed cracks during the fatigue tests have been analyzed, modifications have been incorporated to reduce local stresses at some points that developed cracks, and the loads in the wing structure have been reduced to improve fatigue life.

The current course of action is based on an assumed 30,000-hour lifetime, which has made a major modification appear to be inevitable. Given Air Force policy to escalate (but not discount) the costs of such a modification and recognizing that one intent of the modification is to avoid the possibility of large and unexpected repair costs, it has seemed reasonable not to delay the modification. Moreover, members of the original C-5A design team could assist in an early redesign of the wing. It was within this context that the Aeronautical Systems Division (ASD)

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structures automatically take up the load to the full design load limit. This approach allows ample time to spot and repair faults during routine inspections and normal downtimes before anything catastrophic can occur." See "C-5A Wing Will be Modified, But Lockheed Criticizes Critics," *Product Engineering,* March 16, 1970, p. 18.

[1] $275 million in 1975 dollars; the current Option H is to replace all of the primary wing structure at a cost of $1.3 billion in then-year dollars (the Rand estimate is about $900 million in 1975 dollars).

[2] Although the landing gear and fuselage might need to be strengthened, the engine (the F103) is already in use on the Air Force's 747 airborne command post.

set the current 8000-hour service life[1] limit for *programming and planning purposes.* The roots for this action lie in the 1973 decision that for a *30,000-hour service life,* the *perceived risks* (logistics costs and crew safety) outweighed the *costs* (original Plan H). However, the 30,000-hour life requirement may no longer be a reasonable basis for what is now a major investment decision.

The Requirement

The original plan, in 1965, was to operate each aircraft for 30,000 hours at 1800 hours per year (yielding 17 years of service); service life projections made in 1974 assumed 1000 hours per year. The average annual utilization for 1973-1976 has ranged from about 550 to 650 hours per year for each aircraft in the current 77 aircraft force (four aircraft have been destroyed). Once the Option H modification is made and if the crew ratio is increased from 3.25 to 4.0 crews per unit equipment, the Military Airlift Command (MAC) projects that the average utilization will be 700 hours per year.[2]

In the future, more than one peacetime flying hour can be obtained for each fatigue equivalent service life hour. For the moment, however, let us assume that there is a one-to-one correspondence. Then each 5000-hour increment of service life translates into at least seven to nine years of service for average annual utilization rates in the range of 700 to 550 hours per aircraft. Six such increments (the 30,000-hour design goal for the new wing) represent at least 42 to 54 years of service. One 5000-hour increment will probably have been expended by some time in calendar year 1978 because an average of about 4400 fatigue equivalent service life hours (per aircraft) had been accumulated as of April 1977. A second 5000-hour increment might arbitrarily be set aside for contingencies.[3] The four remaining increments would still yield 28 to 36 years of

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[1]All references to service limits and service life hours are based on the 1974 configuration of the aircraft and 1973 mission use.

[2]The MAC planning factor is 2.13 flying hours per day based on a 360-day year and the 70 aircraft assigned to operating units. Based on the full force of 77 available aircraft, 2.13 x 360 x 70/77 = 697 flying hours per year per aircraft.

[3]A deployment of the outsize equipment for the eight equivalent divisions considered in Vol. 2 would require about 734 flying hours per

service beyond 1978.[1] *Must the primary structure of the wing be replaced to satisfy reasonable expectations of the longevity and use required of this aircraft?* If a life objective of less than 30,000 hours is found to be a more credible basis for a major investment decision, the basic premise underlying past judgments and decisions is fundamentally altered.

Consider a 15,000 to 20,000 hour life objective. Set aside one 5000-hour increment for use through 1978 and another 5000-hour increment for contingencies. The 5000 to 10,000 hours remaining for peacetime service could provide at least 7 to 18 years of use beyond 1978.[2] However, if the life extending benefit of peacetime operations and the recently installed Active Lift Distribution Control System are considered, the 7 to 18 year range becomes 9 to 34 years.[3] This wide range of possible outcomes for peacetime service use beyond 1978 is summarized in Table S.1 for various combinations of assumptions for the case where 5000 service life hours are set aside for contingency use.

C-5A aircraft with average payloads from 20,000 lb for the Airmobile Division to 200,000 lb for the Armored Division. One deployment flying hour (without ALDCS) is estimated to be equivalent to one service life-hour if the aircraft are empty on the return trip. Under these assumptions, 5000 service life hours would be sufficient for eight to ten deployments (depending on the life extension from ALDCS; see note 3 below). An alternative view is that 5000 service life hours would provide for at least 180 days of operation (12.5 hrs/day/aircraft for the first 45 days and 10 hrs/day/aircraft thereafter) with a 190,000 lb payload on all flights (including the return trip).

[1] The aircraft were delivered from 1968 to the middle of 1973. Thus, under these conditions, the *total* service life would amount to about 35 to 43 years.

[2] The low end (7 years) is for the low service life objective (15,000 hours) and high utilization (700 hours per year). The high end (18 years) is for the high service life objective (20,000 hours) and low utilization (550 hours per year).

[3] The ALDCS life extension factor (actual flying hours per service life hour) used by ASD for planning purposes is 1.25. Fatigue analyses show that the factor may be 1.43 at the service limiting area. During the first nine months of calendar year 1976 (a period of reduced scheduled cargo airlift for the C-5A), approximately 1.3 flying hours (without ALDCS) were equivalent to one service life hour. If future peacetime use corresponds to 1973 mission use, then 1.0 flying hour (without ALDCS) would be equivalent to one service life hour. Thus, the life extension factors for peacetime use can range from 1.25 (1.0 x 1.25) to 1.86 (1.3 x 1.43 = 1.86) depending on the peacetime use (1973 or 1976 missions) and the

Table S.1

NUMBER OF YEARS THAT SERVICE IS EXTENDED BEYOND 1978
WHEN 5000 SERVICE LIFE HOURS ARE SET ASIDE
FOR CONTINGENCY USE

(Years in parentheses)

Service Life Objective (in service life hours[a])	Mission Use Typical of	Life Extension Due to ALDCS (percent)			
		25		43	
		Annual Use (flying hours/aircraft)			
		700	550	700	550
15,000	1973	9 (1987)	11 (1989)	10 (1988)	13 (1991)
	1976	11 (1989)	15 (1993)	13 (1991)	17 (1995)
20,000	1973	18 (1996)	22 (2000)	20 (1998)	26 (2004)
	1976	22 (2000)	30 (2008)	26 (2004)	34 (2012)

[a]Based on the 1973 mission use and the 1974 configuration (no ALDCS).

If the service requirement for the C-5A were set at 20 *years* instead of 30,000 *hours*, this would be equivalent to a plan to phase out the force between 1988 and 1993. Table S.1 shows that there is a good possibility that a 15,000-hour service life objective could meet this requirement and still provide 5000 service life hours for contingency use. A 30-year service requirement would be equivalent to a force phase out between 1998 and 2003. A 15,000-hour service life objective might satisfy this requirement if the contingency set aside were reduced from 5000 to 3000 hours (Fig. S.1), or if peacetime use were reduced to about 450 hours per year in the reduced cargo mode of 1976 (Fig. S.1), or if a *more austere* mode of use were adopted. For example, the 10,000-hour band at the top of Fig. S.1 shows that a 15,000-hour service limit (including 5000 hours

effectiveness of the ALDCS modification; application of these factors to the 7 to 18 year range yields 9 (7 x 1.25) to 34 (18 x 1.86) years.

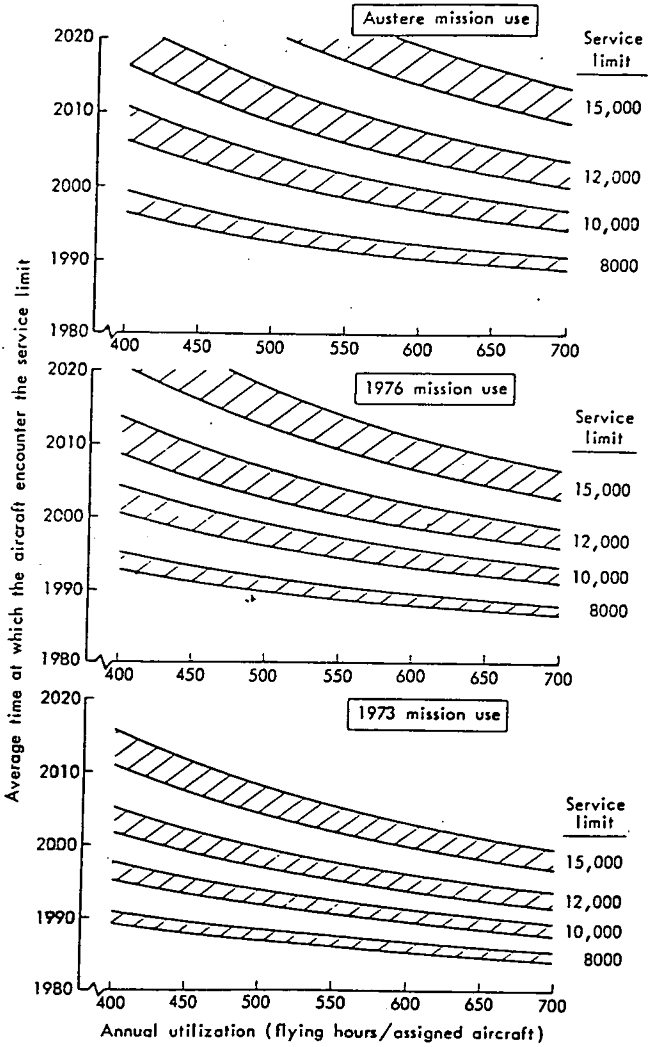

Fig. S.1 — Sensitivity of calendar year service to mission use, service limit, ALDCS life extension effectiveness (shaded area) and annual utilization. No service life hours have been set aside for contingency use. In general, more than one flying hour is obtained for each service limit hour because the service limit is expressed in terms of 1973 mission use and the 1974 configuration (no ALDCS).

set aside for contingencies)[1] could provide service to about the end of the century at 550 hours per year of *austere mission use.*[2] A 20,000-hour service life objective could satisfy a 30-year service requirement for almost all of the assumptions considered in Table S.1. *Thus, service requirements of from 20 to 30 years could be satisfied by service life objectives of from 15,000 to 20,000 hours for a wide range of assumptions, all of which include setting aside 5000 hours for contingency use.*

The 30,000-hour requirement, a fundamental tenet on which past judgments and decisions have been based, needs to be reexamined by the Air Force because a minimum service life objective of roughly one-half of the currently stated requirement may constitute a credible basis for making a major investment decision and yield alternative solutions that could save several hundred million dollars and significantly lessen the degradation in the performance capabilities (payload or range) of the aircraft.

The Technical Issues

Important technical issues that were resolved more by judgment than by physical evidence must be reexamined if the 30,000-hour life objective is reduced. Such a reexamination should address: (1) the physical evidence for the current service limiting concern (i.e., the development of cracks at the typical spanwise joints between the panels on the lower surface of the wing--see Fig. S.2), (2) the interpretations of the physical evidence, (3) the technical implications of the 8000-hour service limit, and (4) the need for a modification.

Physical Evidence from Fatigue Test Articles. Two full-scale fatigue test articles offer the only indications that there may be a problem; 365 cracks (or indications of cracks) were found in the lower surface of the

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[1] Although Fig. S.1 includes no provision for contingency use, the effect of such use may be examined by reducing the "service limit" that is selected in the figure (e.g., use the 10,000-hour curves in Fig. S.1 to represent a 15,000-hour service limit that includes 5000 hours set aside; use the 12,000-hour curves to set aside 3000 hours).

[2] Based on 1.6 flying hours (without ALDCS) for each service life hour. Although such austere mission use is viewed by MAC and ASD as being optimistic, there is reason to believe that the 1.25 life extension factor for ALDCS may be low. In our view, satisfactory resolution of these uncertainties will require better information than currently available.

wing on the first test article during the first 15,000 test hours;[1] a large number of cracks were also detected on the second test article through the first 33,000 test hours. After repairs were incorporated in both test articles, the tests were continued to 24,000 and 60,000 hours respectively.

The rework/repair process for the spanwise splice joints included the removal of the fasteners, inspection with an eddy current hole probe instrument, enlargement of the holes to remove any minute cracks or other irregularities, and the installation of a better type of fastener. During the rework of the first test article, the eddy current device gave 46 indications of surface irregularities at spanwise splice fastener holes in the lower surface of the inner wing box (see Fig. S.2). Nine of the indications were at holes in areas of high local stresses (e.g., at the termination of tapered panels); 37 were in typical locations (this is the service limiting concern) where there was no obvious reason for abnormally high local stresses. The "crack length" assigned to each of these indications was equal to the amount of hole enlargement required to eliminate the instrument's indication of a surface irregularity. According to the Fatigue Damage Reports, none of the 37 indications was confirmed with an independent inspection technique (e.g., fluorescent penetrant or visual), thus, some indications may have been caused by surface irregularities other than cracks (e.g., material or manufacturing defects). The inferred "crack lengths" for the 37 eddy current indications ranged from .016 in. to .187 in.; 28 indications had inferred crack lengths greater than .05 in.; 22 of the 28 were at the joint between the middle beam lower surface panel (MBLP in Fig. S.2) and the aft adjacent panel (e.g., LP4) and five were at the rear beam lower surface panel (RBLP) joint. Thus, the evidence is principally confined to the MBLP and RBLP joints because only one of the crack indications larger than .05 in. was not at one of these joints.

Before the repair at 15,000 hours, 18 crack indications had been discovered (also along the MBLP joint) at other spanwise splice fastener

[1] Evaluation of the fatigue test evidence (see the next subsection) suggests that more than one service life hour is equivalent to one test hour.

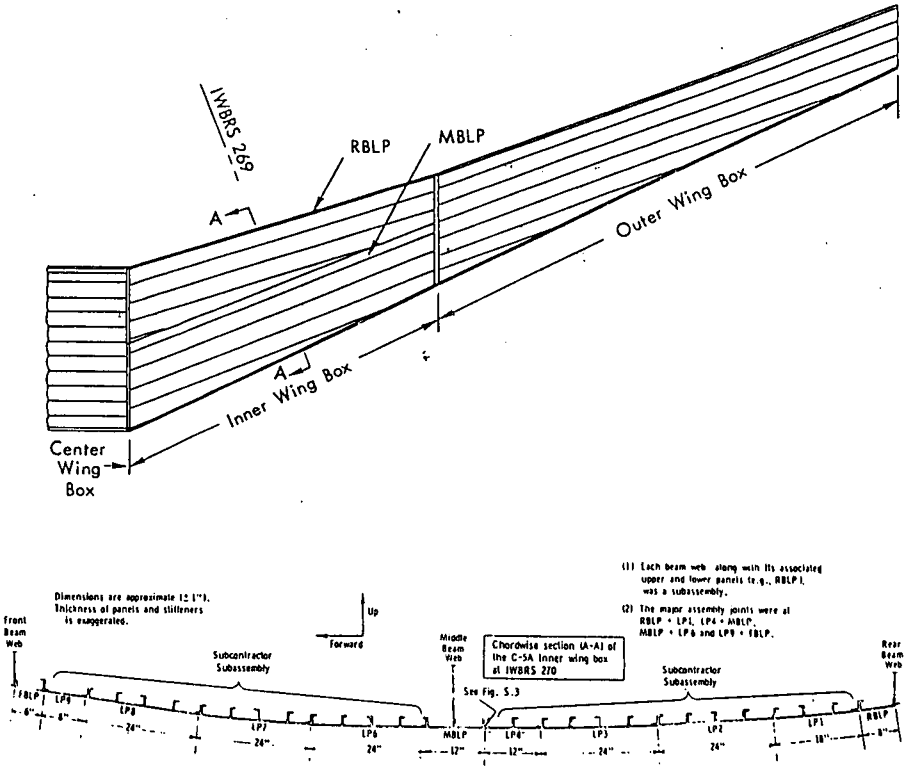

Fig. S.2 — General arrangement of the lower surface panels for the current configuration of the C-5A wing

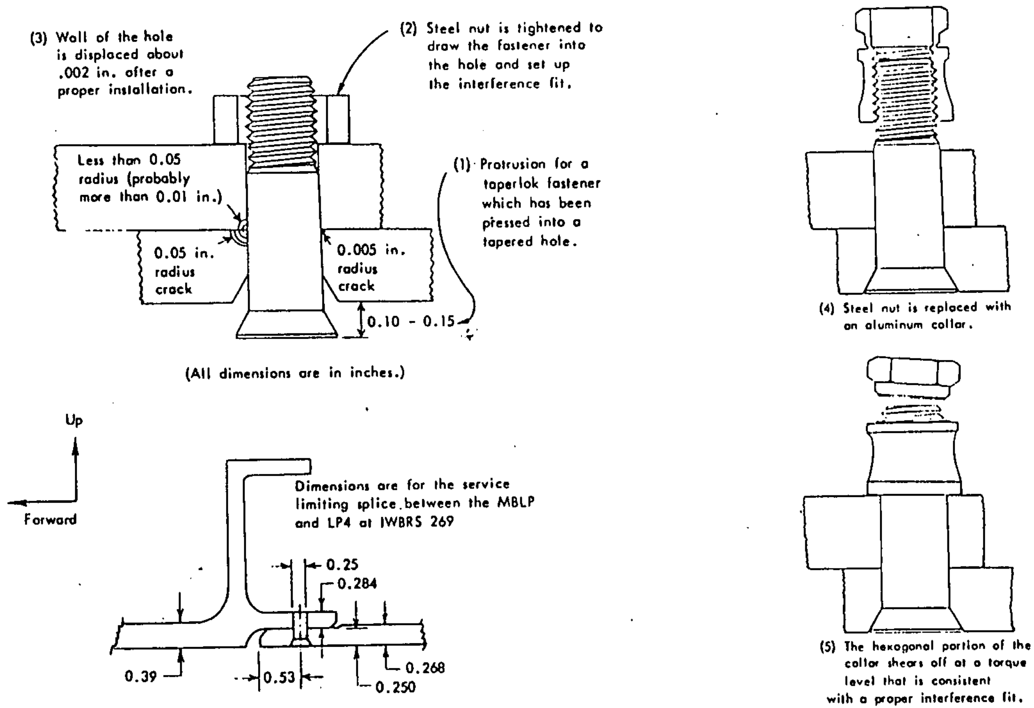

Fig. S.3 — Illustration of the typical spanwise splice lap joint, fastener installation process, and the initial damage model on which the 8000-hr service limit is based holes where there were high local stress concentrations. One crack (.25 in. in length) at the termination of a tapered panel was discovered with fluorescent penetrant at 9000 test hours. The other 17 indications (discovered at 13,926 test hours with fluorescent penetrant and eddy current—the largest crack was 1.0 in.) were where pads transmitted loads into the lower surface of the wing. The remainder of the 365 cracks (or indications of cracks) detected on the lower surface of the wing on the first test article (through the first 15,000 test hours) were at structural details that either have been modified or are being monitored by an inspection program. In the latter case, the indicated fatigue problem is either not expected to materialize in service aircraft before 8000 hours or not expected to lead to the catastrophic failure of the wing if it does materialize.

Evaluation of the Fatigue Test Evidence. It is difficult to relate the fatigue test results to expectations of what is likely to happen with service aircraft because the spectrum of test loads is an approximation of the expected service loads, and the information from only two tests is a meager data base. Moreover, the mission use simulated in the tests was later revised to be less severe,[1] modifications to the fuel use sequence and the aileron control system (ALDCS) have reduced the bending loads in the wing structure, and design changes have been incorporated in local areas that have been found to be weak or susceptible to fatigue.

The modifications to the fuel use sequence and the aileron control system have significantly reduced operational stress levels (e.g., the limit load stress for the high stress area of the lower surface of the wing has been reduced from 52 Ksi to 42 Ksi).[2] As a consequence, Lockheed's classical fatigue analysis of the fatigue test results shows that the cracks discovered in the first test article at 15,000 test hours may not have developed until at least 42,857 test hours if the same test procedure had been used to simulate the mission use and aircraft configuration that are the basis for the present service limit.

[1] Some of the tactical missions (contour flying and landing on unimproved runways) were eliminated.

[2] 1 Ksi is 1000 lb per sq in.

Due to skepticism about the prudence of such an extrapolation of the test results and concerns about the adequacy of the two tests that were conducted, a contract for a third full-scale wing fatigue test was awarded in December 1973. This test, which was to be based on the representative mission use to date and the configuration of the last production aircraft, was canceled in August 1974 in favor of a test of the Option H configuration.

The results from the first fatigue test can also be interpreted with a fracture mechanics analysis of crack propagation times if it is assumed that the tapered fastener failed to achieve any of the prescribed interference fit (see Fig. S.3) that would have significantly retarded the crack propagation rate. For example, development of the largest spanwise splice crack (the 1.0 in. crack detected at 13,926 test hours) can be analytically modeled by the propagation of a hypothetical crack that starts at the corner of the wall of the fastener hole and the panel surface (see Fig. S.3). According to Lockheed's crack growth calculations, the initial crack radius would have to be .003 in. in order to propagate to a length of 1.0 in. in 13,926 hours. However, if the mission use and configuration are assumed to be the same as those on which the current service limit is based, and if the same initial assumptions (.003 in. and no interference) are used, such an initial crack would propagate to 1.0 in. in about 24,300 hours. A similar analysis by Lockheed of the results from the second fatigue test yield an equivalent initial crack length of .001 in. and about 74,000 service life hours for such a crack to propagate to about 1.0 in. (See Fig. S.4; propagation times to 1.0 and 0.8 in. would be about the same.)

Concerns about the full-scale test procedures[1] as well as the analysis methods (both classical fatigue and fracture mechanics) that have been used to interpret the test results have generated questions about the validity of the preceding information obtained from the full-scale tests. Unfortunately, such questions have thus far been resolved more on conservative judgments than on the results of relevant research.

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[1]For example, the spectrum of test loads and the methods used to apply the loads to the test article.

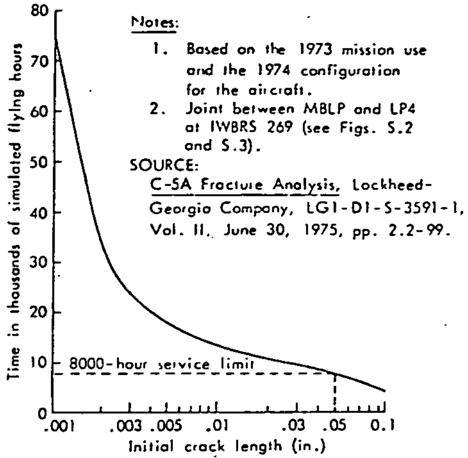

Fig. S.4 — Time for an initial crack to propogate to a limit load critical crack length of 0.8 in.

Although such judgments may have been reasonable in the context of a 30,000-hour life requirement, they may not be in the context of a lesser life objective.

Physical Evidence from the Service Aircraft. Special inspections of the high time aircraft have revealed no cracks at the joints that have been assigned a service limit of 8000 hours and no evidence that there is an unmanageable service limiting fatigue problem[1] with any other joints in the wing. Several aircraft have been inspected after 5500 fatigue equivalent service life hours of use; about 3000 fasteners were removed from an aircraft with 6200 fatigue equivalent service life hours in order to inspect the fastener holes more thoroughly.

[1]A problem where the lengths and numbers of cracks have progressed to such a point that the rework of the fastener holes and the installation of plugs and doublers are no longer practical.

<u>The Current 8000-Hour Limit</u>. The 8000-hour number has been established as the service limit for programming and planning purposes and should not be viewed as the point at which widespread fatigue cracking is expected.[1] *There is no evidence from either the fatigue test or the special inspections of high time aircraft to cause concern that the C-5A wing may have widespread general area cracking at 8000 hours.* The technical basis for the 8000-hour service limit, therefore, is confined to the following chain of necessary assumptions and analytical calculations:

> (1) Manufacturing damage extended to two panels in the lower surface of the wing at a common fastener location where these panels are spliced together; (2) damage occurred in the most highly stressed area of the wing along the MBLP joint; (3) an interference fit[2] was not achieved because the holes in both panels were slightly larger than the allowable manufacturing tolerances; (4) the holes were still small enough that the fastener could not rotate as the aluminum collar was installed (Fig. S.3)[3]; (5) extent of the primary damage in the hole of one of the panels was equivalent in crack propagation terms[4] to a .05 in. radius crack on one side of the hole and a .005 in. radius crack on the opposite side (see

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[1]See Sec. V., Vol. 2, *The Technical Uncertainties*, for a more complete recounting of the points of agreement that were arrived at after detailed technical discussions between personnel from Rand and the Air Force's Aeronautical Systems Division.

[2]An interference fit would retard the propagation of any crack with a length less than the diameter of the .25 in. hole.

[3]If the fastener were free to rotate, it would have been impossible to install the nut and aluminum collar (Fig. S.3), according to the fastener manufacturer, because installation is dependent upon friction for holding the fastener during installation. Even if the collar were installed, any cracks at a hole with such a "loose" fastener would grow at rates slower than calculated, because such a fastener would not effectively transfer load from one panel to another.

[4]Manufacturing damage in an aluminum alloy rarely manifests itself in terms of a crack that begins to propagate with the application of the first load cycle. The initial dimensions of a crack, if one develops, and the time at which it begins to propagate depend on the nature and extent of the manufacturing damage and the loads applied to the structure. A damage site that does spawn a crack may be characterized, for a particular crack growth model, in terms of the initial dimensions of a hypothetical crack that would have started to grow with the application of the first load cycle and had the same length at some later time as the crack observed at the damage site.

Fig. S.3); (6) extent of the secondary damage in the other panel may have been less severe; (7) the major damage to both panels occurred on the side of the fastener hole nearest to the edge of the panel containing the primary damage; (8) the crack from the primary damage site reached the edge of the panel and continued to grow on the opposite side of the fastener hole starting with a .005 in. radius)[1]; (9) neither crack was detected during inspections; (10) Lockheed has calculated that it would take 8000 hours for a .05 in. crack to grow to about 0.8 in. (it must be assumed that the calculation accurately reflects the crack propagation rates that would exist in the service aircraft); (11) at about 8000 hours, the aircraft encounters a limit load condition that would cause the panel with the 0.8 in. crack to fail[2]; (12) the crack in the second panel would be sufficiently long that the second panel would then also fail; and (13) the remaining structure could not carry the loads released by the failure of the first two panels.

Wide variations in the calculated 8000-hour service limit can be achieved by modest changes in these assumptions. For example, even with the same set of assumptions, a Flight Dynamics Laboratory calculation has yielded 11,000 hours plus or minus 3000 hours with 90 percent confidence that the crack growth time would be at least 8000 hours. Moreover, the bases for many of the assumptions are inherently uncertain; thus it is difficult to sort out the technical (and safety) implications that can be associated with the 8000-hour number.

Assessment of the Need and Scope for a Modification. To what extent should the scope, timing, and effectiveness of a modification alternative be evaluated in terms of manufacturing damage hypotheses, interpretations of the fatigue test results, or the experience of service aircraft? Historical precedent favors the last approach (with guidance from tests). For example, new lower surfaces were designed and installed on the B-52D and the KC-135 after service aircraft had

[1]Frequently a crack will cease to propagate when it encounters a fastener hole. Sometimes, however, the crack continues to grow on the opposite side of the fastener hole. This happens more quickly when the opposite side of the hole is also damaged.

[2]Preliminary calculations suggest that there is less than one chance in 100 that a given C-5A will encounter a stress level greater than 80 percent of the limit load stress of 42 Ksi during 1000 hours of operation.

developed serious fatigue problems.[1] Such an approach is less than ideal. Unfortunately, however, current methods cannot precisely predict the time when unmanageable service-limiting problems will develop. This is true regardless of whether one uses the fatigue test results or assumptions about initial manufacturing quality. Thus, there can be wide differences in assessments for the time at which problems might develop in a force of service aircraft.

Rand and ASD agree that "widespread fatigue cracking...is not expected to happen until sometime beyond 8000 hours."[2] Although it is Rand's view that such cracking may not happen before 12,000 to 15,000 hours, Rand does not take issue with the ASD position that it is necessary "to be very careful about offering numbers like 12 to 15 thousand hours as being creditable numbers on the basis of what we now know. We [ASD] recognize the uncertainties that attend the 8000 hour number and agree that 'information enhancement' actions are necessary."[3]

Information Enhancement Initiatives

Three sets of additional items of information (summarized in Table S.2) might be acquired to define the problem more clearly and to set out the alternatives for dealing with it.

Reassessment of the Problem. The objectives for this set would be to (1) better determine when cracks might develop over such a wide general area of the wing that the failure of a single element of the structure would lead to failure of the wing and (2) assess when intermediate modifications (less extensive than the Option H wing box replacement) would no longer be capable of remedying the problem because of the number and lengths of cracks in the wing structure. Examples

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[1] A fastener change modification for part of the C-141A wing is being planned based on cracks discovered in the fatigue test article *and* service aircraft (some aircraft have accumulated 24,000 hours). Calculations for the C-141A, similar to the 8000 hour calculation for the C-5A, yield 17,500 hours for an initial .05 in. crack to grow to a limit load critical crack length. The Air Force expects that the C-141A aircraft with the new fasteners will have a 40,000 to 47,000 hour service life.

[2] See *Technical Uncertainties* in Sec. V, Vol. 2.

[3] Letter to W. E. Hoehn, Jr., from Col. W. A. Newsome, Jr., Airlift Systems Program Director, Aeronautical Systems Division, February 7, 1977.

Table S.2

SUMMARY OF THE INFORMATION ENHANCEMENT INITIATIVES

REASSESSMENT OF THE PROBLEM

I. Inspection Program to Measure
- A. Cracks in service aircraft
- B. Fastener hole quality
- C. Interference fit effectiveness

II. Lead-the Force-Program Modification to
- A. Increase LTF aircraft utilization
- B. Evaluate fatigue damage at 8000 hours
- C. Determine necessity for restrictions on operations beyond 8000 hours
  - 1) Peacetime
  - 2) Wartime
- D. Specify special inspections beyond 8000 hours

III. New Fatigue Test to Assess
- A. Onset of general area cracking
- B. Initial manufacturing quality

IV. Laboratory Crack Growth Tests to Support
- A. Verification or refinement of calculation methods
- B. Assessment of initial manufacturing quality
  - 1) Specimens from service aircraft
  - 2) Back calculation of fatigue test results
- C. Assessment of alternative peacetime operating policies

EXTENSION OF THE PRESENT SERVICE LIMIT

V. Identification of Service Limiting Fasteners that
- A. Fail to satisfy a safety criterion
- B. Are located at a joint where
  - 1) Double panel failure cannot be tolerated
  - 2) There is physical evidence of cracking
  - 3) Probability of crack detection prior to failure is not high

VI. Adjacent Panel Residual Strength Tests and Analysis
- A. Analysis method
- B. Laboratory specimen tests
- C. Full-scale verification tests

VII. Determination of Flight Restrictions
- A. For operations beyond the present service limit
- B. To reduce the number of service limiting fasteners
  - 1) Criterion based on double panel failure from rogue damage
  - 2) Criterion based on single panel failure with general cracking in the adjacent panel

VIII. Verification and Sensitivity Analysis for the 8000-Hour Calculation
- A. Laboratory tests
- B. Analysis of sensitivity to
  - 1) Environment
  - 2) Growth rate data reduction
  - 3) Mean value versus upper bound growth rate data
  - 4) Procedure used to construct the stress spectrum from the stress exceedence curve
  - 5) Crack growth times for the upper panel versus the lower panel in the lap joint
  - 6) Extent of ineffective interference fit
  - 7) Form of manufacturing damage
  - 8) Other relevant parameters
- C. Service aircraft monitoring
  - 1) Stresses used to construct the exceedance curve
  - 2) Crack growth behavior for pre-cracked specimens
- D. Fatigue test article crack growth monitoring

IX. Comparison with Similar Aircraft
- A. Crack propagation characteristics
- B. Residual strength features
- C. Inspectability features
- D. Comparative risk assessment
- E. Initial manufacturing damage

ASSESSMENT OF LIFE EXTENSION MODIFICATIONS

X. ALDCS Life Extension Potential
- A. Effectiveness of current implementation
- B. Examination of alternative implementations
- C. Potential influence on limit load stress

XI. Definition of Modification Alternatives
- A. Specification of service life objectives
- B. Specification of modification criteria
- C. Development of engineering proposals
  - 1) Extent and cost
  - 2) When required
  - 3) Life extension objective

of initiatives include reinstating an accelerated flying program for lead-the-force aircraft,[1] expanding the fastener removal inspection program for the high-time aircraft, reinstating the third full-scale wing fatigue test as a test of the current wing configuration, and laboratory crack propagation tests to assist in the application of the fatigue test results to alternative mission uses.

Extension of the Present Service Limit. The objective of this set of initiatives is to define the measures that would be required to extend the present service limit (e.g., to 10,000 hours) if the criteria on which the limit is based remain unaltered. Examples of initiatives include the identification of the service limiting fasteners that: (1) fail to satisfy a safety criterion (e.g., a crack propagation time of less than 10,000 hours for a .05 in. crack to grow to a limit load critical length); (2) are at a joint where a double panel failure would likely lead to the catastrophic failure of the wing; (3) are at a joint where a significant number of cracks developed during the fatigue test; and (4) are at a joint where detection of a crack before the failure of a panel is not probable. The example initiatives also include: tests and analyses to determine the maximum crack length that may be tolerated near a panel failure site for various flight conditions; an independent verification and sensitivity analysis for the 8000-hour calculation; and an expanded comparison between the bases for the C-5A service limit and those that have been established for other aircraft.

Assessment of Life Extension Modifications. This set of initiatives should refine the assessment of the life extension effectiveness

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[1] To postpone encountering the 8000-hour service limit, the FY 1977 operating plan limits the semiannual use of the four lead-the-force aircraft to 37, 45, 65, and 100 percent of the average for the force. However, an early encounter of the service limit by the lead aircraft would provide the opportunity to more thoroughly assess the service-related fatigue behavior. When and if necessary, restrictions could be placed on the allowable payload and flight maneuvers to protect these aircraft from the double panel failure condition on which the service limit is based. (Proof tests might also be conducted to provide additional protection.) Then, if needed in a contingency, the lead aircraft could be used to transport large but low density items of Army equipment (e.g., helicopters). For the eight division equivalent deployment used in the Rand study (see Vol. 2), almost one-third of the C-5A sorties were with payloads of less than 100,000 lb because they were transporting the outsize equipment for one Airmobile and one Airborne division.

for the ALDCS and develop engineering definitions for intermediate modifications (e.g., a change in fasteners such as was done to the fatigue test articles).

Carrying Out the Initiatives. It would be desirable to constitute a panel of independent specialists to define and carry out a program of initiatives. An additional panel of unbiased senior members of the aerospace community could be convened to organize, monitor, and evaluate the information enhancement efforts to assure that the initiatives are properly integrated and objectively evaluated.

Assessment of Potential Wing Structure Modification Options

In 1972 an Independent Review Team (IRT) developed a set of alternative plans to provide various degrees of wing life extension. In 1973, the Secretary of the Air Force approved the adoption of the ALDCS (Plan D) as a near-term means of extending the life of the current wing while development proceeded on a longer-term solution (Plan H) that would satisfy the 30,000-hour life objective by means of a *rework* of all of the wing boxes (incorporating a change in fasteners and, perhaps, replacing some surface panels). An intermediate plan (Plan E) was projected to be capable of providing 22,600 hours by means of a fastener change similar to that performed on the fatigue test article. (The IRT life extension estimates need to be reappraised in light of new data and analysis procedures.)

By the fall of 1976, the ASD Division Advisory Group had approved a series of modifications to the orginal Plan H, the cumulative effect of which is the *replacement* of the center, inner, and outer wing boxes with boxes of improved design so as to provide a wing that would satisfy the original design mission use and 30,000-hour service life goals.

If the 30,000-hour service life goal is not a constraint, then there is no overwhelming technical reason to foreclose consideration of a number of alternatives--a variation of the IRT Plan E fastener change, a variation of the original Plan H *rework*, or the current wing box replacement program (Option H). Table S.3 provides a preliminary comparison of a set of such alternatives to illustrate the *potential*

Table S.3

AN OVERVIEW OF OPTIONS FOR EXTENDING THE SAFE SERVICE LIFE OF THE C-5A WING[a]

Description of Structural Modification Options	Cost in Millions of 1975 $	Year to Which Service is Extended (Start of the modification in parentheses): 8000-Hour Service Limit	2000-Hour Service Limit Extension[b]	With Austere Use	Austere Use Plus 2000-Hour Extension[b]
Flying Hours/Year[d]		700-500[c]	700-500[c]	700-500	700-500
1. Do nothing		1983-1986	1987-1991	1987-1992	1993-2000
2. New fasteners for 62 low damage aircraft	267	1989-1994 (1979-1981)	1992-1999 (1980-1982)	1997-2005 (1982-1985)	2002-2013 (1983-1986)
3. Rework wing on 15 high damage aircraft	239	1986-1990 (1980-1982)	1990-1996 (1984-1987)	1992-1998 (1983-1985)	1999-2008 (1988-1993)
4. Option H for 15 high damage aircraft	480	1989-1995 (1980-1981)	1993-2000 (1983-1986)	1997-2006 (1982-1984)	2003-2014 (1988-1992)
5. Rework wing on all 77 aircraft	610	1997-2006 (1979-1981)	2004-2016 (1983-1986)	2010-2024 (1982-1985)	2022-2040 (1988-1993)
6. Option H for all 77 aircraft	910	2014-2030 (1979-1981)	2018-2035 (1983-1986)	2038-2063 (1982-1985)	2043-2071 (1988-1993)

[a]Assumes a 25 percent life extension for the ALDCS and no allowance for contingencies.

[b]The 2000-hour extension is assumed to be a consequence of actions unrelated to the structural modifications. These columns illustrate the sensitivity of the results to variations in the 8000-hour service limit.

[c]Based on 1976 mission use.

[d]Assumes 1.63 (1.25 x 1.3) flying hours per service limit hour for 1976 mission use and 2.0 (1.25 x 1.6) for austere mission use.

relative costs and life extension benefits.[1] The modification start dates are also described in the table. The calculated remaining life[2] is expressed in terms of the average year to which service is extended as a consequence of the indicated modification option. Results are

[1]The tentative nature of the cost estimates must be emphasized; they are for comparative purposes and, except for Option H, may represent upper bounds (e.g., the cost for a fastener change would be considerably less than that indicated here if only a modest number of fasteners needed to be changed). The life extension estimates may also prove to be conservative.

[2]The number of service life hours consumed per year is equal to the actual flying hours per year divided by a factor for the number of flying hours that are equivalent to one service life hour; the factor is estimated to range from 1.25 to 2.29 depending on the effectiveness of: (1) the ALDCS (1.25 to 1.43) and (2) reductions in peacetime payloads (1.0 for 1973 missions, 1.3 for 1976 missions, and 1.6 for austere peacetime use where the C-5A would only carry items that could not be carried by the C-141A). Table S.3 is based on factors of 1.25 x 1.3 = 1.63 for 1976 mission use and 1.25 x 1.6 = 2.0 for austere mission use.

presented for annual utilization rates of 500 to 700 hours per aircraft (sufficient to support 3.0 to 4.0 crews for each of the 70 aircraft assigned to operating units). The principal assumptions are a 25 percent extension of remaining service life due to the ALDCS modification, a 1000-hour cushion between scheduled start of modification and encounter of the service limit for the current wing, operation of each aircraft for at least 100 hours per year, and life extension benefits of an additional 4000 hours for the fastener change and 8000 hours for the rework (hours refer to the 1974 configuration and 1973 mission use). Since Table S.3 does not include any allowance for contingency use of the aircraft, subtract 1.5 to 2.0 years for the life reducing effect of each NATO deployment of eight division equivalents considered in Vol. 2.

Table S.3 raises the possibility that not all 77 aircraft may need to be modified to extend the C-5A force service life to the end of the century. For example, no more than the high-damage aircraft (about 15 in the present analysis) might need a wing box rework to extend the C-5A service life to the 1990s. Changing the fasteners on the 62 low damage aircraft might produce the same effect. The preliminary results in Table S.3 suggest that it may be possible to extend the availability of the C-5A to the end of the century at a cost of one-fourth to one-half that of the current wing box replacement program.[1] However, what are the risks associated with such a course of action?

A Management Strategy for Coping with Uncertainties

One can imagine a worst case scenario where the Option H modification might be the minimum risk strategy for dealing with the uncertainties about the current wing's structural integrity and the modification

[1]The cost estimate in Table S.3 for the Option H modification ($910 million in 1975 dollars) was derived by means of a cost analysis that was consistently applied to each of the modification options. The estimate may not be consistent with the official Air Force estimate ($1.267 million in then-year dollars) used in Sec. III, Vol. 2, because the Rand estimate was originally calculated for an earlier version of the Option H modification, which would have involved the rework of the outer wing boxes instead of the current plan to replace them. A revised Rand estimate for the current Option H modification would be somewhat higher than the $480 million (Option 4) and the $910 million (Option 6) indicated in Table S.3. The estimates for the other options would not be affected because the outer wing box does not become a problem within the service life extension goals of the other options.

options for extending service life. For example, if frequent widespread cracking of the wing materialized (e.g., after a period of particularly severe operation--perhaps after a NATO deployment), many aircraft might need to be repaired and restrictions might have to be imposed on the payloads and maneuvers of those aircraft until repairs had been completed.

A strategy that renders the preceding scenario unlikely would be to: (1) reinstate an accelerated flying program for the lead-the-force aircraft, (2) use the change of fasteners that was tested on the fatigue test articles as a basis from which to formulate a fastener change modification for the joints that developed significant cracking during the fatigue tests, and (3) prototype the fastener change on the high time aircraft to establish modification feasibility. If the modification provides a sufficient amount of life extension to meet a new service life objective, then the Option H wing redesign program could be reassessed.[1] If the fastener change fails to meet the new service life requirement, the high time aircraft may have to be modified a second time to receive the new Option H wing. However, if this should prove to be the case, it probably would mean that the wing fatigue problems were more severe than current analyses seem to suggest. In such a case, new fasteners may be required to allow the high time aircraft to participate safely in a strenuous contingency situation because the Option H wing testing and installation will not be completed for those aircraft until sometime in 1983 or 1984. Thus, an early fastener change on the high time aircraft would provide a hedge against two kinds of uncertainties (contingency use and the severity of the fatigue problem) while exploring a less costly modification that may provide sufficient life extension for the C-5A.

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[1]One alternative would be to redirect the wing redesign effort to a much heavier model of the C-5 that could compensate for the payload reducing influence of the heavier wing and could carry substantially higher payloads to Europe without requiring aerial refueling. Such a model, having a takeoff gross weight of 960,000 lb (25 percent greater than the C-5A), was proposed by Lockheed in 1975.

Conclusion

Neither the predicted fatigue problems nor the justification for the 8000 hour service limit have foreclosed the possibility that the service limit might be easily extended to 12,000 to 15,000 hours, providing the opportunity for service to the end of the century without significantly impairing the aircraft's performance capabilities. An aggressive near-term pursuit of additional information could better define the C-5A wing fatigue problems, clarify the value of alternative ways of dealing with them, and possibly lead to long-term savings in the costs of wing modification. These savings could be invested in acquisition of the additional outsize airlift capability that will be needed in the 1980s for the rapid balanced deployment of U.S. forces entirely by air in the crucial early days of a major conflict or crisis.[1]

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[1] A major finding of this study (see Vols. 1 and 2) is that if the United States chooses to preserve the option to rapidly deploy forces entirely by air, while maintaining the unit integrity of those forces, then more large aircraft (e.g., the C-5) will be required to match the growth in (1) Army equipment that cannot be carried by the C-141A and (2) oversize airlift assets (e.g., the 747 CRAF, ATCA, and C-141 stretch) that by definition cannot airlift the Army's outsize equipment.

APPENDIX III

[A Report to the Committee on Appropriations, U.S. House of Representatives, Surveys and Investigations Staff, January 1980]

THE MILITARY AIRLIFT COMMAND AND THE DEPARTMENT OF DEFENSE AIRLIFT SYSTEM

1. The Need For a Full C-5A Wing Modification Program, Estimated at $1.4 Billion, Should Be Reevaluated by Independent Specialists

In 1977, the Rand Corporation recommended a thorough evaluation of the C-5A wing modification by a panel of independent specialists. This still needs to be accomplished before such a costly program is fully implemented.

The C-5A represents 50 percent of the total strategic *military* airlift capability and is the only aircraft capable of airlifting all of the Army's heavy combat vehicles. Although it was not stipulated in the contract, the Air Force requirement called for a design goal of a service life of 30,000 hours of operation. In 1969, evidence of structural problems made it apparent that the C-5A might not be capable of meeting that design goal. Cracking was detected in a wing fatigue test article and one of the test flight aircraft. These problems occurred early in the production schedule of the C-5A, and engineering changes were introduced to strengthen the wing and other parts of the structure where some of the cracking had been detected in the test flight aircraft.

A Scientific Advisory Board (SAB) conducted its first review of the C-5A wing in 1970. As a result of that review, a second wing fatigue test was conducted and the foundation for the present Active Lift Distribution Control System (ALDCS) was laid. In 1971, potential wing panel cracking was judged to be the service limiting factor. Lower surface wing panel cracks had occurred at fastener holes of the *wing fatigue test articles* where adjacent panels were spliced together. During the same year an Independent Review Team (IRT) was formed to review the entire C-5A structure, with particular emphasis on the wing fatigue problem. The team concluded that the C-5A, with the exception of the wing, could meet the 30,000-hour service requirement without major structural modifications. It also developed nine options for extending the wing life, which ranged from taking no action to replacement of the center and inner wing boxes, rework, of outer wing boxes, fastener change, local reinforcement, or installation of design changes. In 1973, a decision was made to evaluate reworking the wing boxes, changing fasteners, and installing local reinforcement and design changes. While that plan was being evaluated, steps were taken to alleviate the load on the wing through an alternate fuel sequence and use of the ALDCS. The projected operating life was then estimated to be 11,300 to 16,700 hours.

During the next 3 years the plan under evaluation was expanded from an extensive rework of the existing wing boxes to a total replacement of all wing boxes. This modification would cause the weights of the wing boxes to increase from 31 to 61 percent. This is paradoxical since the allowable weight target for the original wing was reduced by 15,000 pounds to avoid having to increase the weight of the airframe structure (thereby decreasing the payload). The original weight reduction raised the stress levels and reduced the strength and service life potential of the wing.

While the IRT was conducting its investigation during 1972, Lockheed was awarded a contract to study the improvement of the wing life. That study proposed either an interim measure consisting of local strengthening of the structure of an overall redesign and retrofit of the primary wing structure to meet the 30,000-hour requirement. The enhancement options developed by the IRT in 1972 did not include the proposal for an overall wing redesign and retrofit, although such a proposal was included in the 1973 SAB report. In July 1973, shortly after the delivery of the last C-5, Lockheed recommended a new wing design.

The C-5 Division Advisory Group, meeting in early 1975, conducted a review of the wing rework plan proposed by the IRT, the fatigue test plan, and the modification incorporation dates, and concluded that the rework plan would not be adequate. It also concluded that the risk associated with the proposed planning dates was higher than the 10,000 hours which had previously been established and recommended modification at 8,000 hours. These new assessments were based on an additional inspection of the second fatigue test article and application of a crack growth analysis procedure. During 1976, it was decided that the outer wing box rework would not be sufficient to meet the 30,000-hour service life objective with the aerial refueling requirement and the more aggressive mission profiles envisioned by MAC for the post-modification period.

In 1977, the Rand Corporation conducted an extensive study for the Air Force entitled "Strategic Mobility Alternatives for the 1980's." As part of that study, Rand did extensive research and analysis regarding the C–5A. The Rand report concluded that, "The cracks detected thus far in service aircraft do not appear to indicate a serious service limiting problem with the C–5A." Inspection of high flying hour aircraft at that time did not reveal serious cracking in the critical spanwise splice joints of the C–5A wings. The service limit which had been set by the Air Force was based on a number of assumptions. For example, it was assumed that rare and extensive initial manufacturing damage existed in the C–5A wing. This assumed damage, known as a "rogue flaw," produced initial cracking at the critical spanwise splice fastener holes large enough to be a service limiting factor. It was also assumed that such damage occurred in two adjacent panels and further that the fastener at that location failed to achieve an effective interference fit (which would not retard crack growth).

Rand identified conservatisms and uncertainties in the Air Force's service limit assessment, not the least of which was that the fracture mechanics methods used to determine operational limits were new at the time and were the subject of considerable controversy. Rand noted: "Since the specification of a use limit can have a significant effect on the useful life and the life-cycle cost of a weapon system, it is appropriate to review the approach and methods carefully to identify where significant uncertainties could be resolved through additional research." Other sources of uncertainty in the service life limit computation were also noted in the Rand report. These included differing interpretations of test data used in the calculations because of differences in data between tests, erratic crack growth behavior, and measurement errors; and the load limit stress used in the calculations was 50 percent higher than the maximum stress expected in one aircraft lifetime (this was true even for projected wartime use). Further, the Air Force took the conservative approach in making *each* assumption instead of balancing those assumptions to reach a cumulative conclusion that was conservative yet reasonable. The result, according to Rand, was an overly conservative estimate of the service life limit.

Another factor which had bearing on these calculations was the different use of the aircraft itself. The aircraft configuration had changed, the wing stresses had varied along with the control points, the mission profiles had been reduced, and the loads and flying hours had been limited. Engineering change proposals had been added to the structure, the fuel management sequence had been revised, and the aileror control system had been altered. All of these actions have reduced the stress on the wings and created a service use situation different from that used in the tests.

The Rand report concluded by recommending a number of "information enhancement" initiatives. They recommended:

> "* * * that *a panel of independent specialists be constituted to define and carry out the program of initiatives.* It is critically important that the results of individual research tasks be objectively analyzed and evaluated. The information that is finally distilled from these activities should be presented to top level Air Force management in terms of refined assessment of the problem and the alternatives. *To assure that the initiatives are integrated and objectively evaluated, an additional panel of unbiased, senior members of the aerospace community could be convened to organize, monitor, and evaluate the efforts.*"

The recommended information enhancement initiatives included a reassessment of the problem (inspection program, new fatigue test, laboratory crack growth tests), extension of the service limit (identification of the service limiting fasteners, test of adjacent panel residual strength, determination of flight restrictions, verification of the 8,000-hour service life limit calculation), and assessment of life extension modifications (ALDCS potential and definition of modification alternatives).

In 1977, the Air Force initiated the Structural Information Enhancement Program (SIEP) to:

> "* * * reassess and supplement, as necessary, all actions considered important to the protection of structural safety until H-Mod input and investigate possible approaches for ensuring limited duration safe flight to H-Mod

in the event of adverse: assessment results; force inspection findings; changes in operational requirements."

H-Mod is Air Force terminology for the *full* C–5 wing modification. In its statement of objectives the SIEP noted "that the charter for SIEP *does not include any study of options* to wing mod. *The Air Force has defined the need for a 30,000-hour life for the C–5A* and established a wing modification schedule to install new wings in order to achieve 30,000 hours" (emphasis added).

Overall Air Force management of SIEP was conducted by the San Antonio Air Logistics Center and an Air Force onsite Technical Director was assigned to Lockheed-Georgia Company beginning in October 1977. Overall program guidance was provided by the SAB, and a Technical Steering Committee provided continuing technical guidance. The Steering Committee is composed of representatives from *all Air Force organiaztions* concerned with the C–5A plus a few non-Air Force advisors. Within this organizational framework, the SIEP was to do extensive and new analytical studies, review existing empirical data, develop new empirical data where appropriate, and report its findings. The SIEP reassessed the rouge flaw safety limit, the safe flight beyond that safety limit, and the general cracking limit. It updated force management procedures and determined the operational impact of these procedures.

The analytical and test data bases of the rogue flaw safety limits presently in effect were reassessed, and new analyses and test data were developed. SIEP confirmed most of the elements of the rogue flaw safety limit calculation as satisfactory. Some of the conservative assumptions which the Rand study had criticized were proven to be necessary. The crack growth methodology was modified based on the SIEP findings. The major element in this modification was updated material property data based on extensive testing. The safety limit for the C–5A inner wing was reduced to 7,100 flying hours (mission profile hours) and a higher limit was set for the outer wing.

The reassessment of the general cracking limit conducted by the SIEP includes a probability "risk" assessment and the teardown inspection of a C–5A wing with a high number of flying hours. The general cracking limit assessment was based on the condition of the wing of the C–5A used for the teardown inspection. According to the SIEP: "It was anticipated that if the teardown revealed generalized cracking per the criteria presented at the 1977 SAB then the safety limit might be reduced, *otherwise there would be no change in safety limit*" (emphasis added). A total of 931 cracks with "growth significance" were found in the teardown of the C–5A wing, and 721 of these cracks were located in the critical beam cap to web, spanwise splice joints, and chordwise joints. It is interesting to note that only 20 of these cracks (on a high time aircraft) had exceeded the cleanup crack size of .03 inches that was recommended by Rand. Even so, the cracking that was discovered exceeded the general cracking limit previously established by the risk analysis. SIEP also provided significant new information on the probability of element failure. As part of the force management update, a special inspection plan was developed consistent with the need to prevent element failures based on slow crack growth.

The C–5A wing modification program, which is being pursued by the Air Force to extend the wing life to 30,000 hours, will cost about $1.4 billion. In view of this high cost, the decision to proceed with the full modification should be closely scrutinized. There is no question that the C–5A wing will not perform as originally intended and that some modification of the wing is necessary. However, there are several factors which argue against the need for a 30,000-hour wing life at the present time. The wing modification program is scheduled to begin in February 1982, although $78.6 million is being requested in fiscal year 1980 for the manufacture of components for seven of the wings. In 1982, the C–5A fleet will be from 9 to 12 years old. Even with a new wing, MAC intends to operate the C–5A fewer than 800 hours per year. At that rate, the aircraft would last at least until the year 2019, when the aircraft would be *over 46 years old.*

It is apparent that a 30,000-hour wing service life is not necessary. Air Force officials contend that the design differences between a 30,000-hour wing and a 20,000-hour wing are small and that the 30,000-hour wing does not cost any more. At projected operating rates (and allowing 2,000 flying hours per aircraft reserve for contingency operations), only 14,400 to 16,400 flying hours are needed to sustain the C–5A to the year 2000. Even then the C–5A will be beyond the normal 20-year life expectancy for commercial transport aircraft. Furthermore, the Air Force is presently examining the possibilities of a follow-up cargo transport. Application of advance technology and development of a cargo transport which could be used by commercial carriers and the military are primary consideration in the design of this aircraft. It is anticipated that such an aircraft will be entering the inventory during the next 20 years. Such being the case, it does not seem logical to extend the life of the C–5A significantly beyond that.

The question now becomes how best to reach the lower flying hour service life goal. As MAC continues to fly the C–5A, the possibility for repairing the wings through modifications other than full wing replacement diminishes. In the more than 2½ years since Rand issued its report, it appears that some of the high time aircraft have gone beyond the point of applying any alternative modifications such as a fastener change or rework of the wing boxes (as opposed to complete replacement of them). A minimum of 29 of the oldest aircraft fall into this category and will now require full wing modification. Alternative modification techniques may still be possible for the remaining 48 aircraft.

To reach an appropriate decision regarding the wing modification, the recommendation made by the Rand Corporation in 1977 still needs to be accomplished: A panel of independent specialists needs to thoroughly evaluate the entire C–5A wing modification program to include establishment of a realistic flying hour service life goal for the wing, determination of the feasibility of using optional wing modification programs, and determination of the number of aircraft which could still be modified using the alternative program. The SIEP in no way accomplishes these goals. One of the basic objectives of SIEP was to "help sell wing mod" according to MAC. SIEP was composed of Air Force officials, using the Lockheed-Georgia Company to provide technical support. This lack of independence and the failure to consider any options to full wing modification make the objectivity of SIEP and the need for the full wing modification subject to question.

Finally, MAC plans to fly more vigorous types of missions and a greater number of flying hours after modification of the wing. While all of the mission profiles would be changed to some extent, the primary changes involve raising the peacetime limit on cargo capacity from 25 tons to 95 tons and increasing use of aerial refueling. The latter change should be acomplished to ensure adequate crew proficiency in aerial refueling techniques for contingency situations. However, raising the peacetime cargo limitation serves no practical purpose. The 25-ton limitation should be continued, even after modification of the wing, as it will accomplish several things. It will continue to preserve a valuable asset, the main purpose of which is to provide crew training and airlift for *contingency* situations. MAC has advised that the C–5A crews are its most experienced crews and the training they presently receive is adequate to maintain their proficiency. However, raising the cargo weight limit will do nothing to improve crew training. The continuation of the 25-ton cargo limit would ensure a proper balance of DOD cargo between MAC's organic fleet and the commercial air carriers. By raising the cargo weight limit to 95 tons, the vastly increased capacity of the C–5A fleet would absorb a great deal of the already scarce peacetime DOD cargo, further decreasing the amount of that cargo available to the commercial air carriers. As previously noted, the distribution of DOD cargo between MAC's organic fleet and the commercial air carriers is already imbalanced and needs to be improved. Lifting the peacetime cargo limitation of the C–5A will put those aircraft into direct competition for DOD's cargo and further degrade the stiuation. Therefore, the present peacetime weight limitation should be continued after modification of the wing. For these same reasons, the number of flying hours should be limited to 800 hours per aircraft. This represents an increase over the present hours flown, which would permit additional training such as aerial refueling.

The Investigative staff recommends that the Committee consider requiring the Secretary of Defense to act on the 1977 recommendation of the Rand Corporation to have a panel of independent specialists determine whether there is a valid need for the full C–5 wing modification program estimated to cost $1.4 billion. The evaluation should include the establishment of a valid service-life goal and a thorough review of all options to full modifications of the wing.

2. The C–141 Modification Program, Estimated at $495 Million, is a Questionable Airlift Enhancement

In 1978, the Air Force embarked on a two-part program to modify the C–141 aircraft. The first part involves lengthening the fuselage of the aircraft because its payloads are almost always limited by the available cubic volume and not by the weight lifting capacity of the aircraft. The other part of the program adds an aerial refueling capability.

The Air Force's program to make use of the full weight lifting capacity of the C–141 provides for the insertion of two fuselage plugs into the aircraft—one in front of the wing and one behind it. These fuselage plugs add 23 feet to the length of the cabin floor, allowing the C–141B to carry a total of 13 pallets instead of the 10 pallets that the unmodified C–141A can carry. As a result of this modification, the Air Force claims a 30-percent increase in payload (based on volume) without any significant increases in operating costs.

While modification of the C–141 would provide a 30-percent increase in the volume of cargo the aircraft is capable of carrying, the increase in weight carrying capacity is not as great. The modification itself adds about 8,000 pounds to the aircraft, using up most of the additional weight lifting capacity that was previously available. The claim of a 30-percent increase in capacity would be valid for weight as well, if DOD planned to transport only light cargo in contingency situations. However, military cargo is generally heavy cargo, making weight a factor to be considered.

The Air Force claims that the weight limitation is not a problem and that the aircraft can carry 13 fully loaded pallets. This equates to an increase of over 5 tons of cargo per aircraft sorts, based on MAC's pallet loading standards. However, in carrying this extra weight there must be some tradeoff in the weight of fuel the aircraft can carry. If both the C–141A and C–141D are to fly the same distance (more than 2,300 miles), then the aditional *weight* of cargo that the C–141B can carry is reduced. In peacetime, the fuel for cargo tradeoff will have * * *.

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Appendix IV

APEX BRIEFING—16 JUNE 1975—AFLC/AFSC

Introduction

Charter, study group, objectives, assumptions, facts bearing on objectives, alternatives, discussion.

Operations

OPS subcommittee, OPS (tasks), SOR review, Air delivery, war mission, C–5 capability, C–5 capability (loadability), H-Mod delay-deny, augment/replace summary, OPS—143.2/SIM.

Safety

Specific tasks, C–5 accident summary, accident rates, comparison, accident costs, major safety concerns, fire, collision w/ground.

Engineering

Why 8750, risk reduction, inspect/monitor, AFT ramp, PMO, program schedule/drawdown.

Logistics

Corrosion, spares, cannibalization, materiel deficiency reporting, avionics, maintenance manning, balance resources.

Wrap up

Validate C–5 requirement, identify improvements, determine OPT use, UTR 2.04–4.0, UTR 2.04–min ACL, UTR 1.5–3.0, UTR 1.0–1.88, recommendations, financial summary.

Apex Safety Study

INTRODUCTION

1. The primary objective of the Safety Panel of the APEX Study Group was to identify those operational/maintenance practices or procedures and components, systems or failure modes which could result in the loss of an aircraft. In addressing this task the panel attempted to systematically review all past studies, data and analyses which related to failures, hazard analysis, design and operational/maintenance procedures, practices and occurrences. In view of high dollar loss, the significant outsized airlift capability represented in a single C–5A aircraft and the fact that the loss of another C–5 can have a major impact on a congressional decision to authorize money for the wing modification, as well as perhaps a decision as to whether the C–5 will be maintained in the active airforce inventory, safety was emphasized in all areas of the study.

2. Traditionally, new aircraft have a rather high incident/accident experience factor in the first years of operation and the C–5 was no exception. However,

by the fourth year of flying the C–5 was well within the general accident experience level achieved by the C–130, C–135 and C–141 and from the fourth year of operation through Sept. 1974 the C–5 accident rate, based on major accidents only, was third in the jet cargo category. Only the C–141 and the C/KC–135 aircraft had better accident experience during similar periods of their life. The loss of C–5 227 at Clinton on 27 Sept. 1974 and 218 on 4 April 1975 in Vietnam, move the C–5 cumulative major accident rate into a position behind the C–133.

3. Of major importance is the fact that since May 1970, when a C–5 aircraft was destroyed by fire at Palmdale CA, four C–5s have been lost. In terms of total dollar loss this is approximately equivalent to the loss of 60 F–4D aircraft or 22 C–141s. Equally important is that this loss in terms of a 70 UE force represents a reduction in outsized airlift capability of about 5.70. This could be equated to an average of 18 million ton miles over a 30 day period in the NATO scenario.

4. Perhaps the most challenging part of the overall safety task for the Study Group was the fact that all of these occurrences were for different reasons; all were first events and only two can be credited to inappropriate aircrew action. Thus, there were no obvious trends of failures which might markedly assist in identifying those actions necessary to prevent another catastrophic failure.

5. In addition to the three major accidents since 1972 there have also been four minor accidents which have incurred significant dollar loss and three of these occurred in 1974 Thus, since January 1974 we have experienced a significant upturn in the C–5 accident experience.

6. As pointed out in the Engineering portion of the Study, the C–5 structure and auxiliary equipment were subjected to severe weight saving restrictions during the design and development stages which heavily influence not only component and structural stress levels but also tended to perhaps lower reliabiilty. As a result the C–5 now appears to have certain peculiar problems that are not generally found in commercial cargo type aircraft. While a system safety plan was part of the contractor proposal and some hazard and fault analyses were accomplished, other considerations such as schedule performance, total weight and costs appear to have disproportionately affected certain design decisions. These safety studies were not a part of the documentation purchased from the contractor thus they are not available today in Air Force files. However, a review of the early documents which the contractor has retained did not reveal any areas of concern which were not already being investigated and studied. A rather significant point in this area is that on various other aircraft, such as the C–141, a given level of engineering effort was purchased from the contractor at the time the aircraft went operational. This permitted the contractor to continue his engineering and analysis support past the date of engineering transfer from AFSC to AFLC for both the using and supporting commands needs. This was not done for the C–5 and consequently there has been little or no contractor system safety analysis or design analysis accomplished since engineering transfer. Whether these studies might have materially assisted in identifying, before the fact, the causes of the C–5 accidents is a moot point. The important fact is that the Air Force does not now have an analytical engineering system and fault/failure analyses program either organic to AFLC or on contract with the C–5 weapon system. Additionally, it is extremely difficult, if not impossible, to give adequate engineering design study to failure/incident occurrences and/or trends. Further aggravating this lack of capability is the fact that the material deficiency reporting system does not provide a means where potentially serious incidents are identified and subjected to detailed analytical analysis.

One example, less than a month prior to the accident at Saigon, an aircraft flying out of Dover AFB had a ramp unlock in flight; the events were such that the crew was able to depressurize, descend and recover safely. This failure was not adequately identified or recognized and the EUMR was subsequently closed without positive corrective action. We need to restructure the reporting system, devote the necessary management, safety, and engineering effort to identify the high hazard potential systems/areas in the aircraft and then track all part failures/malfunctions that occur in these areas, systems or subsystems and carefully analyze and rapidly correct these high hazard items. This requires additional data analysis capability at MAC and AFLC plus a funded (level of effort) contract engineering team.

7. Fire has proven to be one of the most serious problems to be contended with in the C–5. Five of the total of 12 aircraft damage accidents involved accidents involved fire and three of the four destroyed aircraft were the result of fire. Three accidents, including two destroyed aircraft, involved hydraulic fires. Accordingly, extensive efforts must be directed toward reducing the probability of fire. In this regard, efforts must be initiated to accelerate already identified corrective actions to insure that crew and/or passengers are protected from fire and/or smoke and are given maximum opportunity to escape in the event of a crash involving fire. Admittedly we are installing a very extensive and sophisticated Fire Suppression System (FSS) to inert the fuel tanks and provide detection suppression and extinguishing capability to both manned and unmanned areas of the aircraft. However, we must clearly recognize that this system does little to address the root cause of the fires. With some exception the systems principal function is to extinguish a fire once it has occurred. What is really needed is a fix which eliminates or significantly reduces the potential for fire. Combustibles are not adequate isolated from sources of ignition, and as a result failures or malfunctions in one system frequently influence and interact with the other to produce fire.

8. Another area which the Study Group felt to be worthy of special attention was collision with the ground where impact with the ground was the primary cause of the accident. Crashes where a fighter pilot delays his initiation of the pull out from a dive bomb pass and impacts the ground are not included. During the period of 1970 to date, Air Force wide, we have experienced 58 collision with the ground accidents. Of these 15 have involved cargo aircraft of which eight were outside the continental limits and seven were within the ZI. Considering the Air Force wide experience these accidents were equally divided between daylight and darkness. A total of 27, or 472, occurred during the descent and approach to landing. During this period we see very little decrease in occurrences from year to year or variation in the experience of the various classes of aircraft. A single primary cause and solution is not clearly obvious. What the data does seem to say is that this is an important area and that we should do whatever is possible in terms of better maps and charts, more training for the crews, or survey and analysis of the letdown and landing procedures at key airfields. Random enroute GCI controlled letdowns appear much more hazardous in terms of collision with the ground than are jet penetrations where the crew is on a surveyed, planned letdown with all ground clearance information clearly displayed. Additionally, crews on published letdowns appear to feel more intimately involved with their own letdown and ground clearance.

9. The most recent C–5 accident stands as grim justification for a thorough evaluation and redesign of the rear ramp and pressure locking and latching mechanism of the aircraft. The AFLC System Manager has contracted with Lockheed Georgia for this task. As a goal, this redesign should be simple enough so that adjustments and rigging will be insensitive to temperature-induced expansion and contraction, uneven parking ramps, and cross wind conditions. Additionally, it should be designed so that aircrews can visually confirm a latch and lock condition prior to pressurization. The large number of EUMRs, and incident reports, along with the projected increased use of the front door and loading ramp as a result of discontinuing use of the aft door all support the need for an emergency analysis of the failure potential of the front pressure door/ramp/visor system as well. Six previous failures in this area have resulted in rapid decompressions. Fortunately, however, none have resulted in catastrophic failure. On at least one aircraft some minor secondary structural cracking in the visor hinge/crew entry door area has been detected which raises the question as to whether failure in this area might result in in-flight losses of visor, forward ramp/door. These conditions might well prove to be equally or even more disastrous than the loss of the rear ramp/pressure door.

10. The most recent accident also highlights the need for continued efforts to provide and protect flight control redundancy and to eliminate areas where single failures (even massive ones such as the entire door/ramp area) will not totally incapacitate the flight controls. Preliminary review indicates this potential may exist in the wing flap torque boxes and center wing rear beam area where all four hydraulic lines pass through a single area.

11. Although the definite safety concern, such safety conditions as structural failure of the wing, fuselage, landing gear, and other major components are not included in this safety section. These are included in either the engineering

or maintenance portions of this report. The potential problem of corrosion induced by the high stress level design is also included in the engineering analysis. Timely attention to these areas is mandatory to ensure these items do not become major safety considerations.

12. During this study it has become increasingly apparent that the C–5 "Total Package" contract did not provide for adequate AF system surveillance during the early developmental and design stages and thus this critical area was not given adequate attention or pursued hard enough. While some hazard and fault analyses were performed by the contractor, these efforts did not achieve their desired results. It should be noted that the Air Force's own system safety efforts resulted in a critical report in 1966, pointing out the almost certainty of personnel loss in the lower cargo compartment if this portion of the C–5 was used as a personnel carrier. Recent accidents have validated this analysis.

13. Except for two cases, aircrew have not been causative factors in previous C–5 major accidents. However, the proposed continued reduction of flying time for line crews is considered to be a definite developing hazard potential. If simulation is to be used to fill the gap in training, it must be realistic, accurate, and adequate in quality and quantity.

14. Safe operation of the C–5, as with any other weapon system, must be an integrated part of the entire operation. A comprehensive evaluation of the safety problems will encompass or involve all other activities such as engineering support, maintenance, supply, overhaul, modification and flight operations. For this reason, the entire APEX Study must be considered addressing safety.

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PART V—ENGINEERING

Part V—Engineering

Four C–5A aircraft have been lost; all were victims of different events. In all cases the loss was the result of a first occurrence of that event, and in all cases the loss was caused by a single failure mode (reference Table 1). Major engineering changes to the aircraft were called for in every case but one. The APEX Engineering Review has been conducted in conjunction with the APEX Safety, Operations, and Logistics Reviews to seek out and eliminate failure modes which could result in the loss of an aircraft. Stated another way, the APEX Engineering Review is designed to look at the question of how long can you safely operate the C-5 with or without the proposed wing fix.

A. BACKGROUND

1. The C-5A development program has been a controversial, trouble-plagued, politically explosive program from its inception in the early 1960s. The source selection design choice was not the final winner. There were almost 2 years of concurrency between testing and production; perhaps unrealistic contract terms were rigidly enforced, and it was almost common knowledge from the onset that the winning contractor had underbid the job. Cost, schedule and technical problems were built into the program. The political impact of these will be a key factor in Congressional deliberations on the new C-5A wing. The prevention of another major C-5A accident is of critical significance to not only the decision to fix the wing, but more importantly, to the preservation of the C-5A in the Active Air Force inventory.

2. The fact that the aircraft successfully completed the majority of its performance requirements, except service life, is remarkable in view of the above. To date, the aircraft has flown nearly 250,000 hours and has a safety record surpassed only by the C-141 and the C-135. Its strategic airlift contributions have received wide acclaim. As for its major shortcoming, service life, slightly less than one third of the original goal of 30,000 hours is now forecast.

3. The greatest quantity of static strength and service life (fatigue) problems have occurred in the wing; however, the rest of the aircraft has had problems that cannot be passed over lightly. The presence of a guaranteed weight empty requirement in the C-5 Contract End Item (CEI) Specification is frequently cited as the source, origin or cause of the structural design problems of deficiencies still facing the C-5. The need for the structural designers to freeze design gross weights almost at the onset of the design effort, coupled with the failure to obtain weight relief as other problems developed, led to some very hard management decisions which now require engineering fixes if the C-5 is to realize its full potential.

4. Fairly early in the program, the contractor found it necessary to make extensive changes in the wing life devices and fairings for drag reduction of about 14,000 pounds of weight empty increase. This was done by Lockheed within the constraints of the specification as part of the contractor's total responsibility to design to achieve the specified performance. It meant that the contractor had to find other design elements from which to extract weight to accommodate the increase. Inasmuch as over 80 percent of the aircraft weight empty is devoted to structure (approximately 10 percent is engines and 10 percent other), it follows that the structure would feel the weight squeeze most acutely. Lockheed, as a consequence, used the highest material design allowables, in the face of this squeeze, to the extent of expecting to realize 100 percent ultimate tensile strength of the material, especially in the wing lower surfaces. This was a radical departure from standard aircraft design practice (including their own) where conservative values ranging from 65 to 80 percent are common (the C-141 used 65 percent). SPO engineers, on questioning the high stress levels, were assured that Lockheed was conducting an extensive component test program to identify and eliminate detail design problems and eliminate or minimize stress concentration problems. Additionally, particular attention was being paid in the manufacturing process, they said, to assure that the values for the fastener systems obtained in the laboratory were obtained on the factory floor.

5. A full-scale static test article and two full-scale fatigue articles have shown beyond doubt that the manufacturing precision and the careful design attention did not carry through. A massive failure of the static article resulted in substantial payload restrictions which are currently being overcome by operating the aircraft with the ailerons uprigged at from 6 to 12 degrees, depending on the flight phase, to reduce wing upbending. Fatigue life has been the subject of numerous changes which will be discussed later.

6. Although the highest stress area of the aircraft is the wing lower surface, other parts of the aircraft were also subject to severe weight control. These must

also be addressed in that any part which is designed to high working stresses is subject to greatly degraded life when also subjected to small initial manufacturing defects or small quantities of almost unpreventable corrosion.

In response to the C-5 structural problems, the Air Force formed, in late 1971, an Independent Structural Review Team (IRT), consisting of about 100 engineers who spent about 1 year analyzing the problems and forming alternative solutions. One of the IRT plans, known as Option H, was selected by the Secretary of the Air Force for implementation. This plan would replace the current center and inner wings with new, redesigned wing boxes and would rework the existing outer wings. Emphasis would be on lowering the stress levels to the 65 percent (of ultimate tensil strength) levels of the fatigue resistant C-141. That plan is now under fire because of its near one billion dollar price tag.

8. Both the Air Force Scientific Advisory Board (SAB) and the Aeronautical Systems Division Advisory Group (DAG) have reviewed the IRT findings; and in January 1975, the DAG reviewed and updated the critical IRT data, approved the latest H Modification configuration and made a very positive recommendation that the H Mod proceed as an urgent safety of flight modification.

9. The issues facing the engineering community relative to the APEX Study are the following:

a. What is the life of the current aircraft?

b. How do you maintain safety of the C-5A aircraft?

c. Are there ways of extending the service life short of the H Mod?

d. Are there additional engineering versus operational trade-offs that could have a significant effect on the life of the current aircraft or on modification costs?

B. DISCUSSION

1. Issue—Life of Current Aircraft: Perhaps the single most critical issue in the C-5 program is the service life of the current aircraft. Although this has been the subject of much study, no precise value can be stated without attaching to that number some band of uncertainty. The final number of flying hours will vary for each aircraft by tail number and will be a function of aircraft usage, original manufacturing quality, effectiveness of corrosion control procedures, etc.

a. Wing: The C-5A wing structure, which weighs about 70,000 pounds without ancillary structure such as leading and trailing edges, is of classical box design with upper and lower surface skins carrying a major portion of the load. The wing was fabricated at AVCO, Nashville, Tennessee, and shipped to Lockheed, Georgia, via rail car for final assembly. It consisted of five major sections (center wing, 240 inches; two inner wings of 457 inches each; and two outer wings measuring 657 inches each). The original wing was to be built to a design goal of 30,000 hours of service life; however, service life was not a firm contractual requirement.

(1) As noted earlier, the most critical area of the wing is the lower surface in that this was designed to 100 percent of ultimate tensile strength. Approximately 50 million dollars have been spent to date for wing structural engineering changes which have eliminated the most critical hot spots. To extend life further now requires a major modification to the wing lower surface; thus the wing lower surface is used as a reference point for all wing service life projections.

(2) Lockheed designed the lower surface in accordance with standard procedures which require that the failure of one member will not cause loss of an aircraft. Thus the lower surface is composed of a series of wing planks joined by fasteners which are referred to as the span-wise splices. For weight saving, Lockheed employed a ship-lap construction as opposed to the more classical butt construction used by other large aircraft.

(3) The C-5 wing was to be tested via classical fatique test methods (i.e., four times the service life goal, or 120,000 cyclic test hours). Problems identified during testing generated engineering changes which were planned for fleet incorporation at one fourth the point at which they occurred, or the 0.25 damage point. Both full-scale fatigue articles (X-998 and X-993 suffered first cracking at about 9,000 cyclic test hours and thus identified a series of engineering modifications for incorporation at or before 2,250 hours. This group was known as the first structural update. It will be completed in Sep 1975. Both test articles encountered general cracking in the lower surface spanwise splices at less than one lifetime thus indicating a total service life for the aircraft on the order of one fourth of the original design goal.

(4) The full-scale fatigue tests started 19 months after first flight, or 1 month after the first operational delivery. Twelve months later, testing confirmed that a significant wing fatigue problem existed. Nine months later, after 50 of the 81 airplanes had been delivered, the degree of cracking indicated the true seriousness of the operational life reduction. The Independent Structural Review Team concluded in 1972 that the life was approximately 6,500 hours, while Lockheed placed the number only slightly above the IRT estimate. Since 1972, the SPO, contractor, and user have concentrated on efforts to minimize fatigue damage and maximize service life of the existing wing. Several sets of mission profiles have been developed. In 1973, an optimistic set of mission profiles and an optimistic prediction by the IRT of the benefit of load alleviation schemes (an Active Lift Distribution Control System (ALDCS) and an alternate fuel sequency) indicated that it might be possible to get 17,000 hours of life from the average aircraft; however, a re-examination of those predictions in 1974, based on actual mission usage and laboratory tests of ALDCS benefits, lowered the estimate to 12,800 hours. A further reassessment, in Jan 1975 by the Aeronautical Systems Division Scientific Advisory Group using an improved technique based on fracture mechanics (crack growth rate), determined that 8,000 Representative Mission Profile (equivalent) hours (without ALDCS) was more realistic.

(5) A general misconception of the C–5 wing life exists in the minds of many who recall that the B–52 and other aircraft have flown well beyond the 0.25 fatigue damage factor. Such an extension is not possible with the C–5 in that the 8,000-hour limit (without ALDCS) is a safety limit and not the 0.25 damage point; in fact, it is significantly below 0.25. For that reason, it is necessary to explain in some detail the derivation of this number.

(a) The basic premise of the C–5 wing life assessment is that:

1. The base line aircraft should not be flown beyond either the time that life extension options can be economically incorporated, or, if no general fix is intended, beyond the point of economical repair. This is known as the economic limit.

2. The baseline aircraft should not be flown beyond the time that safety can be confidently maintained (i.e., the safety limit). To predict the safety limit requires an evaluation of the damage tolerance (crack growth rate) of the structure. (For the inner and center wing, the safety limit occurs well before the economic limit; thus it is the controlling number.)

(b) Two approaches to damage tolerance exist:

1. The fail-safe approach: The structure is designed so as to contain a single member failure without loss of the aircraft, or one lower surface panel could fail all the way across.

2. The safe crack growth approach: The structure is designed (and inspected) so that the maximum expected initial manufacturing damage will not grow to critical size during service life. The time that it takes for the initial flaw to grow to critical size (failure point) is divided by a safety factor of two, and this is set as the service life of the aircraft.

(c) The C–5 wing is considered fail-safe in that a single plank failure will not cause loss of the aircraft; however, the wing rapidly loses its fail safety characteristics if cracks exist in the adjacent wing panels.

The C–5 uses ship-lap construction in the spanwise splices; thus, the question of adjacent panel damage is most significant. During manufacturing, the fastener holes are drilled through both panels simultaneously and poor manufacturing quality (e.g., a bad drill bit) would probably result in defects in both panels at the same time. Therefore, if a panel failed and the adjacent panel hole had a flaw, that panel would fatigue very rapidly and subsequently fail causing loss of the aircraft. There are 22,000 spanwise splice holes in each wing lower surface on each aircraft and a serious defect in a single hole could cause the loss of an aircraft, if it is undetected. Therefore, it is mandatory that the service life limit be set so as to protect against the single worst hole in the fleet, using the safe crack growth approach.

(d) The safety limit versus manufacturing damage size. On the left, it is noted that initial manufacturing damage size of 0.03 inch is probable and damage as large as 0.10 is possible. These values derive from the full scale fatigue article teardown analysis which confirmed the 0.03 average size, although no damage larger than 0.05 was actually detected. The IRT determined that a 0.03 flaw would grow to panel failure in 13,000 hours. Dividing that value by two results in the 1972 IRT recommended limit of 6,500 hours, which happens to correspond to the worst expected crack size of 0.10. The ASD/DAG analysis, based on 1975 usage (representative mission profiles without ALDCS) and the teardown analysis of X–998, lowered the unfactored limit from 13,000 to 10,000 hours. Employing the same safety factor as used by the IRT (i.e., divide by two) would have resulted in a 5,000 hour upper limit; however, in view of the X–998 teardown results, which revealed no initial flaws greater than 0.05, the DAG concluded that a flight value which protected against an 0.05 flaw size was reasonable, provided a quality inspection of all aircraft (22,000 lower surface spanwise splice fastener holes) was conducted to confirm the fact that larger flaws were not prseent. (Such an inspection is now underway.)

(e) In recommending this procedure, the DAG recognized that this results in operation of the C–5 at a higher level than the IRT had been willing to assume. They equated this risk level at approximately equivalent to that of the F–4 operations.

(f) In summary, the DAG concluded that the 8,000 RMP hours without ALDCS (8,750 hours with ALDCS) must be treated as an upper life limit. They recommended that attainment of this limit prior to incorporation of the H Modification should result in grounding of the aircraft and that any subsequent release for flying would be contingent upon the results of either a proof test (similar to that conducted on the B–52D) or from an extensive fastener removal inspection of at least 10,000 fasteners per aircraft, or very severe flight restrictions (reduced flight loads to less than the wing strength with one failed panel and a cracked adjacent panel). They further concluded and recommended that the H Mod be recognized as an urgent safety modification and should not be delayed.

b. Fuselage: The C–5 fuselage is approximately 230 feet long and consists of a two-lobe configuration which provides for separation of the crew and troop compartments in the upper lobe from the cargo compartment in the lower lobe. Structurally, the fuselage shell is conventional skin, stringer, frame construction.

(1) The judgment that the C–5 fuselage is good for 30,000 hours service life, or more, is critical to the decision to spend one billion dollars on the wing. The System Program Office has conducted two detailed reviews of this judgment during the past 2 years, and it was the subject of another review by the APEX group.

(2) It is understood that at the time the contractor launched a major weight reduction program (about 1966), the fuselage design was essentially complete and no major fuselage redesign for weight reduction was conducted; thus the high wing stress levels were not duplicated in it. Nevertheless, it is a very massive structure; the pressure vessel is the largest of any aircraft in the world, and the potential for catastrophic, explosive decompression requires careful analysis and testing, especially of the pressure doors. The most critical pressure doors are the five latch-type doors (visor door, forward ramp, crew forward door, aft ramp, and pressure door).

(3) The C–5A empennage has completed both static and fatigue testing, essentially trouble free. Fuselage static testing has been completed and all of the fixes resulting from that testing have been incorporated. Fuselage fatigue testing is currently in progress and, based on 14 mission profiles, is between one and two lifetimes.

(4) The fuselage structure is subject to a combination of pressurization, flight and ground loads including the effect of cargo loads, wheeled vehicles axle loads, and impact loads of rolling stock. The fuselage, like the wing, is tested to a scatter factor of four. Originally it was subjected to test loads consistent with the 15 mission profiles. These were later changed to coincide with the 14 mission profiles and the incorporation of the Passive Lift Distribution Control System (PLDCS). The scatter factor of four was used to account for variations in manufacturing, utilization and nonaverage environment parameters. In other words, four times as many pressure cycles are applied as are expected to occur in one lifetime; four times as many bending loads resulting from flight operations were applied, etc. Static test loads were one and one half times the expected 2.5G flight loads and pressurization loads for static testing were twice the normal maximum in flight pressurization of 8.7 PSI differential.

(5) The fact that the empennage and fuselage were subjected to the above standard static tests and suffered only minor problems led the IRT in 1972 to the conclusion that the fuselage would be good for 30,000 hours of service life, even though it had less than one lifetime of fatigue testing at that time (the empennage fatigue test article had completed four lifetimes).

(6) Since the IRT review, X998 has been converted to a fuselage-only test and testing has resumed. Minor cracking has occurred in the forward ramp, around the windshield, in the visor hook backup structure, around the crew entrance door, in the wing-to-fuselage mate area, in the pressure door hinge fitting and in the upper edge of the aft service door. All of these areas have been, or are being, corrected by changes. Other minor problems have occurred for which only inspections are necessary and these are called out in the applicable Technical Orders (T.O.s).

(7) One additional fuselage fatigue problem is now pending SPO resolution, i.e., skin cracks in the cyclic test article in the aft fuselage upper lobe over the troop compartment (fuselage station 1523 to 1964). The SPO has delayed its decision awaiting APEX recommendations, in that the decision on a fleet fix is dependent upon how the aircraft will be used in the future. The specific items in question are support area landings and contour flying missions in that the major damage source in this fuselage area derives from the bending loads associated with these missions. This cracking problem began to occur at between 22,000 an 24,000 cyclic test hours of 15 mission/14 mission (no LDCS and standard fuel) usage. Equating these hours to 14 mission (with PLDCS equivalent hours) gives 35,600 CTH or equating to the 1975 (RMP) missions with alternate fuel, this area has 70,600 equivalent CTH, or almost two and one half lifetimes. Inasmuch as this area is fail safe, if support area landings and contour flying are not contemplated, then development of inspection procedures for subsequent PDM cycles constitutes adequate disposition of this problem. If they are a requirement, then an expensive modification is indicated.

(8) As fatigue testing continues, there no doubt will be other minor fatigue cracks which will require engineering changes with incorporation of modifications during future PDM cycles. This situation is no different from that of other large aircraft such as the C–141, which continues to receive minor modifications as a result of test experience and field usage.

(9) Aside from the fuselage fatigue problems, the area of corrosion protection must be addressed. The C–5 fuselage has a large amount of 7075 and 7979–T6 heat treat aluminum which is highly sensitive to stress corrosion, e.g., the wing/fuselage/main landing gear interface structure is of this material, as are the pressure doors, the door latching mechanisms and backup structure. Stress corrosion is not well understood or predictable except it is known that it can degrade the strength of highly stressed, improperly protected material very rapidly. One in-service aircraft has suffered approximately a 2-inch crack in a fuselage main frame, and a review of URs and structural inspection data reveal 28 cases of stress corrosion cracking in the fleet. All but one of the 28 cases were dispositioned via application of a standard T.O. repair procedure. The remaining case involved the failure of the visor actuator attaching structure which caused the visor to fall, doing in excess of one million dollars in damage. A major ECP was required to correct that problem. While no stress corrosion problems have been confirmed in the forward or aft ramps, a misrigged ramp could result in the unequal distribution of loads into the latching structure and this could accelerate stress corrosion cracking and failure.

(10) The possibility that stress corrosion could be a problem on the current C–5A aircraft led the APEX group to request from the SPO and Lockheed an analysis to determine critical forgings and extrusions on the C–5, the failure of which could result in a catastrophic failure. Further, the SPO was asked to conduct a visual examination of these critical components on a high time aircraft such as 69–002 to look for any evidence of corrosion and those results will be available in October 1975. Should visual inspection indicate suspect areas, additional examination will be required.

(11) In summary, the fuselage has passed a series of very rigorous static tests which give confidence that it will give good service life. Final proof lies minor cracking is anticipated and some of these will require engineering changes and fleet modfications; however, these are expected to be relatively low-cost in the fatigue test, which now exceeds one lifetime and is continuing. Additional fixes. The abundance of corrosion sensitive T6 heat treat aluminum is an area of concern; however, an aggressive corrosion protection program, good maintenance, and proper rigging can prevent catastrophic failures from stress corrosion.

c. Systems.—As a result of C–5 test programs and field experience, certain systems within the aircraft have been identified as having lifetimes less than the H modified aircraft. For example, the nose landing gear trunion did not successfully complete four lifetimes of fatiuge testing and will probably require replacement on H modified aircraft. In addition, other major structural components such as the main landing gear yoke could require replacement. Aluminum power distribution cables from the main generators to the power distribution buses are already beginning to deteriorate. Lockheed has suggested informally that the existing navigation systems (IDNE, AHRU, HAMS, and MMR) are not expected to be economically supportable for the proposed life of the modified aircraft. These are essentially 1960 state-of-the-art equipments. Procurement of additional items of equipment and spare parts will be very costly and maintenance costs for these will continue to rise. Replacement of these systems with state-of-the-art equipment could prove to be highly cost-effective. AFLC has been tasked to provide a more complete list of such equipment with estimated replacement costs and schedules. MAC has conducted a preliminary study for the APEX Group of a more cost-effective avionics system for the C–5A. The MAC effort indicates significant potential O&M savings; and a more comprehensive feasibility study by the AFLC and the contractor is now required, such that Class V modification planning can commence.

d. Band of uncertainty.—It is felt that the life of the current aircraft structure is fairly well known, The C–5 fuselage could require significant inspection and repair costs in its later years, primarily resulting from corrosion problems; however, no single problem is now known which will prevent attainment of at least 30,000 hours of fatigue life.

(1) Existing aircraft subsystems will continue to require major maintenance due to their complexity, and some replacements with state-of-the-art equipment will no doubt be required; however, these will probably be cost-effective in terms of lowered maintenance costs. At the present time, no problems are foreseen with aircraft subsystems which would preclude attainment of 30,000 hours of service life.

(2) Some band of uncertainty exists regarding the service life of the current wing. As stated, the 8,000 RMP (without ALDCS) is a safety limit based on fracture mechanics (crack growth) analyses, and as such, represents an upper limit. Realization of lifetimes in excess of 8,000 hours is not anticipated for the representative mission profiles. As for the lower safety limit, a major inspection program at 5,500 hours is designed to detect major initial manufacturing damage such that protection up to the 8,000 hours number is likely. Additional laboratory testing to more accurately determine the benefit of ALDCS (now estimated as 750 hours) is under way, and additional minor operational changes, such as permanent removal of the aft troop kit, are being considered; however, these are more in the nature of fine tuning and are not expected to yield more than a few hundred hours of additional lifetime. (Life extension options such as proof testing are covered in Section V, B3).

(3) In summary, the 8,000 RMP hours (without ALDCS) and 8,750 hours (with ALDCS) for the average fleet aircraft should be used as firm planning numbers.

2. *Issue—How to Maintain Safety of Aircraft*

a. Structure

(1) *General.*—Structural integrity is initially insured by testing; however, its maintenance throughout the life of the aircraft is dependent on proper care (e.g., corrosion protection), usage (e.g., no overload conditions such as would occur due to misrigging) and monitoring to detect unexpected events.

(2) *Inspection.*—A series of C–5A inspection procedures derived from static and fatigue tests are included in the appropriate technical orders. These are re-examined by the user and System Manager and amended periodically based on field experience. Some additional "hot spot" inspections are now being added based on recent crack growth studies.

(b) In addition to these, the C–5 SPO has devised a set of special inspections designed to insure that initial manufacturing damage is not of such magnitude as to cause the aircraft to lose its fail safety prior to reaching its safety limit of 8,000 RMP hours (without ALDCS). Each aircraft will receive an inspection of its 22,000 wing lower surface spanwise splice fasteners as it replaces 5,500 RMP hours. Three aircraft have reached this point, one of these has been inspected with negative findings and the next two are scheduled to input this summer. The objective of this inspection is to find large (greater than 0.05 inches) initial manufacturing flaws, if any. Ultrasonic inspection is used and fasteners are removed and eddy current checks are conducted whenever ultrasonic indications of cracking are recorded. Few such large flaws can be expected, based on fatigue test article analysis; however, the fact that one such flaw in the fleet, if undetected, can cause loss of an aircraft, means that this inspection must continue to be pursued.

(c) As still another confidence measure, a special inspection of 3,000 inner wing spanwise splice fasteners will be conducted on fleet high time aircraft this summer. These fasteners, which are located in one of the worst wing fatigue areas, will be pulled and the holes will receive an eddy current inspection. This inspection is designed to determine if widespread cracking is present from normal quality holes (initial manufacturing damage less than 0.03 inches). Analytic predictions are that widespread cracking of this nature should not appear until about 10,000 RMP hours (without ALDCS).

(d) Yet another planned wing inspection is the analytic condition inspection (ACI) conducted during PDM. It is an in-depth condition inspection of ten aircraft per year to determine not only fatigue problems, but also general condition problems such as corrosion. General problems discovered during ACI result in additional fleet inspections, usually at field level. The C–5A ACI program started in fiscal year 1973, and most inspection areas to date have been in the wing. Expansion of the ACI to include the fuselage is under consideration. As a minimum, the forward and aft ramps and pressure doors and the crew entry door will be added to the fiscal year 1976 ACI program.

(3) *Monitoring.*—(a) A second method of maintaining structural integrity is via monitoring and recording devices. A very thorough individual aircraft service life monitoring program (IASLMP) has been conducted since the C–5A entered operational service. Damage is tracked at numerous wing and fuselage control points on each aircraft, by tail number, and the results are used to determine inspection times and ECP incorporation schedules. Velocity, vertical acceleration, altitude, fuel flow and event data are recorded on every flight on the MADAR tape and fed into a computer program which updates prior structural fatigue (damage) data on that aircraft.

(b) The computer program used in IASLMP is derived from fatigue test data and from predicted environmental (e.g., turbulence) data. Environmental data is verified by a second monitoring program, the service loads recorder program (SLRP). The SLRP was designed to verify that the predicted in-flight turbulence patterns do exist, and a life history recording program (LHRP) is due to replace it when adequate SLRP data has been collected. The technical community generally agrees that the scope of the SLRP program can be reduced, i.e., some recorders removed, thus resulting in reduced O&M and data reduction/storage costs.

(c) Still a third C–5A monitoring device is the flight structural monitoring system (FSMS) now under development and flight test. Inasmuch as the C–5 wing structure loses its fail-safety very rapidly after an initial panel failure, it is important to know when that panel fails. The FSMS is designed to detect a major panel crack and warn the flight crew. No flight hour installation point has been designated for FSMS; however, the consensus is that it should be installed as soon as its reliability has been established.

(4) *Protection against overload.*—(a) A third method of maintaining structural integrity is to protect the design strength of the structure. This involves, mainly, protection from damage due to overloading/overstressing the structure and protection against structural damage (e.g., excessive wear, scratches, corrosion pitting, etc.).

(b) A second cause for overloading could be ramp mis-rigging. This could result in one hook carrying more than its share of the load. Overloading of this type hastens fatigue damage and can result in premature hook, hook latching or hook back-up structure failure.

(5) *Corrosion control.*—(a) Degradation of design strength by corrosion can be quite rapid and lead to very early parts failure. Sensitivity to corrosion is dependent on the material type and heat treat. Aluminum 7075–T6 and 7079–T6. which are used extensively on the C–5A, are very corrosion prone. Large forgings, such as the C–5 fuselage main frames, must be protected at all times. Areas of stress concentration can result in stress corrosion cracking very early in the aircraft life. Numerous minor cases have been discovered in the C–5 fleet to date.

(b) The APEX Group tasked the C–5 SPO to identify safety critical forgings and extrusions (principally T–6) which could be candidates for stress corrosion. The plan is to spot check an early fiscal year 1976 PDM aircraft and run laboratory analysis of suspect parts. Results of that program will not be available until about October 1975. Past experience says it is reasonable to expect to find some problem areas and a close monitoring and follow-up by the C–5A SPO is required.

(c) A vital element in the preservation of C–5A safety and life is an active corrosion prevent program. A system peculiar corrosion control manual, T.O. IC–5A–23, was published in November 1974. The C–5 System Manager (SM) chairs a Corrosion Control Board composed of MAC, AFLC, and contractor representatives. Quarterly meetings are called for; however the board has not met since November 1974 because of the shortage of travel funds. Manpower shortages also appear to have an impact. The SM's obligations under the plan call for well in excess of one man-year's effort, whereas the SM corrosion representative is a full-time C–5A structural technician who can devote only token time to this critical additional duty.

(d) Numerous depot level corrosion control tasks are in progress. Teams are working at Dover and Travis to comply with a T.O. to inspect the wing station 577 joint splice plates. Cleaning, treating, adding inhibited sealant and providing for water drain paths are included. To date, four aircraft have been discovered with corrosions so severe as to cause replacement of the splice plates. a very costly operation. A similar T.O. is in work to protect the fuselage heel beam area, as are other less significant T.O.s. In all cases, these T.O.s are in response to problems which were identified two or more years ago.

(e) The C–5 has been long enough for corrosion trends to develop. These areas have been identified as corrosion prone. Particular ones are the latrine and galley areas, crew entry door area, all hatches, elevator and rudder hinges, cowl doors, visor latches and hinges, wheel fairings/doors, all metal honeycomb areas and all areas of high strength aluminum and steel alloys. At the present time, one aircraft requires a pylon change due to a severely corroded aft engine mount fitting, which is high strength steel.

(f) In summary, the C–5A is perhaps the most corrosion sensitive large aircraft ever built. Additionally, it is a victim of an Air Force-wide lack of understanding of corrosion in general. A mechanism does exist to minimize corrosion problems in the form of a Corrosion Control Board and a Corrosion Prevention Manual (T.O. 23); but the above lack of understanding, coupled with a lack of TDY funding and inadequate staffing, indicate a serious potential safety problem.

(6) *Operating restrictions.*—(a) Finally, structural integrity can be maintained by operating the aircraft at reduced stress levels. MAC defined operational procedures (i.e., payloads, fuel loads, flight patterns, etc.) which insure that normal design stresses are not exceeded.

(b) Whereas MAC aircrews, in normal operations, avoid turbulence whenever possible, the lower flying altitudes, coincident with the pressurization limitations in effect following the loss of aircraft 68–0218, are making that task difficult. Indications of higher fatigue damage are being seen in the IASLMP program since pressurization restrictions went into effect. With the onset of summer thunderstorms flight in increased turbulence and the potential of exceeding normal stress levels do exist.

(c) Load alleviation (ALDCS) has been shown in wind tunnel testing to reduce peak gust and maneuvering loads about 30 percent. Such a system on the C–5A increases static strength margins and helps insure structural integrity. In addition to the fatigue relief it is expected to provide, its safety value is significant.

b. Flight Critical Systems

(1) *General.*—The safety or protection of flight critical aircraft systems, from a design standpoint, involves the provision of redundant systems, physically separated such that the failure of one does not affect the other. The loss of aircraft 67–0218 revealed that the C–5A has single failure modes which cause the loss of multiple systems and can cause loss of the aircraft.

(2) *Engineering tasks.*—(a) Several engineering tasks has been assigned and are in progress which are intended to re-examine a'l C–5A failure modes, pinpoint single and double failures, redesign against single failures and, where possible, protect against multiple failures. Those are:

1. Review past failure modes/engineering hazard analyses. Look at past assumptions and conclusions in light of operational experience and identify areas for reanalysis. Estimated Completion Date: 13 June 1975.

2. Examine C–5A dash one emergency procedures for adequancy relative to emergency control of the aircraft in the event of flight control system loss. Estimated Completion Date: 1 August 1975.

3. Conduct a study of the ways of protecting flight control system redundancy. Estimated Completion Date: 15 July 1975.

4. Conduct a study of ways of assuring the locking of the aft ramp. Estimated Completion Date: 15 July 1975.

(b) *Item 1.*—Is intended to develop additional systems for protection. Examples of areas which are currently being re-examined include: thin wall hydraulic tubing, less flammable hydraulic fluid, less volatile engine fuel, routing of multiple hydraulic lines through the same area and elimination of ignition sources where fluid spills are possible. One item noted to date is the fact that all four hydraulic systems have lines through the wing torque box fittings and a single failure, such as the loss of a flap in flight, could cause loss of all hydraulics and thus the loss of an aircraft.

3. Issue—Ways of Extending C-5A Structural Life

a. General.—As stated earlier, the life of the C-5A wing is a function of the fail safety of the panel adjacent to a failed panel, and the fail safety of the adjacent panel is a function of the size of initial manufacturing damage: for the maximum expected initial damage (0.05 inches), that limit is 8,000 RMP (without ALDCS) hours.

b. ALDCS.—(1) Based on the January 1975 ALDCS incorporation schedule, and assuming the ASD/DAG assessment of ALDCS benefit is 25 percent (i.e., damage from 4 flying hours without ALDS equals damage from 5 flying hours with ALDCS), then the average aircraft upper limit becomes 8,750 hours. Two options for life improvement then are first, advance the ALDCS schedule and second, see if it might yield more than a 25 percent improvement.

(2) Since the Jan DAG assessment, the C-5 SPO has requested and received permission to accelerate the ALDCS schedule by almost 1 year, which amounts to slightly over 100 hours/aircraft life extension. The contractor has been tasked to conduct further analyses and testing of the ALDCS to see if more than 25 percent benefit is possible. The tests to date place ALDCS benefit between 5 and 69 percent, varying by location on the aircraft and varying at a particular location according to the phase relation between bending and shear loads. Although these tests are continuing, the general consensus is that more than a few percent improvement (a yield of an additional 100-200 flying hours) should not be counted on. Thus, the upper limit of C-5A RMP flying hours, with ALDCS, appears to be about 9,000. The C-5 SPO expects additional test results in October 1975.

c. Mission changes.—Another possible option is to further alter the RMP missions. Figure 11, for example, shows the effect of payload on fatigue life for one particular set of conditions. It also shows the effect of being forced to operate with the standard fuel sequence for payloads under 50,000 pounds (due to aft c.g. limits). The C-5A Operational Utilization Management Program, implemented by the C-5A SPO and MAC in 1972, is being re-established to see if further operational refinements are possible. One item now under study is the effect of removing the aft troop kit (seats, galleys). This could lead to use of the alternate fuel sequence for payloads under 50,000 pounds. The C-5 SPO and the contractor are exploring, with MAC, such ways of obtaining additional service life and expect to have additional proposals in late June. No estimates of life extension have been made, but the likelihood of obtaining more than an additional 300-400 hours is remote. Better estimates are expected in late June or early July 1975.

d. Proof Testing.—(1) As for still further life extension, the only additional method seems to be a proof test similar to that conducted on the B-52D. The B-52D tests cost about $94,000 per aircraft and extend service life about 750 hours. Following proof tests, the aircraft are operated with flight restrictions which will insure that the proof test loads are not exceeded. The C-5 SPO and Lockheed are studying the advantages/disadvantages of such a program for the C-5 and will have results in late June.

(2) With the exception of the tests to more accurately determine the benefit of ALDCS, no other testing is planned that will assist in predicting the life of the current wing. Efforts must now turn to "listening to the fleet" via monitoring and inspection. As additional hours are accumulated, more frequent and detailed inspections will be required. Lead-the-forces aircraft will be watched closely for fleet indications as well as to assure their continued safety. Bad news, such as greater damage than expected, cannot be ruled out.

c. Summary.—In summary, the extension of service life of the current wing beyond 8,750 hours in likely; however, the possibility of obtaining in excess of 10,000 hours, even with a proof test, now seems remote.

4. Issue—Engineering Versus Operational Tradeoffs

a. General.—The C–5 SPO has received only general requirements for the planned wing modification. No Program Management Directive (PMD) has been issued. Prior to issuance of the PMD, there are several tradeoffs which have emerged and should be decided.

b. Mission Usage After Modification of the Wing.—The C–5 SPO has assumed, and briefed, the fact that the new wing will be designed for the 1972 mission profiles which include contour flying and support area landings. As noted in paragraph V–Blb, these two missions are the chief contributors to fuselage bending loads; and because of them, the fatigue article has suffered extensive cracking in the upper skin over the troop compartment. If these missions are retained and the aircraft must be capable of withstanding them, the fuselage skin over this area will probably require replacement (when the wing is modified) at a cost of $35–60M. If these are not planned, it now appears that no fix is required. Additionally, elimination of these loads from the fuselage fatigue test spectrum will result in reduced test costs. The C–5 SPO is studying these tradeoffs and expects to have results in late June.

c. Service Life After Modification.—(1) The C–5 SPO has assumed that the new wing is to have a service life of 30,000 hours and is designing the new center and inner wings to that requirement. The outer wing, however, is to be modified, not redesigned, and there is a higher risk associated with its attaining 30,000 hours after the modification. Current estimates are that it will have no trouble in attaining 20,000 additional hours after modification but that inspection and repair costs for the extra 10,000 hours may be high.

(2) The decision to modify rather than install new outer wings was based on costs; a new wing was estimated to add over $90 million to the program. The C–5 SPO and the contractor are re-examining the question and will have a new tradeoff study about 90 days after the "H" design effort goes on contrast.

(3) The APEX Group has taken a brief look at this question and notes the following:

(a) Availability of cargo to haul plus the high cost of operating the C–5A will probably always restrict flying to the minimum necessary to maintain crew proficiency. No number in excess of 1,000 hours/aircraft year can now be foreseen.

(b) At 1,000 hours/aircraft/year with the currently planned H incorporation schedule (1979–1985), this will extend C–5A life well past the year 2000.

(c) By the year 2000, the aircraft will be 30–35 years old and will likely be beset with other wearout problems.

(d) Proceeding now to modify rather than replace the outer wing does not preclude a later decision to replace the outer wing; however, the costs of such action would be much greater than the current estimated difference of roughly $90 million.

5. Issue—Key Decision Dates

a. "H" Mod funding.—The C–5 SPO has proposed, SECAF has approved, and SECDEF has accepted for budgeting and planning purposes schedule. The corresponding H Mod budget for the near-years is shown in Table 2. Congress has not approved fiscal year 1975 money and there are indications that the C–5A wing fix will be a subject for floor debate during the fiscal year 1976 budget hearings. A March 1974 start date for the design effort, which was proposed by the Tri Commanders in Mid 1973, continues to slip with July 1975 as the most recent target (that target was 1 April 1975). Additionally, the start date for Phase IV (production modification) which was planned for late 1979 has been challenged by the OSD/SDARC (Defense Systems Acquisition Review Council), which is known as the "no concurrency" schedule, is now indicated. Phase IV start would slip to February 1982.

b. Major decisions.—The Air Force decision to fix the current C–5A rather than go for a replacement aircraft was made by Dr. Seamans, Dr. McLucas, and General Ryan in March 1973; however, to date, the only decision that has OSD blessing is the one to proceed with the design and test phases. The 1973 decision was based on cost-effectiveness, i.e., the C–5A cost $4.45b in the 1968 dollars, a replacement in then year dollars would be at least twice that much, whereas a wing fix in then year dollars was estimated at well under $1b. The C–5A wing fix then proposed promised at least a doubling of life for less than 20 percent of the original investment. The next major decision is whether to modify or redesign the outer wing (reference paragraph V–B4c). This must occur not later than about 4 months after signing the H design contract to prevent cost and schedule impact. Succeeding major decision points, which assumes that the SDARC desires for no concurrency will prevail. Here, the first production aircraft would enter modification in February 1982. Any number of events/finding could occur that would affect this schedule. Table 2 lists some of them and their potential impact.

c. Utilization rate.—The current C–5A wing life will be reduced to zero in 1983 if the February 1982 production mod start date and the currently planned minimum UTE rate of 2.04 hours/day/aircraft are flown; it will dip below the desired contingency reserve in 1980. Two other cases are shown for comparison purposes, a 1.5 and a 1.0 UTE rate. With the optimistic assumption that the efforts to prolong the life of the current wing (including proof testing) will yield an average of 1,000 additional hours/aircraft, the lifetime is extended by 17, 24, and 35 months for UTE rates of 2.04, 1.5 and 1.0 respectively. However, in view of the many uncertainties in predicting the C–5A service life, as noted in Table 3, any planning for any average life greater than 8,750 hours becomes very risky.

C. CONCLUSIONS

1. Maximum preservation of the predicted service life of the current C–5A aircraft seems prudent in view of the potential that Congress will not provide funds for the new wing.

2. The current C–5A wing life limit of 8,750 hours in a safety limit based on crack growth analysis, not the classical 0.25 fatigue damage factor used in such aircraft as the B–52, and should not be exceeded without additional testing (i.e., proof test).

3. By operating the C–5A to the 8,750 hours safety limit, the risk of aircraft less due to structural failure is about equal to that of the F–4. It is higher than that for commercial and for most Air Force aircraft.

4. The life of the current wing can probably be extended somewhat over 9,000 hours and possibly near 10,000 hours by conducting a proof test when the safety limit is reached. This could involve even higher risk (reference conclusion #3).

5. The C–5A fuselage should be good for a total of 30,000 flying hours. XOPs will result from fatigue testing which must be incorporated.

6. An extensive and costly wing inspection program will be required in order to maintain aircraft safety prior to wing replacement.

7. A less extensive but costly fuselage inspection program is required for the life of the aircraft. Key factors to guard against are corrosion and damage to pressure doors and ramps.

8. The Individual Aircraft Service Life Monitoring Program (IASLMP) is highly beneficial in maintaining aircraft safety and must be continued.

9. The SLRP program is a good candidate for cost reduction.

10. The Flight Structural Monitoring System (FSMS) is a valuable safety device and should be incorporated as soon as its reliability is demonstrated.

11. C–5 leading must be carefully monitored to avoid damage to the forward and aft ramps.

12. Rigging of the forward and aft ramps/doors must be closely monitored.

13. The forward and aft ramps and pressure doors must be inspected at a frequency which will assure that they are free of cracks or damage.

14. Vigilance against stress corrosion must be very strong, especially on safety critical structure, due to the high design stress levels.

15. Turbulency encounters have increased since the pressurization restrictions were imposed, thus fatigue damage has been accelerated.

16. Single failure modes do exist in the C–5A which can cause loss of an aircraft. These must be identified and either eliminated or reduced to a very low probability occurrence.

17. Engineering tasks associated with conclusion No. 16 must be aggressively pursued.

18. An active C–5A Operational Utilization Management Program is necessary to maximize the service life of the current wing.

19. The benefit of the Active Lift Distribution Control System (ALDCS) is not yet determined.

20. No set of requirements for the new C–5A wing have been stated via a Program Management Directive (PMD).

21. The long-range requirement to keep the C–5A in the active Air Force inventory has not been determined.
22. The need to replace versus modify the outer wing (H Modification)is dependent on the requirement for 30,000 versus 20,000 hours of service life after modification.
23. Mission usage (UTE) after incorporation has not been determined and thus makes long-range planning difficult.
24. The decision to fix the C–5 wing has been made by the Air Force but does not have solid OSD backing.
25. The decision to fix the C–5 wing must be made no later than during the fiscal year 1979 budget finalization period (mid 1977) when Phase III (kit procurement) money must be included.
26. The currently planned UTE rate of 2.04 must be reduced if maintenance of contingency reserve of flying hours is required to H Modification.
27. Uncertainties in predicting the C–5A life are such that planning based on any service life average greater than 8,750 hours is very risky.

D. RECOMMENDATIONS

1. The C–5A should be used at a rate consistent with "no H Mod" until the fleet retrofit decision for the H Mod has been made (about late 1977). (Action: MAC/DO).
2. All C–5A utilization/modification/planning should be based on an average service life of 8,750 MP hours/aircraft. (Action: MAC/KP/DO/LG; AFLC/MT/MA; SAALC/MMB; C–5A SPO).
3. Normal fuselage BCPs resulting from fatigue article testing should be recognized, planned for and funded. (Action: C–5A SOP; SAALC/MMB).
4. A study of the C–5A Service Loads Recorder Program should be conducted to see if cost reductions are in order. (Action: SAALC/MMB).
5. Preservation of the structural integrity of the C–5A ramps and pressure doors must be carefully maintained; loading, rigging, inspection, corrosion control are key factors. (Action: MAC/DO/LG: SAAL/MMB).
6. The current failure modes study must be aggressively pursued; actions must be assigned and safety modifications implemented. (Action: C–5A SPO for study: SAALC/MMB for follow-on efforts).
7. The C–5A Operational Utilization Management Program (OUMP) must be reinstated. (Action: C–5A SPO for APEX Tasks: SAALC/MMB and MAC/DOO for follow-on efforts).
8. A Program Management Directive (PMD) must be issued which clearly defines the planned C–5A usage and the required C–5A service life after incorporation of the wing fix. (Action: AFRD).
9. An active C–5A corrosion control program must be formulated, funded and implemented. Adequate manning must be provided. (Action: SAALC/MMB; AFLC/NM/BA; MAC/LG).

TABLE 1

Accident date	Location	Failure mode
1. May 25, 1970 (total loss)	Palmdale, Calif., on the ground	Reverse flow valve in air turbine motor failed, motor was driven backwards, overheated and set underfloor area on fire.
2. Oct. 17, 1970 (total loss)	Lockhead, Ga., on the ground	Improper AGE used to purge fuel tank. Tank exploded. (Brake overheated on takeoff. Retracted gear/tire caught on fire. Burned on landing.)
3. Sept. 27, 1974 (total loss)	Clinton, Okla., air/ground	Brake overheated on takeoff. Retracted gear/tire caught on fire. Burned on landing.
4. Apr. 4, 1975 (total loss)	Tan Son Mart, RVN, air/ground	Aft pressure door lost and destroyed all tail controls. Aircraft destroyed on crash landing.

TABLE 2.—*AP Approved "H" MOD Budget*

[Dollars in millions]

Fiscal year 1974	$7.6
Fiscal year 1975	2.8
Fiscal year 1976	26.1
Fiscal year 1977	13.5
Fiscal year 1977	59.1
Fiscal year 1978	57.7

TABLE 3

Event	Date	Potential life impact/aircraft
1. Accelerate ALDCS schedule	May 1975	+100 hrs.
2. ALDCS benefit study	October 1975	+100–200 hr.
3. Remove aft troop net	July 1975	+300–400 hr.
4. Special fastener pulling inspection results on aircraft 69–002	October 1975	+None; −possible.
5. Results 5800 Nr MDI of spanwise splice	Mid-1976	Do.
6. Results of forgings/extrusions inspection on aircraft 69–002	October 1975	Do.
7. Fiscal year 1976 fuselage ACI program results	Mid-1976	Do.
8. Contingency operations	Unknown	+None; −likely.
9. Proof test study	July 1975	+500–750 hr; −possible.

Senator PROXMIRE. Our witness is Mr. Robert B. Ormsby, president of the Lockheed-Georgia Co. Mr. Ormsby, we are delighted to have you with us. Will you rise and raise your right hand? Do you swear the testimony you are about to give will be the truth, the whole truth, and nothing but the truth?

Mr. ORMSBY. Yes.

Senator PROXMIRE. Thank you, sir. You have a prepared statement and we will put it in the record in full. You also have some very helpful appendixes which will be incorporated in the record. You might introduce your colleagues.

TESTIMONY OF ROBERT B. ORMSBY, JR., PRESIDENT, LOCKHEED-GEORGIA CO., MARIETTA, GA., ACCOMPANIED BY JAMES A. NEILSON, DIRECTOR OF C–5 PROGRAMS; AND FRED M. CONLEY, GROUP ENGINEER, C–5 DAMAGE TOLERANCE ANALYSIS

Mr. ORMSBY. Thank you, Mr. Chairman. I have with me today Mr. James Neilson, director of the C–5 programs and Mr. Fred Conley, group engineer, C–5 damage tolerance analysis.

Senator PROXMIRE. Thank you, Mr. Ormsby.

Mr. Ormsby, is it correct that Lockheed redesigned the C–5A, in 1965 in order to reduce its weight and in doing so took a great deal of weight out of the wings?

Mr. ORMSBY. Yes; that's true. I think that's been a matter of a number of testimonies.

Senator PROXMIRE. And wasn't that reduction in the weight a matter of getting the cost down too?

Mr. ORMSBY. To get the cost down?

Senator PROXMIRE. Yes, sir. Didn't that help get the cost down?

Mr. ORMSBY. Yes; but the primary motive was to meet the mission requirements.

Senator PROXMIRE. Didn't it also help you in your competition with Boeing to win the contract?

Mr. ORMSBY. Obviously, the best airplane design wins and we were certainly trying to do that, get the most cost-effective, lowest weight, least costly airplane that could be commissioned.

Senator PROXMIRE. So you took the weight out of the wings. How much weight was taken out of the wings?

Mr. ORMSBY. I don't recall exactly. It was about 10,000 pounds. I might note furthermore that we took weight out of the rest of the airplane too, including the fuselage and empennage.

Senator PROXMIRE. How much weight did you take out?

Mr. ORMSBY. About 10,000 pounds.

Senator PROXMIRE. Could you give us a notion of what that is in terms of proportion, how much?

Mr. ORMSBY. The airplane empty weighed at that time about 320,000 pounds. So that was about 3 percent of the airplane weight.

Senator PROXMIRE. Did that have any effect in reducing the strength of the wings?

Mr. ORMSBY. Yes; it did.

Senator PROXMIRE. It did. What was the effect on the strength of the wings by that reduction?

Mr. ORMSBY. It was to make them more critical in meeting the design requirements.

Senator PROXMIRE. So it weakened the wings?

Mr. ORMSBY. In designing an airplane, it's a question of how much conservatism you put into it and what we were attempting was to take out conservatism.

Senator PROXMIRE. It made them less able to stand up to stress?

Mr. ORMSBY. Yes.

Senator PROXMIRE. Is the present wing problem a result or largely a result of the decision to take weight out of the wings?

Mr. ORMSBY. I believe it is.

Senator PROXMIRE. Did Lockheed know or should it have known at the time of the redesign that the wings would not last for 30,000 hours, and that its life would be much less than 30,000 hours?

Mr. ORMSBY. No, sir, and as evidence of that I would like again to say we took weight out of the fuselage and empennage which did meet that guarantee. I might say we came very close to meeting all the requirements and we did meet them in the rest of the structure. We did not make it on the wings.

Senator PROXMIRE. In your prepared statement you charge that "the unyielding total package procurement concept" drove you to make undesired design tradeoffs, including higher stress levels than you would have liked. Shouldn't this have tipped off your engineers to expect trouble?

Mr. ORMSBY. In all airplane design you're trading off against risk and so all I can say is that the design became more critical as we took the weight out. I don't believe any airplane wins a contract on which you're comfortable and can sit back and just let the airplane design unfold. You have to work critically. I mentioned that in the case of drag. We had an equally critical problem in drag. We solved that one. We solved all of them except one.

Senator PROXMIRE. Basically, you did expect trouble?

Mr. ORMSBY. Expected trouble?

Senator PROXMIRE. Having made the reduction in the strengths of the wings, weakened the wings, as you just testified——.

Mr. ORMSBY. We did not expect any trouble more than the other areas of the airplane I'm talking about.

Senator PROXMIRE. Shouldn't the engineers have expected trouble? How is it possible for aeronautical engineers not to know that the wings of an aircraft would last 7,100 hours or even 12,000 hours when the objective is 30,000 hours? How could engineers miss by that wide a mark without knowing they would miss?

Mr. ORMSBY. You asked what did we do to recognize it? Let me answer that. The fastener system on the C–5 was changed from the previous practice to minimize fatigue sensitivity. Many of the manufacturing practices were changed to recognize that.

Senator PROXMIRE. My question is. Why couldn't you have known? After all, if you have a tire you say will get 30,000 miles and it gets 7,000 miles, you can sue for fraud. The tires have to be recalled. It's considered virtually fraudulent as far as the consumer is concerned. Here's a case where we're told 30,000 hours. The engineers say 30,000 hours. They don't miss by a factor of 3 percent or 10 percent. They miss by a factor of over 50 percent.

Mr. ORMSBY. Well, the situation with regard to the tire I think you're talking in terms of a warranty. The wing design was a design goal because it was recognized to be a very difficult and challenging task. I don't think a tire manufacturer gives that kind of warranty when he's right up against the absolute limits of technology. It's a different situation in the commercial product than the airplane.

Senator PROXMIRE. Again, it's hard for me to understand how the engineers' estimates can be that far off. That doesn't sound like they are very competent if they can't come within 50 percent.

Mr. ORMSBY. Well, with regard to the competence of the design group, they are the same group that developed the C–141A which has had an excellent record. They are the same group that worked on the C–5 wing modification, which has been tested now and is excellent. So I don't think the competence of the engineers is the key to it.

Senator PROXMIRE. I'd just like to ask a general question now. As you know, this subcommittee was responsible for the—as a matter of fact, the full Joint Economic Committee— and I was chairman then in 1968 when we discovered the $2 billion overrun. That broke all records at the time as an overrun for a single weapons system. Now we have what appears to be the biggest cost in history to correct a mistake of a weapons system. I have asked the staff and off the top of their head they can't think of any case where we have had to spend over $1 billion to correct a mistake of this kind in order to provide something like the life that we expected to get when we bought this C–5A. So here we have the biggest overrun in history at the time the C–5A was produced and the same weapons system also is going to require us over $1 billion—$1.4 billion to make a correction. Isn't that correct?

Mr. ORMSBY. May I comment on that?

Senator PROXMIRE. Yes.

Mr. ORMSBY. The first one on the overrun, our position is that if the terms of the contract would have been allowed to run, there would have been no overrun. I think you know that story. It's been very well presented in testimony, the provisions of the contract. But that's past history. I can't add anything to what's been said on that except to say that.

With regard to the comparison of numbers, I would like to suggest that if we take the original cost of the C–5A and escalate it to 1980 dollars, we will find, I think, that the modification program cost is about 10 percent of what the C–5 would cost in today's dollars.

Senator PROXMIRE. Sure, but we allowed fully for inflation at the time it was constructed and built.

Mr. ORMSBY. I'm talking about dollars actually spent when it was built. You can't compare 1970 dollars to 1980 dollars without converting. My point is that the modification will cost about 10 percent of what the weapons system cost would be today.

Senator PROXMIRE. You can take $1 billion in 1968 compared to 1980.

Mr. ORMSBY. OK. We deescalate back to then to get the effort, so that it's comparable.

Senator PROXMIRE. You're not saying the $1.4 billion is a bargain for the taxpayer, are you?

Mr. ORMSBY. I believe it is in terms of the requirements of the need for the airplane.

Senator PROXMIRE. Now if your engineers expected trouble early on, why weren't the Congress and the public told of these difficulties?

Mr. ORMSBY. Again, I was not involved in those discussions. As I said, I believe that's been thoroughly discussed. I don't know that they were not told.

Senator PROXMIRE. Could the gentlemen who are with you at the table testify on that?

Mr. ORMSBY. No, sir.

Senator PROXMIRE. None of you were here before 1975?

Mr. ORMSBY. We were with Lockheed-Georgia but we were not in a position in which that was addressed in discussions with the public or the Air Force.

Senator PROXMIRE. Do you know whether during the design and early manufacturing period the Lockheed Corp. furnished reports to the Air Force which notified them to expect technical problems?

Mr. ORMSBY. I believe we did, but again, I don't know.

Senator PROXMIRE. For the record, would you see if you could furnish us with any reports that were made warning of the possibility of technical problems?

Mr. ORMSBY. Yes; I will.

[The following information was subsequently supplied for the record:]

The attached documents are some of the various communications between the U.S. Air Force and Lockheed Corporation regarding potential technical problems during the design and early manufacturing period of the C–5A aircraft under Contract AF 33(657)-15053. (Reference, Pages 61–62 of Transcript of Hearing on C–5A on August 25, 1980, of the Subcommittee on Priorities and Economy in Government of the Joint Economic Committee.)

There may be other documents which could be obtained; however, we believe this submittal satisfies the request.

Attachment 1: LGD/504198, dated 5 January 1967, "Briefings Made to C–5A SPO Personnel."

Attachment 2: LGD/504403, dated 13 January 1967, "Contract AF 33(657)-15053, C–5A Program; Air Vehicle Performance Requirements."

ATTACHMENT No. 1

DEPARTMENT OF THE AIR FORCE,
HEADQUARTERS AERONAUTICAL SYSTEMS DIVISION (AFSC),
Wright-Patterson Air Force Base, Ohio, January 5, 1967.

Attn. of: ASZZ.
Subject: Briefings made to C–5A SPO Personnel.
To: AFPRO.
In Turn: Lockheed-Georgia Co.

1. Reference is made to briefings made to C–5A SPO representatives on 5 December 66 at the Lockheed-Georgia Company and at the C–5A SPO on 6 December 66 and 4 January 67.

2. The SPO wishes to express its appreciation for your highly informative briefings. However, there are a number of areas that we feel additional clarification is in order. One in particular that is of major concern is the weight problem since it affects so many performance elements. Mr. Gibson's portion of the presentation gave the impression that some of the initial C–5As would not fully meet the requirements of the contract, particularly in the area of guaranteed weight. These comments gravely concerned us and we would like to have additional information in this area, such as number of vehicles that may be affected, degree of degradation, etc.

3. Your attention is invited to Part XII of the contract (Correction of Deficiencies). Cat I & II test aircraft are to be refurbished to operational configuration prior to tendering to the Government for acceptance. We envision the task associated with taking out excess weight in the basic structure could be a problem of considerable magnitude. We are therefore very much interested in your plans for refurbishing these aircraft so they will meet all the requirements of the contract. We are also concerned as to whether or not the initial 16 aircraft that are to be delivered to MAC are to meet all of the contractual requirements. In connection with these aircraft your attention is invited to Part XXXVIII of the contract (Liquidated Damages). This provision of the contract provides that in the event the contractor shall fail to deliver aircraft which are acceptable to the Government by the last day of the month in which each of said aircraft is scheduled for delivery, the contractor shall pay to the Government the amount of $12,000 for each day that delivery of each of said aircraft shall be delayed beyond the last day of the month in which each of the aircraft is scheduled for delivery. The Government's position in this regard can be essentially stated as follows. Where the contract sets the standard of performance on the basis of quality (contract specification requirements and guarantee) and time (schedule requirements) it cannot be said that the contract has been performed to, as to time, unless it has simultaneously been performed to as to required quality. Therefore, aircraft that do not meet all of the requirements of the contract cannot be considered acceptable for the purpose of meeting the provisions of the Liquidated Damages clause of the contract.

4. Although the comments set forth above are primarily directed toward a potential weight problem, it is not to be construed that we are not equally concerned about all of the requirements and guarantees provided for in the contract. In view thereof and in the interest of precluding a potential problem at the time the aircraft are presented to the Government for acceptance, your comments and clarification in the specific area referred to in paragraph 2 are requested.

For the Commander:

GUY M. TOWNSEND, Col., USAF,
System Program Director,
C–5 System Program Office.

ATTACHMENT No. 2

DEPARTMENT OF THE AIR FORCE,
HEADQUARTERS AERONAUTICAL SYSTEMS DIVISION (AFSC),
Wright-Patterson Air Force Base Ohio, January 13, 1967.

Attn. Of: ASZZ.
Subject: Contract AF33(657)-15053, C–5A program, air vehicle performance requirements.
To: AFPRO.
In turn: Lockheed-Georgia Co.

1. Reference is made to C–5A SPO letter dated 5 January 1967, subject, "Briefings made to C–5A SPO Personnel."

2. Contractor personnel, in presenting C–5A program status on 4 January 1967, admitted to the possibility that certain performance requirements may not be met in the delivered air vehicles. On the basis of certain missions selected by the contractor, it was shown that some parameters, such as weight-empty, take-off distance, landing distance and initial cruise altitude, may fail to meet requirements because the contractor was having difficulty in achieving the target values of weight, lift and drag which he had established as necessary to provide the required performance. Contractor personnel also stated that range/payload performance was considered to be paramount, and that other performance parameters may be degraded in order to meet the range/payload requirements.

3. The contractor is reminded that all performance requirements for all contractual missions in the System Specification and Air Vehicle Specification are to be met. In those instances where one requirement is stated in combination with others, the interdependence of all the requirements in the combination must be considered in determining the value of each parameter.

4. It appears that the contractor has not put enough emphasis on the possible deficiencies in take-off, approach and landing performance. These can severely limit the range/payload productivity which might otherwise be achievable. The SPO has not observed a contractor sense of urgency or management emphasis in the airport performance area comparable to that in the weight control and cruise drag areas.

5. It is noted that the contractor's estimates of maximum lift coefficient in the take-off and landing configurations are below his target values. To date a model which reasonably simulates the total, current configuration has not been tested in a wind tunnel. The contractor's current estimates of C_{LMAX} are based on analysis of several tests of different components and configurations. The SPO is of the opinion that the contractor was too optimistic in the consolidation and analysis of these data; and feels that additional analysis and test effort are required to substantiate the likelihood of adequate improvement in the high lift performance demonstrated thus far. For example, results of recent tests of flap design changes indicate a degradation of the lift coefficient achieved in other tests of the leading edge slat design. A possible explanation is a change in circualtion due to flap reconfiguration has "detuned" the slat-to-wing relationship. The SPO knows of no current contractor effort to investigate this possibility and determine the magnitude of the configuration changes required to "re-tune" the slat-wing flap combination. If anything more than minor modifications to reposition the existing shapes is required, the probability of economically achieving the target lift coefficients on schedule will be significantly degraded.

6. In view of the C–5A procurement concept which emphasizes complete compliance with all contractual requirements, including aerodynamic performance, in all air vehicles at the time of delivery, it behooves the contractor to address all areas where confidence that performance requirements will be met on schedule has not been rationally demonstrated. The advantages of applying an adequate quantity and quality of resources for this purpose should be obvious to the contractor, in view of the possible consequences should the contract provisions not be met as were previously outlined in the referenced SPO letter.

7. It is requested that comments to this letter be included in your reply to the referenced SPO letter. Specific comments are desired regarding the program for determining the high lift capability and the planned alternate approach if the contractor's expressed hopes do not materialize.

GUY M. TOWNSEND, Colonel, USAG,
Systems Program Director,
C–5A System Program Office.

Senator PROXMIRE. Isn't it correct that Lockheed knew the C–5A would not last 30,000 hours at the time it was being built?

Mr. ORMSBY. When we started, no, absolutely not.

Senator PROXMIRE. You didn't know that?

Mr. ORMSBY. We did not know that when we started.

Senator PROXMIRE. Didn't Lockheed know there would be wing problems before the C–5 program was complete? In fact, weren't the problems predictable because of the weight and structural strength taken out of the wings when they were redesigned?

Mr. ORMSBY. No, sir. As I indicated earlier, the design and manufacturing approach was adjusted to reflect the increased risk due to taking weight out. We changed the fastener system to tapered fasteners. We changed the manufacturing by chem milling. We changed many things; all designed to offset that risk. Unfortunately, we were wrong.

Senator PROXMIRE. What will be the total cost of the wing fix under the Air Force contracts to Lockheed?

Mr. ORMSBY. I can't estimate the total Air Force cost. Our contract with them is for $1.6 billion, I believe, all up price.

Senator PROXMIRE. That does not include the total cost because they have contracts with other——

Mr. ORMSBY. Well, the Air Force has other activities that have to be counted in the total program and I can't really speak to those.

Senator PROXMIRE. So you don't know the total cost to the Air Force of the wing fix program?

Mr. ORMSBY. No, sir; I do not.

Senator PROXMIRE. How much profit will Lockheed make on the wing fix?

Mr. ORMSBY. 13.7 percent, about $140 million.

Senator PROXMIRE. Now you're responsible for the defects in the C–5 wings because you built them, right? Why should Lockheed get any profit for fixing the wings?

Mr. ORMSBY. Let's go back to the original program. I might note that in the settlement that was almost unprecedented, Lockheed sustained a $255 million loss as a result of the original C–5 contract. If you include the cost of money, which is a real cost to a corporation, the Lockheed loss rises to $302 million, and I can throw in some other things that would increase that number. But let's just say we have already lost $302 million.

Senator PROXMIRE. Think of all the great publicity you got.

Mr. ORMSBY. Yes. Thanks. So I guess $302 million we have lost assuming that the current program is on target, which I think it will be, we still have a net loss position. So we have not benefited the corporation and we certainly—well, you know the whole story better than I.

Senator PROXMIRE. My time is up. Congressman Wylie.

Representative WYLIE. Thank you very much, Mr. Chairman.

Mr. Ormsby, can you identify the names and affiliations of the non-Lockheed or non-Air Force structural experts who participated in the various reviews conducted on the C–5 wing problem?

Mr. ORMSBY. Yes, sir. I can summarize them for you.

Representative WYLIE. Would you do that for the record? I think it might be good to have it.

Mr. ORMSBY. From the world of academia, universities, there were 10 people; from aerospace companies, not including Lockheed, there were 26; and from the National Aeronautics and Space Administration, there were 6, and 1 from the FAA. Those were people that were not with Lockheed nor with the Air Force. I have their names and they are included in one of my appendixes and we will submit that for the record.

Representative WYLIE. Were they hired by Lockheed?

Mr. ORMSBY. No.

Representative WYLIE. They were under a contract with the Air Force?

Mr. ORMSBY. That's correct. There were 11 different independent committees.

Representative WYLIE. Did they all agree as to the necessity to fix the wing?

Mr. ORMSBY. I believe so. Recognize again that this is a group not run by Lockheed nor managed by it, and so we only know in terms of the questions they asked us, the data they asked for. To the best of my belief, with one exception, the people agreed in those groups as to what should be done with the C-5 wing.

Representative WYLIE. I think you heard me say a couple times this morning that I think we need to know whether SIEP is objective and whether it's credible. How would you characterize the membership of SIEP? Would you call it an objective, independent review group?

Mr. ORMSBY. Yes; I would. Let me expand that a little bit. I know some of them, and let me say particularly in this group of people, their prime responsibility is professional integrity. That's their only stock in trade, their principal stock in trade is professional integrity, and the people I know who were on these groups certainly fit that characteristic. I would say that they are certainly people of high integrity and therefore were objective.

Representative WYLIE. I know a little bit more about this subject this morning. I heard Mr. Paris a little while ago talk about the teardown and 930 cracks, et cetera, and he wasn't sure whether all of the cracks were serious or not. During the teardown inspection, was a condition of general cracking observed or found to exist?

Mr. ORMSBY. Yes; and let me expand on that. The suggestion has been made that these cracks are sufficiently small that they could be drilled out and the problem would go away. Let me say that has already been done in certain critical areas of the C-5. They have been drilled out. Fasteners have been reinstalled, and we are beginning to see cracks there again in certain selected areas.

Again, let me point out that the airplane on which that was done had 6,200 flying hours, and therefore if we drilled out those fasteners and put in new fasteners and retained the same wing and we could expect the same problem in the same time span because the high-stress levels are still in the wing. So that would be the best that could be expected actually with the damage to the structure already. I would suggest that would be an optimistic upper limit.

Representative WYLIE. A suggestion was made I think by Mr. Keating that perhaps this contract ought to at least been advertised for bids, assuming we ought to go ahead with something in the way of fixing the wing, and I suggested that that might not be too bad an idea, that maybe Rockwell would get some of the work. Then there was a suggestion that we have a learning curve disability here.

Why shouldn't we let this out for bids? Why shouldn't we advertise and see if we couldn't get a lower bid?

Mr. ORMSBY. Here again, recognize that the bid would come from the Air Force, so I'm giving an opinion based on certain peripheral facts. One of the peripheral facts is that as a part of our contract we were required to prepare and submit to the Air Force bid packages which would be submitted to the rest of the industry. I believe that that was done. At least there were suggestions——

Mr. NEILSON. We did it.

Mr. ORMSBY. What happened is the other contractors that had been mentioned examined the program in detail and concluded that for a variety of reasons they could not be cost effective with our effort and that's not at all unreasonable. I have looked at bidding on modifying some of my competitors' airplanes, and typically you can't do it as cost effectively as the man who did it in the first place who has the expertise, the tools, and the background, and we in many cases—in every case have elected not to do it. The cost of preparing the proposal is very extensive and so a contractor would not likely undertake the effort to turn in a proposal which he was pretty sure would not be cost effective. I believe that's the situation with regard to the bids from other aerospace contractors.

Now there was some discussion earlier that the Air Force then went through a buildup of projected costs. My understanding of that is that it was done because competitive bids were not forthcoming for the reasons I have just said, and therefore to make sure the taxpayers' money is being managed as best they could, the Air Force then went through their own exercise to determine what the probable level of bid would be from the other competitors.

Representative WYLIE. You mentioned the taxpayers' money, and that is a consideration of course. We have an obligation in Congress to be right on this question and you have been under heavy fire almost since the inception of this program. Wouldn't a study by the Office of Technology Assessment be helpful?

Mr. ORMSBY. Well, let me answer it this way. First of all, the Office of Technology Assessment, I have no qualms about their objectivity and professional integrity, but harkening back to some earlier testimony about the relatively limited number of experts in this field, I think we would all agree from what we have heard today that this is a very specialized field. It's difficult for me to see who they would call in to look at the problem except from the body of people that have already looked at it—I guess a total number of over 100. I'm sure that there are just not a lot of other structural fatigue fracture mechanics specialists that haven't been involved in this. I would submit that they would have to come from the same group of people in large measure as the ones that have already done the study unless they would get a completely new group, and I don't know where that would come from.

Representative WYLIE. Thank you very much.

Senator PROXMIRE. Let me just clear up a question that I asked a previous witness. Is it correct or incorrect that the structural information enhancement program—SIEP—that study was done under an Air Force contract to Lockheed, or was it done under an Air Force contract under some other group?

Mr. NEILSON. We did the actual work for the Air Force under the directorship of an onsite Air Force man, as previously testified.

Senator PROXMIRE. Did you get a contract for it?

Mr. NELSON. Yes, sir, we had a contract for it.

Senator PROXMIRE. You were paid for it. So you received the funds to finance the study and then you paid the people who made the study; is that right?

Mr. NEILSON. That is correct. The people who did the work, the analytical work, were Lockheed employees who have to draw a salary. They draw a salary and are paid by Lockheed.

Senator PROXMIRE. Very good. That was a question I asked Mr. Keating and it's good to have that verified.

Mr. Ormsby, Mr. Paris testified that Lockheed gave misleading data to Rand and to the SIEP study group, and that during the studies Lockheed did not give the outside experts full access to the raw data. How do you respond to that?

Mr. ORMSBY. I'm surprised I haven't heard that from some of the outside experts. Mr. Paris is the only one.

Senator PROXMIRE. He was pretty specific and definite in indicating this.

Mr. ORMSBY. I understand what he said, but that has not been brought to my attention by anybody other than Mr. Paris.

Senator PROXMIRE. Will you examine—we'll make available the full statement by Mr. Paris and we would appreciate it very much if you give a more detailed response.

Mr. ORMSBY. We would be happy to do that.

[The following was subsequently supplied for the record:]

The following comments are in response to the allegation ". . . that Lockheed gave misleading data to Rand and to the SIEP study group, and that during the studies, Lockheed did not give the outside experts full access to the raw data." (Reference, Transcript of Hearing on C–5A on August 25, 1980, of the Subcommittee on Priorities and Economy in Government of the Joint Economic Committee). The full statement of Mr. Paris and the Transcript have been reviewed and we have been unable to determine what specific data provided by Lockheed to Rand and the SIEP study group was misleading and any situation during the studies that Lockheed did not give the outside experts full access to raw data. After a review of our records, Lockheed denies that there is any basis for the aforesaid allegation.

Senator PROXMIRE. Now if the fuselage or tail of the C–5 won't last for 30,000 hours, if they last only 20,000 hours, wouldn't it be senseless to spend the money to make the wings last for 30,000 hours?

Mr. ORMSBY. As I said earlier, I don't think the empennage and fuselage will only last 30,000 hours.

Senator PROXMIRE. When was the last study done estimating the life of the fuselage and empennage?

Mr. ORMSBY. On the SIEP program in the last year, 1979. The last report was in 1979.

Senator PROXMIRE. Did you say 47,000 hours?

Mr. ORMSBY. 46,900 hours, and that was fully reported.

Senator PROXMIRE. You're saying the SIEP program looked at this and they reported that the fuselage and tail section would last 46,900 hours?

Mr. ORMSBY. As a minimum, yes.

Senator PROXMIRE. Now Lockheed has repeatedly given assurances that the C–5 will meet or exceed performance specifications. These assurances turned out to be incorrect with respect to the wings. What assurances can you give us now that there are no serious structural problems in the fuselage and tail?

Mr. ORMSBY. The empennage has completed four lifetimes of testing, 120,000 hours, four times the life. The fuselage has been tested and the results were analyzed in exactly the same way the wings were and that's how the 46,900 number comes up. Could I make a point here? I know it's a very difficult subject.

Senator PROXMIRE. Sure.

Mr. ORMSBY, Let me point out that the hours that have been talked about are not clock hours. We keep talking representative mission profile hours. They are not the hours that any particular airplane will fly and so when we talk about 14,000, 8,000, 7,000, 30,000—let me put it this way. The average of the C–5 fleet today has 5,600 actual flying hours. They were clocked on the instrument panel every time the airplane was flown and if you averaged that, it would be 5,600 hours. If you go through the structural analysis we're talking about, you can go a variety of different ways. The end point is in actual flying hours. If the airplanes are used the way they are today, they will reach a limit and it's been talked about as a safety limit and I'll come back to that later—10,000 hours. That limit is really not a safety limit except additional maintenance and repair activity would have to be undertaken and in a very extensive way.

Senator PROXMIRE. Are you saying without any addition——

Mr. ORMSBY. Doing all the things that are being done today.

Senator PROXMIRE. This would include repairing the wings?

Mr. ORMSBY. Yes, sir. All the things we're doing today, inspecting repair, and then at 10,000 hours——

Senator PROXMIRE. Is that putting on new wings?

Mr. ORMSBY. No, sir.

Senator PROXMIRE. Not putting on the new wings, not buying that $1 billion-plus program?

Mr. ORMSBY. That's right.

Senator PROXMIRE. If we don't buy that, they will still last 10,000 hours?

Mr. ORMSBY. Flying hours.

Senator PROXMIRE. In other words, twice what you have now.

Mr. ORMSBY. None of the numbers talked about this morning nor the numbers I have talked about here include any contingency mission and the purpose of the military is to be able to go to war when the time comes.

Senator PROXMIRE. That's the purpose of the C–5A.

Mr. ORMSBY. So if we had a contingency mission that would take up about 2,000 hours.

Senator PROXMIRE. I understand the Rand study does include contingency hours.

Mr. ORMSBY. It does or does not?

Senator PROXMIRE. It's my understanding it does.

Mr. ORMSBY. I'm sorry. I'll have to—I thought it was the other way around.

Senator PROXMIRE. It's our understanding that the Rand study does include contingency hours.

Mr. ORMSBY. We'll have to look at that.

Senator PROXMIRE. Can you give us a breakdown showing all the areas where weight was removed and all the equipment was removed? Maybe you can do that for the record.

Mr. ORMSBY. Yes; we will do it for the record. It's very extensive.

[The information referred to follows:]

The attached document is a breakdown showing all the general areas where weight was removed or added after contract award. The airplane was provided with all contractually required equipment. (Reference, Transcript of Hearing on C-5A on August 25, 1980, of the Subcommittee on Priorities and Economy in Government of the Joint Economic Committee.)

Increased Allowable Shear Stress for Wing Beam Webs.—Net weight effect was a decrease of 2,084 pounds.

Additional Wing Changes.—Net weight effect was a decrease of 3,976 pounds.

463L System Detent Mechanism Spacing.—Net weight effect was a decrease of 1,170 pounds.

Beef-Up to Fuselage Frames, Skin, and Stringers.—Net weight effect was an increase 4,569 pounds.

Redesign Underfloor Structure.—Net weight effect was an increase of 2,344 pounds.

Aluminum Cargo Floor.—Net weight effect was an increase of 855 pounds.

Mechanically Attached Beryllium Brakes.—Net weight effect was an increase of 647 pounds.

Nose Landing Gear Door Redesign.—Net weight effect was an increase of 954 pounds.

Landing Gear Concept Changes.—Net weight effect was an increase of 1,694 pounds.

Reduced Main Landing Gear Bogie Width.—Net weight effect was a decrease of 1,032 pounds.

Landing Gear Door Redesign.—Net weight effect was a decrease of 238 pounds.

Four In Lieu of Six Hydraulic Systems.—Net weight effect was a decrease of 377 pounds.

Tire Revision.—Net weight effect was a decrease of 1,412 pounds.

Fixed Aft Upper Lobe Deck Floor Panels.—Net weight effect was an increase of 1,545 pounds.

Wire Weight Reduction.—Net weight effect was a decrease of 2,518 pounds.

Increased Allowable Tension Stress for Wing Skin Planks.—Net weight effect was a decrease of 3,044 pounds.

High Lift Sealed and Slotted Slat System.—Net weight effect was an increase of 4,070 pounds.

Empennage Changes.—Net weight effect was an increase of 2,011 pounds.

Material Changes in Landing Gear Components.—Net weight effect was an increase of 1,064 pounds.

Fuselage Main Frames.—Net weight effect was a decrease of 997 pounds.

Bullet, Visor, and Radome Drag Reduction.—Net weight effect was an increase of 553 pounds.

Move Engines Aft.—Net weight effect was a decrease of 1,039 pounds.

Wing to Fuselage Fairing Drag Reduction.—Net weight effect was a decrease of 1,125 pounds.

Optimized Configuration of Thrust Reverser.—Net weight effect was a 2,700 pound decrease.

Aft Fuselage Drag Reduction.—Net weight effect was an increase of 1,234 pounds.

Main Landing Gear Fairing Drag Reduction.—Net weight effect was an increase of 1,698 pounds.

Main Landing Gear Side Brace Concept.—Net weight effect was an increase of 2,260 pounds.

Fowler Flaps.—Net weight effect was an increase of 1,750 pounds.

Reduced Flap Placard Speed.—Net weight effect was a decrease of 908 pounds.

Substandard Runway Gross Weight Reduction.—Net weight effect was a decrease of 584 pounds.

Unusable Fuel Reduction.—Net weight effect was a decrease of 1,168 pounds.

Dive Speed Reduction.—Net weight effect was a decrease of 436 pounds.

Delete Wing Anti-Icing.—Net weight effect was a decrease of 676 pounds.

Titanium Fasteners.—Net weight effect was a decrease of 1,783 pounds.

Vertical Stabilizer Taper Ratio.—Net weight effect was a decrease of 30 pounds.

Soundproofing.—Net weight effect was a decrease of 1,241 pounds.

Additionally, during my testimony there was some confusion regarding the inclusion of contingency hours in the Rand study. I have confirmed my understanding that the Rand study did not include any contingency hours. Attached is a copy of pages xxvii and xxviii of the Rand report R–1941/3–AF, dated March 1977.

Page xxvii, which summarizes Rand's considered options, states conclusively that they did not allow for contingencies. This fact is even further recognized on page xxviii where, based on this omission, it is stated:

". . . subtract 1.5 to 2.0 years for the life reducing effect of each NATO deployment . . ."

Thus, since we have apparently agreed that the purpose of the military is to be able to go to war when the time comes, it is imperative that any life projection of the C–5A aircraft include adequate reserves for such contingencies.

Table S.3

AN OVERVIEW OF OPTIONS FOR EXTENDING THE SAFE SERVICE LIFE OF THE C-5A WING[a]

Description of Structural Modification Options	Cost in Millions of 1975 $	Year to Which Service is Extended (Start of the modification in parentheses)			
		8000-Hour Service Limit	2000-Hour Service Limit Extension[b]	With Austere Use	Austere Use Plus 2000-Hour Extension[b]
Flying Hours/Year[d]		700-500[c]	700-500[c]	700-500	700-500
1. Do nothing	.	1983-1986	1987-1991	1987-1992	1993-2000
2. New fasteners for 62 low damage aircraft	267	1989-1994 (1979-1981)	1992-1999 (1980-1982)	1997-2005 (1982-1985)	2002-2013 (1983-1986)
3. Rework wing on 15 high damage aircraft	239	1986-1990 (1980-1982)	1990-1996 (1984-1987)	1992-1998 (1983-1985)	1999-2008 (1988-1993)
4. Option H for 15 high damage aircraft	480	1989-1995 (1980-1981)	1993-2000 (1983-1986)	1997-2006 (1982-1984)	2003-2014 (1988-1992)
5. Rework wing on all 77 aircraft	610	1997-2006 (1979-1981)	2004-2016 (1983-1986)	2010-2024 (1982-1985)	2022-2040 (1988-1993)
6. Option H for all 77 aircraft	910	2014-2030 (1979-1981)	2019-2035 (1983-1986)	2038-2063 (1982-1985)	2043-2071 (1988-1993)

[a]Assumes a 25 percent life extension for the ALDCS and no allowance for contingencies.

[b]The 2000-hour extension is assumed to be a consequence of actions unrelated to the structural modifications. These columns illustrate the sensitivity of the results to variations in the 8000-hour service limit.

[c]Based on 1976 mission use.

[d]Assumes 1.63 (1.25 x 1.3) flying hours per service limit hour for 1976 mission use and 2.0 (1.25 x 1.6) for austere mission use.

relative costs and life extension benefits.[1] The modification start dates are also described in the table. The calculated remaining life[2] is expressed in terms of the average year to which service is extended as a consequence of the indicated modification option. Results are

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[1]The tentative nature of the cost estimates must be emphasized; they are for comparative purposes and, except for Option H, may represent upper bounds (e.g., the cost for a fastener change would be considerably less than that indicated here if only a modest number of fasteners needed to be changed). The life extension estimates may also prove to be conservative.

[2]The number of service life hours consumed per year is equal to the actual flying hours per year divided by a factor for the number of flying hours that are equivalent to one service life hour; the factor is estimated to range from 1.25 to 2.29 depending on the effectiveness of: (1) the ALDCS (1.25 to 1.43) and (2) reductions in peacetime payloads (1.0 for 1973 missions, 1.3 for 1976 missions, and 1.6 for austere peacetime use where the C-5A would only carry items that could not be carried by the C-141A). Table S.3 is based on factors of 1.25 x 1.3 = 1.63 for 1976 mission use and 1.25 x 1.6 = 2.0 for austere mission use.

presented for annual utilization rates of 500 to 700 hours per aircraft (sufficient to support 3.0 to 4.0 crews for each of the 70 aircraft assigned to operating units). The principal assumptions are a 25 percent extension of remaining service life due to the ALDCS modification, a 1000-hour cushion between scheduled start of modification and encounter of the service limit for the current wing, operation of each aircraft for at least 100 hours per year, and life extension benefits of an additional 4000 hours for the fastener change and 8000 hours for the rework (hours refer to the 1974 configuration and 1973 mission use). Since Table S.3 does not include any allowance for contingency use of the aircraft, subtract 1.5 to 2.0 years for the life reducing effect of each NATO deployment of eight division equivalents considered in Vol. 2.

Table S.3 raises the possibility that not all 77 aircraft may need to be modified to extend the C-5A force service life to the end of the century. For example, no more than the high-damage aircraft (about 15 in the present analysis) might need a wing box rework to extend the C-5A service life to the 1990s. Changing the fasteners on the 62 low damage aircraft might produce the same effect. The preliminary results in Table S.3 suggest that it may be possible to extend the availability of the C-5A to the end of the century at a cost of one-fourth to one-half that of the current wing box replacement program.[1] However, what are the risks associated with such a course of action?

A Management Strategy for Coping with Uncertainties

One can imagine a worst case scenario where the Option H modification might be the minimum risk strategy for dealing with the uncertainties about the current wing's structural integrity and the modification

[1]The cost estimate in Table S.3 for the Option H modification ($910 million in 1975 dollars) was derived by means of a cost analysis that was consistently applied to each of the modification options. The estimate may not be consistent with the official Air Force estimate ($1,267 million in then-year dollars) used in Sec. III, Vol. 2, because the Rand estimate was originally calculated for an earlier version of the Option H modification, which would have involved the rework of the outer wing boxes instead of the current plan to replace them. A revised Rand estimate for the current Option H modification would be somewhat higher than the $480 million (Option 4) and the $910 million (Option 6) indicated in Table S.3. The estimates for the other options would not be affected because the outer wing box does not become a problem within the service life extension goals of the other options.

Senator PROXMIRE. Among the items removed was an electric motor and jack screw intended as a backup to the hydraulic activators and tail stabilizers taken out, and is such equipment present in other aircraft built by Lockheed?

Mr. ORMSBY. I can't answer that. I know that the system is redundant. There are two independent systems required to operate it and that has always been a hallmark. We may have changed one from electric to hydraulic.

Senator PROXMIRE. Are they both hydraulic systems?

Mr. ORMSBY. I believe they are both hydraulic today, but they are independent hydraulic systems driven off different engines.

Senator PROXMIRE. So the hydraulic, if something would happen to it, you wouldn't have the backup?

Mr. ORMSBY. You would have to wipe out all the hydraulics. There are four independent systems with a power transfer unit that can transfer power from one hydraulic system to the other even if the engine fails. So there are four systems.

Senator PROXMIRE. If OTA does conduct a study of the C–5A structural problems, will you give them unrestricted access to pertinent records?

Mr. ORMSBY. Yes.

Senator PROXMIRE. I'd like to make a comment and I'm just about through and you may or may not want to comment on what I say.

My conclusion is that Lockheed did, on the basis of testimony this morning, reduce the weight of the wings and weakened the wings in the process to reduce their cost in order to win the contract. They made a big mistake in indicating that the aircraft would fly for 30,000 hours because obviously it can't without enormous cost. Lockheed will, because of that mistake, make a profit of $140 million, which is the profit you told us you would make.

Mr. ORMSBY. That excludes the loss we had on the first program of $300 million.

Senator PROXMIRE. Yes; of course. Well, of course, as you know, if you were dealing in the private sector, I would think if you made a mistake previously and lost money you couldn't expect to come back and say, "Gosh, I'm sorry I made a mistake, but we'll fix it up but we want to make a profit on it."

Mr. ORMSBY. Well, I think the difference is between military and civil programs which are quite different in terms of risk you have to take and the performance you have to achieve. I guess what I'm saying is I don't think overruns like this are unique to the C–5.

Senator PROXMIRE. Overruns like this were unique to the C–5. At the time the $2 billion overrun broke all records. Now as you say, that was in 1968. Today that would be $5 billion overrun or $10 billion overrun. It would be much, much bigger and the latest $1 billion-plus mistake also breaks all records and gives you a nice tidy $140 million profit in the process. It's an unusual kind of a situation. I think a lot of businessmen would wish they could make mistakes like that.

Representative WYLIE. I just need to ask one more question. Senator Proxmire made the point that Lockheed was hired for the SIEP study; is that correct?

Mr. ORMSBY. Yes, sir.

Representative WYLIE. Now I asked the question a little earlier, would you say that the SIEP study was made by an independent review group, and you said, yes, that it was made by an independent review group.

Who appointed the people to the SIEP steering committee?

Mr. ORMSBY. The Scientific Advisory Board was the group to which the SIEP group reported.

Representative WYLIE. So the Air Force gave Lockheed a contract for the SIEP study and you used Lockheed employees?

Senator PROXMIRE. Would the Congressman yield? I don't think the question was answered. Who appointed the 100 people or whatever there were who served on the SIFP study? Who actually designated them?

Representative WYLIE. Did you do it or the Air Force?

Mr. ORMSBY. The Lockheed folks who generated the data were, of course, people we brought to the program to develop data. I thought your question was the steering committee. The management of the SIEP effort, that was apointed by the Scientific Advisory Board.

Representative WYLIE. Are there two groups here, a review group and a steering group?

Mr. ORMSBY. Yes.

Representative WYLIE. I see.

Mr. ORMSBY. It's multitiered for just the reasons mentioned earlier.

Representative WYLIE. Who made the final decision or recommendation from this structural information enhancement program?

Mr. ORMSBY. It was reported to the SAB which was the overseeing group and all of that information has been reported in their final report. So my point is that it was not just a single level of review.

Representative WYLIE. OK. Who appointed the review group?

Mr. NEILSON. The steering committee group?

Representative WYLIE. There was a review group and a steering committee group?

Mr. NEILSON. The Scientific Advisory Board is appointed by the Air Force.

Representative WYLIE. And that was the final review group for the SIEP study?

Mr. NEILSON. Yes.

Representative WYLIE. Then who appointed the steering committee?

Mr. ORMSBY. That was done by the SAB. I might note further on this question of the makeup of these groups, in almost every case the head of these groups was someone from academia or certainty not someone from Lockheed or the Air Force. Professors from Stanford, from MIT and so forth were the heads of the groups you have referred to. They were not headed by Lockheed or the Air Force.

Representative WYLIE. I think that's sort of important.

Mr. ORMSBY. The last one was headed by Mr. Houbolt, who was the Chairman. He's the Chief Aeronautical Scientist of NASA at Langley. Professor Holt Ashley from Stanford University chaired the one who appointed the steering committee.

Representative WYLIE. The real thesis of your claim is that the study was made by an objective, credible group with some expertise, so I think that needs to be fairly well established.

Mr. ORMSBY. Yes, sir.

Senator PROXMIRE. Let me just see if I understand this. The Lockheed employees under the contract generated the data, analyzed the data. The steering group, according to Mr. Paris, at least in that case, felt they could not get access to the raw data so they were in the position of making a judgment based on the data that Lockheed employees wanted them to have. Isn't that right?

Mr. NEILSON. Senator, let me say that I think we have established several things here. The Scientific Advisory Board, the top tier group, was appointed by the Air Force. Professor Holt Ashley was chairman of that. Out of that group they appointed the SIEP steering committee. Initially a Mr. Tiffany was the chairman of that steering committee. The chairmanship subsequently fell to Mr. Lincoln when Mr. Tiffany accepted a job with the Boeing Airplane Corp. Now that steering committee decided what technical work should be done under SIEP. All Lockheed did was respond to the wishes of that committee and we did whatever technical work they directed in accordance with their request and statement of work, that's all.

[The prepared statement of Mr. Ormsby, together with appendixes, follows:]

PREPARED STATEMENT OF ROBERT B. ORMSBY, JR.

My name is Robert B. Ormsby, Jr. I am president of Lockheed-Georgia Company, Marietta, Georgia. By education and professional training, I am an aeronautical engineer. I have been president of Lockheed-Georgia Company since October, 1975. I have with me Mr. James Neilson, director of C–5 programs, and Mr. Fred M. Conley, Group Engineer, C–5 damage tolerance analysis.

The subcommittee's letter requesting that we appear today contained specific questions. I will deal with those questions in today's session or however the subcommittee deems appropriate.

Before delving into specifics, Mr. Chairman, may I take a few moments to define the C–5 wing modification program we shall be talking about? It is a four phase program that has been underway for five years. The design phase is complete. We are more than halfway through phase II testing over five months ahead of schedule and under budget. We have initiated the phase III fabrication which will lead to the final phase of installation of modified wings on the operational fleet. Scheduling of these phases has been carefully structured to provide maximum control and efficiency in implementing the program. Thus, it is not a proposed program, but rather an ongoing program to enhance our nation's strategic, outsize airlift capability.

Since 1970, the C–5 wing service life has been the subject of intensive study by independent specialists. Beginning with the initial scientific advisory board review in February–June, 1970, there have been eleven separate technical evaluations of the structural problems and their repair alternatives. In my prepared statement I have provided additional details including a list of the reviews and the independent structural experts who have spent thousands of hours on this subject and who are in general agreement with the scope and direction of the current wing modification program. (Appendix A)

Many alternatives short of a full wing modification including those touched upon in the 1977 Rand report, were studied and concluded to be unacceptable because of higher technical risk, high cost, extended loss of airlift through excessive aircraft downtime, or the insufficient or unknown life extension gained.

Your request to the Office of Technology Assessment apparently is based on the assumption that a further review will arrive at different conclusions than those previously reached. In my mind, this is highly unlikely.

Let me emphasize, we at the Lockheed-Georgia Company have had no objection to any and all necessary technical evaluations and reviews by competent experts in this field. We are confident that the present C–5 wing mod program is the most technically sound, cost-effective and reasonable approach to solving—and I emphasize the word solving—the C–5 wing problem.

We would be very concerned, however, if future evaluations or reviews, if required by Congress, caused a delay in the current program.

Even if a new independent review team agrees with the previous findings, which we believe it would, we still must consider the deleterious effect such delay would have on our nation's outsize airlift capability.

When I refer to airlift capability or military needs, I mean the Lockheed-Georgia perceptions of capability or needs as defined by the Government. Let me say our nation's airlift requirements are not established by the aerospace industry. We are not in the business of setting or defining U.S. Air Force or Department of Defense policy. Setting of such policy is properly the province of the Department of Defense, the Administration and Congress. As defense contractors, we work diligently, in competition with other aerospace firms, to provide the systems necessary to fulfill our nation's military needs.

Mr. Chairman, concerning your request that I "explain the origins and nature of the wing problem, how and when Lockheed first learned of the problem . . .", I will briefly address these questions and I respectfully refer you to more complete testimony taken by various congressional committees during 1975–76 when decisions were being made on whether or not to implement the wing mod program. Transcripts of several of these hearings are included in my prepared statement which I request be printed in the hearing record. (Appendix B)

These statements generally present the history of the C–5A program and the origin of the wing structural problem. In retrospect, both Lockheed and the Government would have altered many C–5 decisions if they had the power to relieve the experience. In a few moments I will discuss steps taken to insure this situation will not be encountered in the future.

Before addressing the C–5 wing, let me comment on system design philosophy for military aircraft. For obvious reasons, military mission requirements demand a maximum of performance and that everything be designed with a minimum of conservatism. Since the designers do not have the luxury to be conservative, they must push the state-of-the-art to a greater degree than with a commercial system. Areas of concern include drag, engine performance, structures and short field capability, to name a few. In the case of the C–5, we were concerned with all of these. In the area of drag, some early and serious problems were overcome and, as finally built and tested, the airplane met its requirements. Engine performance during the test program, an area of equal concern with a new airplane, was outstanding. Structural integrity of the C–5 fuselage and empennage has been proven. Short and soft field performance requirements were met. In the case of C–5 concurrent development and production, it is impressive to me that so many critical requirements were met satisfactorily.

I believe that a look at the history of the development of large, swept-wing military aircraft will reveal that virtually all have had some problems in one or more specific areas. The performance requirements are so rigorous that satisfying each of them is extremely difficult. Designers have to be concerned about all these areas because each is critical.

But to directly address your question the C–5 wing, typically, an aircraft wing is designed with a sufficient amount of material (or metal) to result in stress levels which will provide the required strength for good structural life.

The unyielding total package procurement concept under which the C–5 was developed and produced precluded the designers from having the flexibility to make acceptable design decision trade-offs while maintaining total mission capability. As a result, Lockheed reduced wing weight to the absolute minimum within the design requirements. This minimum weight and the associated hgher stresses resulted in the structural life presently forecast for the C–5 wing box structure.

Structural problems with the wing were first discovered in 1969, but the nature and extent of the problems were not fully defined by tests until 1971. During the next several years we initiated extensive testing and study to evaluate the problem further. The final results of these efforts indicate that the present wing can be operated approximately 7,100 representative mission profile hours [1] without excessive maintenance and inspection costs. In order to stretch these available hours until the airplanes are scheduled for wing modification, the military airlift command has instituted an intensive operational management program which controls the usage of each individual C–5. Although the C–5 force

[1] This considers the use of a passive lift distribution control system (PLDCS).

has experienced some wing cracking, it is not an unmanageable burden at the present time. It is projected, however, to become increasingly difficult.

In recognition of this situation and after 5 years of testing and study, the Air Force with the Lockheed-Georgia Company initiated a wing modification program in 1975, as I said earlier, to preclude any degradation of this country's outsize airlift capability in future years. The purpose of this program is to design, test, and install a wing box structure that meets or exceeds the 30,000 hour fatigue test life requirement.

The design phase of this C–5 wing modification program, that I mentioned earlier, was completed in 1978 on schedule and about $3.6 million under budget. We are well into the test phase and an important milestone, 30,000 hours of fatigue testing, was completed on May 9, 1980. This represents a full lifetime of flying and I can proudly say that this milestone was completed more than four months ahead of schedule with no problems with the new wing box. The first C–5 to be equipped with the new wings flew on August 14 with excellent reports on the flight. We have just started on the production phases of this program and we have every confidence that C–5 wing modification will be accomplished with the on-schedule, under-cost performance that has become a hallmark of Lockheed-Georgia in recent years as evidenced by both this program and the C–141 stretch modification production program. On balance, we feel our record of performance has been creditable and I point with pride to our accomplishments at Lockheed-Georgia Company during the past five years.

The question of what steps Lockheed has taken to prevent future occurrences of problems similar to those associated with the C–5 can be answered several ways. It should be recognized that the C–5 was the lead technology in wide-body, heavy-weight airlift design. Since 1965 there have been 15 years of advancement in design and analytical capabilities by the aerospace industry on several follow-on aircraft programs, along with giant strides in computer capability.

In addition to the emerging techniques of fracture mechanics and advancements in aerodynamics, the use of computer aided design of structures has been integrated with manufacturing technologies, reducing development time spans and costs as well as assuring higher levels of quality in the production of the aircraft design. If the question deals with fatigue problems, I remind you, back in the mid-1960's the discipline of fracture mechanics was much less developed than it is today.

Since those days, significant advances have been made in the analytical procedures used to predict crack growth. Lockheed has engaged heavily in fracture mechanics independent research and development (IR&D) programs directed at improving our capability to design structural details which are fatigue resistant. Newer materials with improved fatigue resistance are available. Advanced manufacturing techniques directed at eliminating human error and more stringent control on processing are employed. These are integral parts of the fatigue and fracture control plan currentlyl being utilized on the C–5 wing modification program. In addition, we have adopted advanced cost controls, specifically cost/schedule control system criteria (C/SCSC) which was introduced by the Air Force, our own computerized material and production controls as well as manufacturing techniques, precision tooling and tool control concepts and intensified in-process quality controls.

Secondly, significant changes have occurred in the contracting methods available. The total package procurement concept first used by the Department of Defense for the original C–5 program has been rejected totally as an unworkable method of contracting. We, at Lockheed, concur with this decision. We have endorsed and supported Air Force efforts to develop better contracting vehicles. We encourage greater use of design and test type contracts prior to full scale production. Greater flexibility in the application of technical trade-offs would be beneficial as would even greater use of proven technical and manufacturing techniques.

Thirdly, we cannot ignore the point that the military plays, perhaps, an even more important role in this arena than contractors. It is not easy for a contractor unilaterally to prevent recurrences of the problems experienced on programs like the C–5. The dedicated and professional management talents in our military are significant forces in developing new and better acquisition procedures. General Lew Allen, chief of staff of the Air Force, has indicated his commitment in this area. The design to cost concept is but one example. The "new initiatives" program introduced by General Alton Slay is another. In fact, I have yet to meet an Air Force general officer who is not committed totally to achieving system acquisition objectives within budget. We at Lockheed are dedicated to supporting their actions and working with the Department of Defense in developing more cost effective approaches to meeting America's military requrements.

As you requested, Mr. Chairman, I will now address myself to the Paul Paris letter by summarizing a more detailed response in my statement submitted for the record. (Appendix C)

Mr. Paris has told you that his suggestions to perform safety limit calculations on the fuselage and empennage consistent with those used to establish wing life were simply dismissed. We are at a loss to understand how he could reach this conclusion since a special task to calculate safety limits for the fuselage and empennage was an integral part of the structural information enhancement program (SIEP). The results of these calculations were presented to the steering committee on July 12, 1979, a meeting that Professor Paris failed to attend. They were also presented to the August 1979 Scientific Advisory Board, a meeting that Paul Paris chose to leave prior to the scheduled presentation. Had Professor Paris remained at this meeting he would have found that, when calculated to the same ground rules, the fuselage and empennage exceed the 30,000-hour wing life. The lowest projection for either of these components is 46,900 hours of post wing mod usage.

Mr. Paris also charges that the recalculated 7100 Representative Mission Profile (RMP) hour safety limit number was not reviewed by the steering committee. A Structural Information Enhancement Program (SIEP) steering committee meeting was held April 18, 1979 at which time an outline of the procedure to be used in the recalculation was reviewed by the steering committee, including Paul Paris. At the next steering committee meeting, held July 12, 1979, the committee was given a complete review of the results of tests and studies which supported a reduction in the safety limit from 8,000 hours to 7,100 hours. As stated earlier, Paris failed to attend this meeting.

Apparently, Mr. Paris does not understand how the effects of the active life distribution control system were included in our analyses and he alleges that a firm basis exists for postulating a much longer service life in the C–5A fleet. According to our analyses and those of other independent specialists, we cannot concur in this opinion. Let me assure this subcommittee that all effects of this system have been properly included.

Since the Structural Information Enhancement Program (SIEP) was established by the Air Force, at least in part, to address questions raised in the 1977 Rand report co-authored by Professor Paris, we are disappointed that he failed to attend very important meetings and discussions. Had he done so he would not have missed these excellent opportunities to develop a better understanding of the C–5 wing modification program. Throughout the Structural Information Enhancement Program (SIEP) Lockheed cooperated fully with all members of the steering committee and attempted to supply whatever data they required.

Let me repeat, Lockheed has not objected to the many reviews the program has undergone, but we are gravely concerned about any delay on this program to provide enhanced, outsize strategic airlift capability.

Mr. Chairman, that concludes my prepared remarks.

Appendix A

C–5 Wing Modification Program Structural Reviews

A 1977 Rand Corporation report recommended an independent review of the C–5 Wing Modification Program. The Air Force instituted the Structural Information Enhancement Program (SIEP) with Scientific Advisory Board (SAB) oversight in response to this recommendation.

In a January 1980 report to the House Appropriations Committee, the Surveys and Investigations Staff recommended another independent review. This report drew heavily on the 1977 Rand Report and apparently did not consider the SIEP as fully responsive to the Rand recommendations. The S&I staff failed to recognize that some of the Rand recommendations had been previously addressed by SABs and Aeronautical Systems Division Advisory Groups (DAGs). Further, both recommendations appear to ignore the history of a decade of independent program reviews and evaluations of options. (Enclosure 1)

Since 1970, the C–5 wing service life has been the object of intensive study by independent specialists. Beginning with the initial Scientific Advisory Board review in February–June 1970, there have been eleven separate technical evaluations of the structural problems and their repair alternatives. Additionally, there were periodic evaluations of progress in the design phase and independent reviews have continued during the current full scale testing of the approved repair configuration.

Many alternatives short of a full wing modification have been examined including the lower level modification recommendations touched upon in the 1977 Rand study. These alternatives were studied by the SABs and DAGs and subsequently determined to be unacceptable because of higher technical risk, high cost, extended loss of airlift through excessive aircraft downtime or the insufficient or unknown life extension gained.

An independent SAB was convened in August 1979, to review and judge the adequacy and results of the SIEP program. Members of the SIEP Steering Committee were specifically invited to attend and participate in the analysis of the data being provided to ensure a proper and fully objective presentation of material for SAB action. The SAB endorsed the findings of the SIEP and strongly urged the wing mod program be implemented without further delay.

In December 1977, a DAG reviewed in detail, the proposed full scale fatigue test plan as part of an overall independent review of the C–5 Wing Modification Program design phase. The DAG concluded that the fatigue testing plan was well designed and would assure the adequacy of the new structural components for the projected service life.

The C–5 wing fatigue test article successfully achieved the equivalent of one lifetime (30,000 CTH) of testing over four months ahead of schedule. Currently the test program has attained 38,617 CTH toward the goal of a second lifetime of testing (60,000 CTH) with no structural problems. This testing is on a flight-by-flight basis with no two flights or loadings being repeated over the total lifetime. To continue a policy of objectivity, which has been of concern to the Rand Corporation and is endorsed in the HAC S&I report, another Scientific Board was convened in July 1980, at OSD request, to review the Fatigue Test Program. The purpose was to assess the scope of the test effort to meet stated objectives, determine the validity of the findings of the completed testing, assess the adequacy of proposed corrective actions, and make recommendations to ensure adequacy for the remainder of the full scale fatigue test program. A formal report of their findings has been published.

The most capable people available have reviewed and generally concurred in the justification of the wing mod program. Further delay in accomplishment of the program is not justified.

ENCLOSURE 1

SUMMARY OF C–5A STRUCTURAL REVIEWS

DATE: 16 JUNE 1970; GROUP: USAF SCIENTIFIC ADVISORY BOARD AD HOC COMMITTEE ON THE C–5A

Dr. Raymond L. Bisplinghoff, (Chairman) Massachusetts Inst. of Tech.

Dr. Alfred J. Eggers, Jr., (Vice-Chairman), Headquarters, NASA.

Brig. Gen. Carroll H. Bolender, (General Officer Participant), Headquarters, USAF.

Col. Harold A. Steiner, (Secretary), Headquarters USAF.

Subcommittee on Avionics

Mr. David McCall (Subcommittee Chairman), Aerospace Corporation.

Mr. James P. Andersen, NASA Electronics Research Center.

Mr. George W. Church, Bendix Aerospace Electronics Company.

Mr. Duane McRuer, Systems Technology, Inc.

Mr. Walter Morrow, MIT Lincoln Laboratory.

Mr. Cedric F. O'Donnell, North American Rockwell Corporation.

Mr. Harry B. Smith, Westinghouse Electric Corporation.

Subcommittee on Landing Gear

Dr. Eldon E. Kordes, (Subcommittee Chairman), NASA Flight Research Center.

Dr. Eric B. Kula, Army-Materials and Mechanics Research Center.

Mr. David McCall, (Avionics), Aerospace Corporation.

Mr. L. L. Rhodes, North American Rockwell Corporation.

Subcommittee on Performance

Mr. Waldemar Brenhaus, (Subcommittee Chairman), Cornell Aeronautical Lab, Inc.

Mr. Donald D. Baals, NASA Langley Research Center.

Mr. Edward A. Carroll, Trans World Airlines, Inc.

Mr. Williams T. Hamilton, The Boeing Company.

Subcommittee on Wing Structure

Mr. Herbert F. Hardrath, (Subcommittee Chairman), NASA Langley Research Center.

Mr. Ralph H. Drant, Federal Aviation Administration.

Mr. William L. Gray, The Boeing Company.

Mr. Ira G. Hedrick, Grumman Aerospace Corporation.

Mr. Harvey J. Hoge, North American Rockwell Corporation.

Mr. James M. Hay, The Boeing Company.

Dr. James W. Mar, Special Consultant, SAFRD.

Mr. Edmund B. Maske, General Dynamics Corporation.

Mr. Regis M. N. Pellous, Masachusetts Institute of Technology.

Dr. Hassell C. Schjelderup, (Liaison from SAB–F–111 Committee), McDonnell-Douglas Corporation.

DATE: NOVEMBER 1971; GROUP: USAF C–5A STATIC TEST FAILURE AD HOC COMMITTEE

Col. George Haviland, (Chairman), ASD.

Mr. Robert Bader, (Member), FDL.

Mr. Herbert Hardrath, (Member), NASA.

Dr. John Lincoln, (Member), ASD.

Mr. Sanford Lustig, (Member), FDL.

Mr. Don Shinn, (Member), ML.

Mr. Don Strand, (Member), Boeing.

Mr. Charles Tiffany, (Member), ASD.

Mr. Harold Howard, (Advisor), AD.

Mr. Stanley Naughton, (Advisor), ASD.

Mr. Oral Smithers, (Advisor), ASD.

Mr. John Wolfe, (Advisor), ASD.

DATE: JANUARY 1972–MARCH 1973; GROUP: C–5 INDEPENDENT REVIEW TEAM

Codirectors

Dr. J. W. Lincoln, ASD; Mr. F. A. Cleveland, Lockheed California Company.

Some Members and Affiliation

C. F. Tiffany, ASD.

Glen F. Purkey, ASD, Assistant Deputy for the C–5 IRT.

Richard Abbott, Cessna Aircraft Company.

Stanley C. Bailey, Ga. Tech.

K. W. Bates, Boeing.

T. H. Bennett, ASD.

P. J. Coles, AVCO.

D. F. Bryan, Boeing.

D. E. Diller, GD/Ft. Worth.

A. E. Dudman, BAC—England (Assoc. Fellow in Royal Aeronautical Society).

J. E. Littlefield, LTV.

G. W. Perrett, BAC—England (Assoc. Fellow in Royal Aeronautical Society).

R. M. Thornton, Private Consultant.

T. D. Stronge, Northrop.

J. Y. Wang, Fairchild Industries, Republic Division.

K. H. Cotter, ASD.

Plus 92 others made up of Lockheed-Georgia, Lockheed-California, AVCO, Boeing, LTV, BAC, Grumman, Lockheed-Missiles, North American Rockwell, Ga. Tech and private consultants.

DATE: APRIL 1973; GROUP: USAF SCIENTIFIC ADVISORY BOARD, C–5 ADVISORY GROUP FOR THE INDEPENDENT REVIEW TEAM

Prof. John F. McCarthy, Jr., (Chairman), MIT.

Prof. Holt Ashley, Stanford University.

Mr. William C. Dietz, GD/Fort Worth, Texas.
Mr. William L. Gray, Boeing.
Col. Charles K. Grimes.
Mr. Herbert F. Hardrath, NASA.
Col. George P. Haviland, ASD.
Dr. Alan M. Lovelace.
Dr. James W. Mar, MIT.
Mr. Charles F. Tiffany, ASD.
Major John V. Schafer, Jr., USAF.

DATE: JUNE 7–8, 1974; GROUP: DIVISION ADVISORY GROUP MODIFICATION COMMITTEE

Prof. John F. McCarthy, Jr., (Chairman), MIT.
Mr. William C. Dietz, GD/Fort Worth, Texas.
Mr. Willis Hawkins, Lockheed-California.
Dr. John W. Lincoln, LTV.
Dr. Oscar Orringer, MIT.
Mr. Charles F. Tiffany, ASD.

DATE: JANUARY 13, 14, 15, 1975; GROUP: DIVISION ADVISORY GROUP, STRUCTURAL REVIEW

Prof. John F. McCarthy, Jr., (Chairman), MIT.
Mr. C. F. Tiffany, ASD/ENF.
Dr. John W. Lincoln, LTV.
Dr. Oscar Orringer, MIT.
Mr. W. A. Stauffer, Lockheed-California Company.
Col. Monty D. Coffin, ASD/ENF.
Col. L. C. Setter, AFLC/MMA.

DATE: MARCH 26, 27, 1976; GROUP: ASD DAG AD HOC COMMITTEE ON C–5 STRUCTURE

Professor J. F. McCarthy (Chairman), Director, Center for Space Research, MIT.
Mr. W. C. Dietz, Vice President, F–16 Engineer, GD/Fort Worth.
Dr. J. C. Houbolt, Chief Aerodynamic Scientist, NASA, Langley.
Professor J. W. Mar, Dept. Aeronautics and Astronautics, MIT.
Dr. O. Orringer, Assistant Director Aeroelastic and Structural Research Laboratory, MIT.
Mr. W. Stauffer, Division Engineer, Lockheed California Company.

Advisers

Dr. J. W. Lincoln, ASD/ENF.
Col. L. C. Setter, AFLC/MMA.
Mr. C. F. Tiffany, ASD/EN.

DATE: SEPTEMBER 7, 8, 1977; GROUP: USAF SCIENTIFIC ADVISORY BOARD, AEROSPACE VEHICLES PANEL, COMMITTEE ON C–5 STRUCTURE INFORMATION

Prof. Holt Ashley (Committee Chairman), Department of Aeronautics and Astronautics, Stanford University.
Mr. William C. Dietz, Vice-President, F–16 Engineering, General Dynamics Corporation.
Prof. James W. Mar, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology.
Mr. Gerald J. Posakony, Section Manager, NDI Testing, Battelle NW Laboratories.
Major General Charles F. G. Kuyk, (General Officer Participant), Headquarters USAF (RDQ).
Major Thaddeus H. Sandford, (Executive Secretary), Headquarters USAF (NB).

DATE: DECEMBER 12, 13, 1977; GROUP: ASD DIVISION ADVISORY GROUP, AD HOC COMMITTEE ON THE C–5 "H" MODIFICATION PROGRAM

Prof. Holt Ashley (Chairman), Stanford University.
Prof. J. W. Mar, Massachusetts Institute of Technology.

Mr. W. C. Dietz, Vice President, General Dynamics Corporation.
Dr. R. L. Bisplinghoff, Tyco Laboratories, Inc.
Dr. G. S. Ansell, Dean, School of Engineering, Renssalaer Poly. Inst.
Mr. D. White, Secretary, Hq ASD.

DATE: AUGUST 13, 14, 1979; GROUP: USAF SCIENTIFIC ADVISORY BOARD, AERONAUTICS PANEL COMMITTEE ON C-5A STRUCTURAL INFORMATION ENHANCEMENT PROGRAM

Prof. Holt Ashley (Chairman), Stanford University.
Mr. William C. Dietz, General Dynamics Corporation.
Prof. James W. Mar, Massachusetts Institute of Technology.
Major General Kelly H. Burke, HQ USAF/RDQ.
Major General Robert F. Coverdale, HQ MAC/XP.
Dr. George P. Haviland, Rockwell International Corporation.
Mr. Charles F. Tiffany, The Boeing Wichita Company.

Advisers

The SIEP Steering Committee was invited. Attending were: J. W. Lincoln, ASD/ENFS/WPAFB; G. F. Purkey, ASD/EN/WRAFB; and Paul C. Paris, Washington University (Minimum Attendance).

DATE: JULY 1, 2, 1980; GROUP: USAF SCIENTIFIC ADVISORY BOARD, AD HOC COMMITTEE TO REVIEW THE C-5A WING MODIFICATION TEST PROGRAM

Dr. John C. Houbolt, (Chairman), Chief, Aeronautical Scientist, NASA Langley Research Center.

Mr. William C. Dietz, General Dynamics Corporation.

Mr. Ira G. Hedrick, Senior Vice President and Presidential Assistant for Corporate Technology, Grumman Aerospace Corp.

Advisers

Mr. Charles Tiffany, Director of Engineering, Boeing Military Airplane Company.

Major General Robert D. Russ, (General Officer Participant), Director, Operational Requirements DCS/RD&A, USAF.

Lt. Col. Philip A. Roberts, (Secretary), Assistant Executive Secretary, HQ USAF/CVB (S).

APPENDIX B

CONGRESSIONAL TESTIMONY ON THE ORIGINS AND NATURE OF THE C-5 WING PROGRAM

Reference No.	Committee	Date	Witness
B-1 Senate	Armed Services	Feb. 20, 1975	John L. McLucas, Secretary of the Air Force.
B-2 Senate	Appropriations	June 24, 1975	Do.
B-3 House	Armed Services	Feb. 25, 1976	Lt. Gen. Alton D. Slay, USAF.
B-4 Senate	Appropriations	Feb. 3, 1976	Dr. Malcolm R. Currie, Director, DD R. & E.

REFERENCE B-1

Senator THURMOND. Mr. Secretary, is this necessary because the company that made the plane did not supply the proper wing at the time or was it because of the use of the plane now since we have obtained it that causes this trouble?

Secretary MCLUCAS. Senator, it is a result of a mistake, I am afraid, that we all were party to back there in the 1966 to 1968 time period. Neither General Jones nor I was here at the time, but the company got in trouble in the sense that they found that the design which they had proposed was going to be overweight and the Air Force asked them to reduce the weight, to live within the weight limit that they had been given in the beginning, and in the process of reducing the weight of the airplane, they took structural strength out of the wing. Everyone, I guess, was hopeful that by reducing that weight and hence, the strength, that it was still strong enough to do the job, but we have found in actual tests, the fatigue tests that are run on test articles, that that wing is not as strong as it ought to be, and it will achieve a life of something like 10,000 hours instead of 30,000 hours. We feel that since we have already made such a heavy investment in the C-5, the only thing to do is to fix it.

Reference B-2

RESPONSIBILITY FOR DEFECTIVE WINGS

Chairman McClellan. Now, whose fault was it? I don't want to belabor the situation, but who is responsible for procurement of these planes with this defective wing?

Secretary McLucas. Well, there are a lot of people in the act, Mr. Chairman. The Air Force policy at the time and the Department of Defense policy at the time went in for a lot of concurrency.

Chairman McClellan. Concurrency?

Secretary McLucas. What we call concurrency which means you decide to produce at the same time you are doing design work and you buy the parts accordingly. In the early 1960's, we felt, through advent of computers and their application to aircraft design and development of new materials and so forth, that we were in shape to go ahead and lay out very accurately a design, and with confidence procure the parts and start building the airplane.

I don't know how the Department of Defense got caught up in that philosophy, but we did.

Chairman McClellan. Does that philosophy still prevail in the Defense Department?

Secretary McLucas. No, sir, it does not.

Chairman McClellan. When was the philosophy instigated?

Secretary McLucas. I said the early 1960's.

Chairman McClellan. And it continued until when?

Secretary McLucas. Late 1960's. In the late 1960's, we had problems such as the one we are talking about here. It was in 1969 we had the first evidence there was a problem in the C-5 wing. By that same time, we had evidence of problems in the F-111, so we decided, you know, that it is really not a very good approach to assume the best, to assume that we know through use of computers and advance design techniques, just how to build an airplane that would hold up.

We decided in 1969, we better go back to the old way. And in fact, we went further back than that, because we never had as thorough a concept of testing before construction as we now have.

Chairman McClellan. If I understand correctly, your preesnt policy is to determine definitely that a weapon meets the criteria set for it before you undertake mass procurement?

Secretary McLucas. That is right, and we have established, under the Department of Defense, now, the Office of Testing and Evaluation, which reports to Dr. Malcom Currie and which reviews all of the programs in the Department of Defense to see that they have made adequate provision for early testing.

We have sort of a running debate with him, because, you know, they want to test forever—and I am exaggerating here—and we want to get on with the program, so you have to reach compromise, because you can't literally wait forever. Eventually you have to say, "If I need the weapons system, I have to accept the test results I now have and go ahead."

I think, frankly, on the program we are proposing to you, this question will be a serious one, because we do feel the pressures to get the new wing before the old wing wears out.

Chairman McClellan. You estimate that will occur in about 5 years?

Secretary McLucas. No, sir. We think that we should start modifying the existing fleet in about 5 years, so, when the program is finally completed, we will have caught all of the airplanes before they have reached the end of their useful life.

General Slay. As far as the C-5, I am sure you are familiar with it. I say it was bought under a novel production concept—there are other words that have been used. It was a total package procurement. It was a total disengagement philosophy. And we were projecting and had a goal, although not a contractual requirement, a goal of 30,000 hours planned. We now project without the modification a 8,000-hour life. We have had extensive testing on 2 fatigue test articles.

As I said, perhaps the other day when we were talking B-1, there was zero fatigue testing done on the C-5 before production was committed.

Actually when the first cracks started to appear, the 40th airplane was already on the ramp and we had committed up to 75. We only brought 81, total.

We have since that time done extended testing on two fatigue test articles. We have studied this for over a year by an independent review team of technical experts. The wing is the only life limiting structure in achieving 30,000 hours, in preventing us from achieving the 30,000-hour goal. But it does require a major modification. I will tell you how we got into this mess, if you want. Of course, we were disengaged.

Mr. DICKINSON. What does disengage mean?

General SLAY. Under this total package procurement philosophy the thought was at the time that we were tweaking the knobs too much. The philosophy said that what you should do is tell the contractor what you want him to do and tell him how much performance you want, back off and allow him to do it; give him a price to do it, and let him do it. So we did that. We disengaged. And that was very unfortunate because things started to happen.

What happened, really, was in order to meet the takeoff requirements and the load-carrying requirements, Lockheed decided that they had to increase the wing size by, as I recall, better than 500 square feet. They also found that the wing structure had to be increased about 5,000 pounds, and the total airplane weight grew about 15,000 pounds.

That equated in the total weight of the wing, to about 9 percent.

Well, as they saw their performance dwindling in order to keep that performance which was required by the contract, they reduced the structure in the wing. Even though they had increased the area—they reduced the structure weight from the figure of 63,000 pounds. I believe it was, supposedly, down to 58,000 pounds. So they wound up with a structure that was less than they started out with on a smaller wing, with a wing that was larger and weighed more—the aircraft weighed more, I should say.

That is how we got into this problem. And when we found out about it and reengaged, it was too late to do anything significant to the airplane. It was a very disastrous story.

REFERENCE B-4

RESPONSIBILITY FOR C-5 WING FAILURE

Chairman MCCLELLAN. Whose mistake was that? The contractor's or our engineers'?

Dr. CURRIE. Mr. Chairman, in going back, I would say that it was a combination. Everybody contributed to that. The Air Force had a fixed price total procurement contract with Lockheed. Lockheed, as you well remember, suffered very significant overruns on that contract and the Air Force, wherever possible, tried to hold the contractor's feet to the fire on it, as they should. In turn, the Lockheed engineers, in order to save weight, designed right up into the margin from a structural point of view and from a material point of view. They designed right up to a margin, they had no margin left. They satisfied the acceptance specifications but now, several years later, we find that fatigue is setting in and those wings just won't last.

We should have invested more in phase 2 to overdesign, if necessary, rather than to underdesign.

Chairman MCCLELLAN. We just did not test it sufficiently and make an accurate judgment about it before we started procurement?

Dr. CURRIE. We cut it pretty thin, yes. As you remember, I believe that was in the days of a good deal of concurrency between R. & D. and production, and that program entered procurement almost as soon as it entered R. & D. I think we have learned a lot since then and we are not doing our business that way these days.

Senator YOUNG. There was a lot of emphasis then on an airlift capability in the Congress at that time.

Dr. CURRIE. Yes; and of course that airlift capability is even more important now than it was then. I think, however, in retrospect and with all the advantages of hindsight we, all of us—the Air Force, DOD, and the contractor, Lockheed—should have done a better job.

APPENDIX C

LOCKHEED RESPONSE TO STATEMENTS BY PAUL PARIS CONCERNING H-MOD

Paris Statement: "... I am the only person so deeply involved whose livelihood does not depend on Lockheed or USAF sources. Thus ... less biased than others with similar qualifications and knowledge of the technical issues."

Lockheed Comment: Professor Paris has been involved with the C-5 wing modification but others have also been involved for quite some time who have no financial dependence upon Lockheed and do not depend directly upon the USAF; Professor Holt Ashley of Stanford University, Professor James W. Mar of the Massachusetts Institute of Technology, Mr. William C. Dietz of the General Dynamics Corporation and Dr. George P. Haviland, formerly of Rockwell International Corporation, to name a few.

Professor Paris' statement that he is less biased than others is questionable. Certainly, a person who was as deeply involved as Professor Paris was in formulating the original Rand conclusions conceivably could retain some "pride of authorship" for his original work. We do not understand his apparent reluctance to accept the results of extensive studies verified by test as a basis for changing his conclusions. Further we question his knowledge of the basis for the Wing Modification Program since as a member of the Steering Committee he missed very key meetings and discussions on the very subjects he is now questioning.

Paris Statement: "First, I would like to compliment the House Appropriations Committee Surveys and Investigation Staff for their very perceptive report!"

Lockheed Comment: We would certainly expect Professor Paris to find the S&I report "perceptive" since it draws heavily upon his 1977 work in the Rand Report. We cannot account for this failure to recognize that the Structural Information Enhancement Program (SIEP) has provided firm answers to many questions raised by the 1977 Rand Report.

The 1977 Rand Report drew from data prepared about 1975-77 while the SIEP developed data in 1979. The SIEP report was available to Professor Paris prior to his letter to Senator Proxmire.

Paris Statement: "An implication of the Rand Report was that the limit might be raised considerably."

Lockheed Comment: As a part of SIEP, a reassessment of the safety limit using extensive test data and the latest analytical techniques produced a slight decrease in the safety limit rather than a considerable increase.

Paris Statement: "However, when the new 7,100-hour number was presented during the final S.A.B. review of the Structural Information Enhancement Program, it was without explanation to my satisfaction."

Lockheed Comment: Professor Paris left this meeting before a thorough explanation was presented. To the best of our knowledge, Mr. Tiffany, who also had not been exposed to this number previously, was satisfied with the material presented at the SAB. This information had been presented and discussed in great detail at the final Steering Committee Meeting on July 12, 1979 which Professor Paris did not attend.

Paris Statement: "Indeed that 'reduced' number and the treatment of A.L.D.C.S. effects are complex."

Lockheed Comment: This is one statement that Lockheed can support fully.

Paris Statement: "However, the effects of the A.L.D.C.S. were not incorporated into the 7,100-hour number, instead it was put into the 'tracking program', i.e., the usage hours attributed to individual aircraft is reduced by it."

Lockheed Comment: This is a correct statement, but it does not support the following statement.

Paris Statement: "That explains why the wing teardown airplane had only 6700 hours instead of 8,000 hours the Air Force was aiming at, i.e., apparently the A.L.D.C.S. had added 1,300 hours of life to a high time airplane, where it only came to be used late in the life."

Lockheed Comment: This conclusion is not correct. This airplane was being tracked by the then in-use fatigue tracking method and under this system the airplane was approaching 8,000 Representative Mission Profile with Passive Lift Distribution Control System (RMP/PLDCS) hours. After the airplane was input for the teardown inspection, it was reevaluated utilizing the fracture mechanics tracking procedure developed during the SIEP which we consider to be more accurate. Utilizing this methodology showed the airplane to have 6,700 RMP/PLDCS hours. The difference in the numbers comes primarily from the difference in tracking methods.

Paris Statement: "Consequently, though the 7,100-hour number appears to indicate even less than the old 8,000-hour number, if the actual effects of A.L.D.C.S. were included, the 8,000-hour number has been raised in terms of actual equivalent flying hours for each airp'ane (in terms of the same basis as the 8,000-hour number, it is my own estimate that it might be as high as 12,000 to 14,000 hours)."

Therefore, though it might casually appear otherwise, a firm basis exists for postulating a much longer service-life in the C–5A fleet, which may be utilized to establish alternatives to replacing all of the C–5A wings through establishing a valid service-life goal (other than 30,000 hours)."

Lockheed Comment: Professor Paris earlier stated in his letter that the effects of ALDCS were not incorporated into the safety limit but were included in the tracking program and we have agreed. However, it is appropriate to address why the effects of ALDCS were not included in the recalculation of the 8,000-hour number. One of the specific tasks of the SIEP was to recalculate the safety limit (8,000-hour number). To accomplish this, it was necessary to evaluate individual elements of the fracture mechanics methodology, which included such things as material properties, spectrum development procedures, geometric factors, retardation, etc. This specific task was not intended to evaluate the effects of ALDCS since the 1975 DAG established the 8,000 RMP–PLDCS number as a baseline for future operations. As a further explanation, the Representative Mission Profiles (RMP) were based on average force usage during the 1973–1974 time period. Aircraft at that time were being flown with a Passive Lift Distribution Control System (PLDCS). Thus RMP–PLDCS became the baseline for structural evaluations and projecting aircraft operations.

The SIEP did not change the baseline because doing so would not provide meaningful comparisons before and after the recalculation of the subject limit. Without a common baseline any number derived from the recalculation would have little value.

Furthermore, an explanation can be given to the manner in which the effects of ALDCS are incorporated into the tracking program. The tracking program includes both a system to compute current individual aircraft status and a means of making projections relative to when an individual aircraft will require a structural inspection or when it will reach the safety limit. Mr. Paris apparently agrees that the status of aircraft computed by fracture tracking includes the effects of ALDCS as referenced by his comment regarding the status of the wing teardown airplane. What he apparently does not realize is that all projections relative to inspections or when an individual aircraft will reach its safety limit also include the total effects of ALDCS. Current usage projections are based on average force operations in the 1978 time period adjusted to include forecasted 1980 operations. All aircraft now have ALDCS incorporated, thus, all projections are based on the ALDCS configuration. A very important part of monitoring aircraft status and projections includes maintaining a capability of this force to support a six (6) month NATO contingency reserve.

In summary, total effects of ALDCS are included in the individual aircraft status and projections. This is currently being accomplished using fracture tracking which is a part of the C–5 Operational Usage Program managed by SA/ALC.

Paris Statement: As a member of the S.I.E.P. Steering Committee, I frequently asked whether the fuselage, empennage, etc., of the C–5A would last another 30,000 hours after wing modification . . . A suggestion that it might be relevant to perform safety limit calculations consistent with those used to establish wing life was simply dismissed."

Lockheed Comment: Mr. Paris did ask questions relative to the safety limit of the fuselage and empennage. However, we do not agree that his suggestion to perform calculations was simply dismissed. In fact, a special task to evaluate the structural capability of non-wing structure and calculate safety limits for the fuselage and empennage was an integral, scheduled part of the SIEP program. This evaluation was conducted, and included a complete review of C–5A fatigue test results, in-service history and material fracture properties testing. Safety limits were calculated for both the fuselage and empennage using procedures consistent with those employed on the wing. The safety limit for the fuselage was determined to be 46,900 hours of post wing modification usage. The safety limit for the empennage was determined to be 87,400 hours of post wing modification usage. These safety limits were presented to the Steering Committee at the final meeting July 12, 1979 which was not attended by Dr. Paris. They were also presented to the August 1979 SAB and are documented in the final SIEP Report. Reference LG79ER0044 Vol. 2, pages 303 and 305.

Paris Statement: "Indeed, all of the numbers I heard at the final S.A.B. Committee Meeting were new and as far as I know completely unreviewed by the Steering Committee."

Lockheed Comment: A specific task was defined as part of the SIEP Program and assigned the title "Reassessment of the rogue flaw safety limit" (8,000 hour number). Progress on this particular task was reviewed at each Steering Committee Meeting. Professor Paris attended the April 18, 1979 Steering Committee Meeting at which time a complete review of the results of material properties tests which were to be used in the reassessment were presented. Some of these tests were conducted specifically at his request. Additionally, an outline of the procedure that was going to be used to recalculate the 8,000 hour number was presented. Professor Paris had little comment on the results of the tests and voiced no opposition to the outlined recalculation procedure. Also during this meeting, the Steering Committee was informed that the results of the recalculation would be available at the final Steering Committee Meeting. Professor Paris did not attend the final Steering Committee Meeting on July 12, 1979 at which the Steering Committee completely reviewed the results of tests and studies which supported a reduction in the safety limit from 8,000 hours to 7,100 hours. The Steering Committee concurred with the reduction in the safety limit.

Senator PROXMIRE. I want to thank you very, very much. This isn't a pleasant hearing for you I'm sure. I think you have done an outstanding job under difficult circumstances and have been very frank and very helpful and you have made a fine record and we appreciate it.

The subcommittee will stand in recess until September 16, when our witness will be the Secretary of the Air Force.

[Whereupon, at 12:35 p.m., the subcommittee recessed, to reconvene at 10 a.m., Tuesday, September 16, 1980.]

ECONOMICS OF DEFENSE PROCUREMENT: THE C-5A AND STRATEGIC MOBILITY

TUESDAY, SEPTEMBER 16, 1980

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON PRIORITIES AND
ECONOMY IN GOVERNMENT OF THE
JOINT ECONOMIC COMMITTEE,
Washington, D.C.

The subcommittee met, pursuant to recess, at 10:05 a.m., in room 5302, Dirksen Senate Office Building, Hon. William Proxmire (chairman of the subcommittee) presiding.

Present: Senator Proxmire and Representative Wylie.

Also present: Richard F. Kaufman, assistant director-general counsel.

OPENING STATEMENT OF SENATOR PROXMIRE, CHAIRMAN

Senator PROXMIRE. Will you gentlemen please remain standing?

[Witnesses are sworn.]

Senator PROXMIRE. Fine. Be seated. We meet today to hear the official Air Force version of the C-5A story. In my letter of invitation, I asked Secretary Mark to explain the origins and nature of the wing problem, how and when the Air Force first learned of the problem, Air Force efforts to assess the problem, the basis of the decision to approve the H-mod, the costs of the H-mod, the justification for awarding the R. & D. and production contracts to Lockheed, and the steps taken by the Air Force to prevent this type of problem from recurring in other programs.

Recent public disclosures partially answer the question of why the C-5A is experiencing structural wing problems. The new disclosures make it clear that the wing problems are largely the result of the decision to reduce the weight of the wings. The weight was reduced primarily by thinning out the wing planks through a chemical milling process. Estimates of the weight taken out of the plane in this manner range from 10,000 to 15,000 pounds. Now, since the wing planks provide the structural support, thinning them reduces their strength. In effect, the wings were intentionally weakened.

Now, according to Lockheed, a decision was made to comply with the Air Force requirement concerning the total maximum weight of the airplane. It seems unbelievable that the Air Force would assign hundreds of Air Force officials to administer the C-5A contract and monitor the production and then sit idly by while Lockheed crippled the airplane.

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These disclosures are about actions that were taken years ago. They do concern an aircraft program for which billions of dollars have already been spent, and for which additional billions will be spent in the future.

There are important lessons to learn from this program, but I wonder if they have been learned. Was the decision to weaken the C–5A wings a case of planned obsolescence? Did Lockheed know that reducing the weight would weaken the wings and shorten the service life? Did the Air Force understand the consequences of reducing the weight and the strength of the wings? Why didn't the Air Force take any action to stop Lockheed from weakening the wings? Why did the Air Force accept delivery of C–5A with defective wings?

Why should the company responsible for producing a defective airplane be given a lucrative, profitable contract to fix their own mistake?

The Air Force plans to spend about $1.4 billion to fix the wings. Several experts have criticized that plan. It's argued that the studies commissioned by the Air Force to determine the extent of the wing problem and the best approach to solving it were conducted by Lockheed and independent outside experts have not had adequate access to Lockheed's raw data.

For example, all the wing tests in which cracks have occurred were performed by Lockheed at the Lockheed plant in Marietta, Ga. According to a 1977 Rand report recently partly released to the public, it may be possible to extend the life of the C–5A to the year 2000 or later for a fraction of the cost of the present program.

Because of the criticisms that have surfaced, I have requested the Office of Technology Assessment to do an independent study of the wing and the wing problem. This morning we will hear testimony from Hon. Hans M. Mark, Secretary of the Air Force.

Secretary Mark, if you can summarize your prepared statement, we will be able to get to the question-and-answer period that much sooner.

TESTIMONY OF HON. HANS M. MARK, SECRETARY OF THE AIR FORCE, ACCOMPANIED BY JOHN McCARTHY, DIRECTOR, LEWIS RESEARCH CENTER, NASA; CHARLES TIFFANY, BOEING CORP.; JAMES MAR, PROFESSOR, MASSACHUSETTS INSTITUTE OF TECHNOLOGY; AND HOWARD WOOD, AERONAUTICAL SYSTEMS DIVISION, AIR FORCE SYSTEMS COMMAND, WRIGHT PATTERSON AFB, OHIO

Secretary Mark. Mr. Chairman, I am very pleased to have the opportunity to appear before you today to discuss the very important C–5 transport aircraft program. My remarks will deal with the general issues raised by your letter to me of August 14, regarding the proposed refurbishment of the C–5 aircraft force. Comments relative to the specific concerns raised by Mr. Paul Paris in his letter to you have been provided to the subcommittee for the record.

I would also like to ask, sir, that my entire prepared statement be made part of the record.

Senator Proxmire. Without objection, it will be printed in full in the record.

Secretary MARK. I will summarize it more briefly so we can get on with the questions and answers.

Senator PROXMIRE. Very good.

Secretary MARK. I am accompanied here today by Mr. Charles Tiffany, who is currently with the Boeing Corp. in Wichita.

Senator PROXMIRE. Secretary Mark, you go right ahead. I am going to step out of the room for just a minute. I've got an urgent phone call from another Senator. I am going to ask Mr. Kaufman to preside while I am out of the room. I'll be right back. You go right ahead.

Secretary MARK. I'm accompanied here today by Mr. Charles Tiffany, currently of the Boeing Corp.; Mr. John McCarthy, Director of the NASA Lewis Research Center; Mr. James Mar of the Massachusetts Institute of Technology; and Mr. Howard Wood of the Aeronautical Systems Division, Air Force Systems Command, at Wright Patterson AFB, Ohio. All four of these individuals have been associated with the C–5 program for a long time, and three of them took part in the most recent review of the program in 1978 and 1979, which was conducted by the Air Force.

We are here today to discuss an important issue regarding the future of our national defense. The 77 C–5 airplanes we have provide a unique military capability. They are the only aircraft that our Nation possesses which can carry the largest equipment that the U.S. Army has in its inventory. Before the C–5 aircraft entered our inventory in late 1969, the United States could move only light infantry and airborne forces to a conflict area in a rapid and timely manner. With the C–5, we can move any piece of heavy firepower equipment of our combat forces to any area in the world, be it tanks, self-propelled artillery, infantry fighting vehicles, helicopters, or airplanes, in rapid order.

These C–5A aircraft, therefore, are crucial to our ability to deploy our Armed Forces around the world should we need to do that.

Therefore, the judgments we make on this matter must be made with the greatest of care. We must be absolutely certain that we preserve the capability to move our forces with all of their equipment overseas quickly. As you know, our ability to do this has received the personal attention of the President and his principal advisers on national security in the past year. It is for this reason that I plead with you to look at this matter in detail, and also in the broadest sense possible, because vital national interests are at stake.

Let me begin by briefly laying out the technical problem as I see it. What we are concerned with is predicting the "safe lifetime" of the C–5 aircraft. The number of hours that can safely be flown in any aircraft is determined by two factors, one technical and one operational. The technical factor deals with the structural design of the airplane, and the materials out of which it is fabricated. The operational factor depends on how the aircraft is employed.

The fundamental structural design of a C–5 is similar to that of a C–141, a remarkably trouble-free airplane. The C–141's success shows that the C–5's fundamental design concept is sound. The reason we have a problem with C–5 is that the implementation of that design concept was unsatisfactory in one respect.

Quite simply, the material used to fabricate the wings is too thin. The subcommittee is very familiar with the decisions taken 13 to 15 years ago which resulted in this thin material being used for the wing planks. Some of these decisions were reached by the Government and others by the contractor involved, the Lockheed Georgia Co.

The problem we face today, Mr. Chairman, as a consequence of these decisions, is to deal with the situation at hand to make certain that the C–5 aircraft force remains a useful weapon system for a period of time which is consistent with our requirements for national security. To understand the situation we face, it is necessary to become familiar with some technical details which I have described in my prepared statement and have submitted for the record. I propose to skip these in my oral testimony so that we can get on with the questions and answers.

What I have done on those pages, sir, is to outline two methods for calculating the safe lifetime of the aircraft. These are (1) the so-called rogue flaw method, and (2) a method that is based on examining the generalized cracking or the widespread cracking that appears in aircraft after some service.

These methods of calculating the accumulated damage in the aircraft, if you will, that has been under stress, are well accepted by the technical community.

I said at the beginning of this description that the lifetime of an aircraft also depends on the way in which it us used. Obviously, if the aircraft is used sparingly, it will last a long time; and if it is used heavily, in a manner which taxes the structure, then cracking damage accumulates in the aircraft structure much more rapidly. I have a chart, sir, which is shown in the prepared statement that I believe clearly demonstrates what the situation is. And what I would like to do, sir, if I may, is to uncover it there. On the left side of the chart, that is, on the vertical axis, I have plotted the accumulated damage in the C–5 wing as we know it to be today.

The state of each aircraft, all the 77 aircraft in service, is represented by a line with a short tick mark at the top. The damage, the accumulated damage, due to cracking, is represented by the length of these lines and is determined in the case of widespread cracking from the experimental evidence that was obtained when the wing of an operational aircraft was actually dismantled and examined. And I might add, Mr. Chairman, examined not only by the Lockheed Corp. but by two other independent laboratories.

And in the case of the rogue flaw method, the calculation or the estimate is based on a calculation which is described in the prepared statement that has been submitted.

On the right side of the graph, as you can see, I have shown a number of time scales, and these time scales, Mr. Chairman, represent the fact that the lifetime of an aircraft depends on how it is used. If you use the aircraft sparingly, then it lasts a long time; if you use it in a harsh environment, then it does not last as long.

The first time scale, that is the one on the very left of the time scales, represents the lifetime of the airplane if it is flown according to what has been called the "representative mission profile." This mission profile is most easily described as the way in which the C–5 force was flown during the year 1973. This is an arbitrary definition, but nevertheless it has been one that has been used to form the base line to describe the lifetime of the aircraft. It is the basis, if you will, of the C–5 standard flight hour, even though we no longer fly the aircraft now in the same manner as we did in 1973.

As you can see from the horizontal lines, all the way across the chart, the safe limit of the aircraft, in terms of representative mission profile hours, is 7,100 hours, when calculated according to the rogue flaw method that I had described, and 7,500 hours from the method of widespread cracking.

I want to return to these numbers a little bit later, because it is important to understand why these numbers are indeed credible. I would at this time, however, like to continue to make the point that I started, which is that the lifetime of an airplane depends on how it is used.

Let me skip the second line because, while it's important, it's not really germane to the argument, and go through the third vertical line on the right side of the chart. This shows what the lifetime of the aircraft would have been, Mr. Chairman, had we flown the aircraft from the very beginning the way we fly it today. As you know, we have installed an active load alleviation system on the airplane that reduces the stresses on the wings.

Also, we fly the aircraft under what is called a restricted mission profile. We do not use full payloads under normal circumstances on our cargo missions and generally we restrict the C–5's maneuvering envelope. We do not refuel the aircraft in flight unless we have to, and we do not land and take off on very short runways.

It must be recognized that while these restrictions limit the military capability of the C–5, they do have the effect of greatly lengthening the C–5's lifetime. As you can see from the third line on the right, the safe life of the aircraft on this scale, calculated according to the rogue flaw method, is approximately 19,800 hours and the widespread crack limit, as you can see, is a little bit higher, but not significantly higher.

Under current conditions, the lifetime remaining on each of the 76 C–5's—and that's what's important about this chart—can be obtained by drawing a line from the time of each line like so—and let me go over here and show you. If you draw a line from the top of each aircraft line over here, and then what time remains is the remaining lifetime of the aircraft, depending on how you see it.

As you can see, if we operate the aircraft as we currently do, then we have approximately 5,000 hours of service life left. And roughly speaking, we fly these airplanes now at about 750 hours a year, and that means we have 5 or 6 years of service left on each aircraft, provided, Mr. Chairman, that we keep operating the aircraft under the restricted mission profile that we now use.

Let me, sir, get to the important line on the chart, and that is the last line over on the right, because that line represents how the aircraft would be used in the event of a military contingency. And for these contingencies, as you know, we must make very detailed plans. If we have to detail large forces overseas to supply and support them, then the aircraft would be used at that rate.

Six months of such service would consume approximately 1,600 flight hours on that scale. I have shown by a bracket which is plotted down from the road flaw limit line that 16 hours, and I will explain why I have done that in a moment. This scale is based on the kind of war that we would fight in Europe that we are projecting that we would have to fight in Europe if there were a problem. And we have used this contingency here only because it has been studied more thoroughly than others. But there are many other contingencies as well, for example, the deployment of a force in the Middle East or elsewhere in the world where similar usage figures would apply.

As you can see, if the aircraft are flown according to a wartime mission during their entire lifetimes, the safe limit of the aircraft would have been approximately 12,000 hours. What we are interested in, of course, is what lifetime remains on each aircraft. And as you can see from the chart, the average force could be flown on the wartime mission profile for something like 3,000 hours or approximately 1 year.

You can see from the individual aircraft plots on the left that we already have several C–5's which would have to be grounded during the contingency. If the contingency occurred 3 years from now, after the force had accumulated roughly another 2,000 hours on the peacetime scale, a major portion of the C–5 force would have to be grounded in the course of the contingency.

That fact is what is behind the urgency of getting on with the wing modification program now and that is why it is supported by the Chairman of the Joint Chiefs of Staff, the Secretary of Defense, the administration, and the Armed Services Committees of both Houses of the Congress.

What I am saying, Mr. Chairman, is that we are in a position today with respect to the C–5 force that we must continue appropriations for the production of the wing modification now in order to avoid the situation where a large fraction of the C–5 force may have to be grounded during a conflict in the future. As a responsible public official with a certain responsibility for our national defense posture, I could not regard such a situation as tolerable.

Let me now return to the important question of whether the lines that indicate the safe life of the airplane on this chart that go across the top are actually correct. It has been said many times in testimony before this subcommittee that the determination of the number of hours which constitute the safety limit of the airplane is a matter which involves some subjective judgment. This is correct, and it is therefore very important to understand the qualifications of the people that have collectively rendered the judgments which have caused us to decide on the wing modification program.

The Air Force in the last decade has conducted five major studies of the C–5 aircraft, none of which have recommended a safety limit significantly different from those shown here. Approximately 200 people who are expert in the fields of structural mechanics and structural engineering have been involved in these five study efforts. Seven members of the group belong to the National Academy of Engineering which, as you know, is the body that represents the most distinguished engineering talent in the United States.

These seven gentlemen, Mr. Chairman, represent the finest talent that could have been obtained to evaluate this problem. I know them well. I have worked closely with some of them for two decades. I am a member of the National Academy of Engineering myself, so I know the qualifications people must have in order to be selected. Mr. Chairman, I find it inconceivable that any one of these gentlemen could be misled either by a technical presentation or a technical report that was in any way dishonest or incorrect.

We came to the modification decision on the basis of the collective judgment of people such as these, rendered over many years on the basis of an ever-growing body of evidence and experience with the C–5 aircraft. I have every reason personally to rely on that collective judgment and see no reason at all to distrust it.

Mr. Chairman, what you and Mr. Paris are recommending is another study to look at the C–5 wing situation. I understand that you have already asked the Office of Technology Assessment to conduct such a study. As Secretary of the Air Force, I do not have any control over whether the Office of Technology Assessment does such a study. That is between you, Mr. Chairman, and that office, as it properly should be.

But as Secretary of the Air Force, I must make up my mind as to what to recommend to the Secretary of Defense, to the administration and to the Armed Services and Appropriations Committees of the Congress with regard to the wing modification schedule—pending the results of any study by the Office of Technology Assessment.

I am assuming that to be credible, such a study would have to be based on work at least as thorough as that done in previous studies, and I assume that an independent review by the Office of Technology Assessment would take at least 2 years. It would also, of course, have to be conducted by a group that is at least as qualified as the groups which have already looked at this problem.

Mr. Chairman, I would like to tell you that I have made up my mind on what to recommend and I would like to describe to you the process I went through in doing so.

Senator Proxmire. Could you do that in about 5 minutes or so?

Secretary Mark. Yes, sir.

In looking at the situation, I am faced with two possibilities with regard to the lifetime of the C–5. One view is supported by a consensus of highly qualified technical people, the other by one individual expert, Mr. Paul Paris.

Faced with that situation, I know the chance that the consensus view is correct is much greater than that the individual's view is correct. Nonetheless, I must deal somehow with the fact that the opposite might be the case. When we are dealing with aircraft lifetimes, there are risks associated with acting as if the consensus view is correct and different risks associated with acting as if the individual were correct.

For instance, if Mr. Paris were claiming that the C–5 lifetime were less than the consensus claims, I would perceive two grave risks which I would have to balance. When the C–5 fleet reaches the lower limit, that claimed by the individual, I would have to either act in accordance with his warning by grounding the aircraft, over the protest of the consensus opinion that I was therefore unnecessarily risking national security, or I could continue to fly the fleet over the individual's protest that I was thereby unnecessarily risking the lives of the people who fly and fly on the aircraft.

I cannot now tell you how I would decide. The prudent course in such a situation is by no means clear.

Fortunately, I am not facing that situation. On the contrary, what we have here is Mr. Paris implying that the C–5's lifetime is greater than that claimed by the consensus of all other technical experts, and the alternative risks are therefore quite different. In this case, I could recommend a delay in the modification program while another study is conducted, over the protest of the consensus view that I was thereby risking national security, or I could continue the modification program over the protests of Mr. Paris that I was improving the C–5 fleet either prematurely or unnecessarily, at some costs in money.

The prudent choice in this case is as clear as it is unclear in the other. If I go along with the view of the consensus of experts, that is, that the wing modification program must continue during any further study, the worst outcome is an unnecessarily improved airlift fleet at a dollar cost that is known. If I go along with the recommendation of Mr. Paris, the worst outcome is an inability to successfully support a military contingency, and incalculable costs in lives, territory, and freedom could result.

Mr. Chairman, I really see no choice but to proceed with the wing modification now, even if a new study of the C–5 is conducted. This is the recommendation that I would make to the Secretary of Defense and that I am making here to the Congress.

Mr. Chairman, I am very grateful for the opportunity that you have given me here today to discuss this important matter. Before I close, I would like to repeat that it is my considered technical judgment—and I have been involved in many similar exercises in the past—that the Air Force has taken the correct technical course in adopting the proposed modification program, and that the judgments that have been made on deciding on that course are unbiased, technically sound, and prudent from the point of view of flight safety and national security.

Accordingly, I am most gratified with the support shown for the program by the Congress during the recently completed authorization process. And I would like to enter a plea with you, sir, and with the other members of the Appropriations Committee that the proposed modification program of the C–5 wing be maintained.

Mr. Chairman, my colleagues and I are prepared to answer any questions you may have.

[The prepared statement of Secretary Mark, together with additional material, follows:]

Prepared Statement of Hon. Hans M. Mark

Mr. Chairman and members of the subcommittee, I am very pleased to appear before you today to have the opportunity to discuss the very important C–5 transport aircraft program. My remarks today will deal with the general issues raised in the Chairman's letter to me of August 14th, 1980, regarding the proposed refurbishment of the C–5 aircraft force. Comments relative to the specific concerns raised by Dr. Paul Paris in his letter to the Chairman have been provided to the Committee for the record. I am accompanied here today by Mr. Charles Tiffany, currently with the Boeing Corporation, Dr. John McCarthy, the Director of the NASA Lewis Research Center, Professor James Mar of the Massachusetts Institute of Technology and Mr. Howard Wood of the Aeronautical Systems Division of the Air Force Systems Command at Wright Field. All four of these individuals have been associated with the C–5 program for a long time and three of them took part in the 1978–1979 C–5 wing review by the Air Force.

We are here today to discuss an important issue regarding the future of our national defense. The 77 C–5 airplanes we have provide a unique military capability. They are the only aircraft that our nation possesses which can carry the largest equipment that the U.S. Army has in its inventory. Before the C–5 aircraft entered our inventory in late 1969, the United States could move only light infantry and airborne forces to a conflict area in a rapid and timely manner. With the C–5, we can move any piece of heavy firepower equipment of our combat forces to any area in the world, be it tanks, self-propeller artillery, infantry fighting vehicles, helicopters or airplanes. These aircraft, therefore, are crucial to our ability to deploy our armed forces around the world should we need to do that. Therefore, the judgments we make on this matter must be made with the greatest of care. We must be certain that we preserve the capability to move our forces with all of their equipment overseas quickly. As you know, our ability to do this has received the personal attention of the President and his principal advisors on national security in the past few months. It is for this reason that I plead with you to look at this matter in detail and also in the broadest sense possible because vital national interests are at stake.

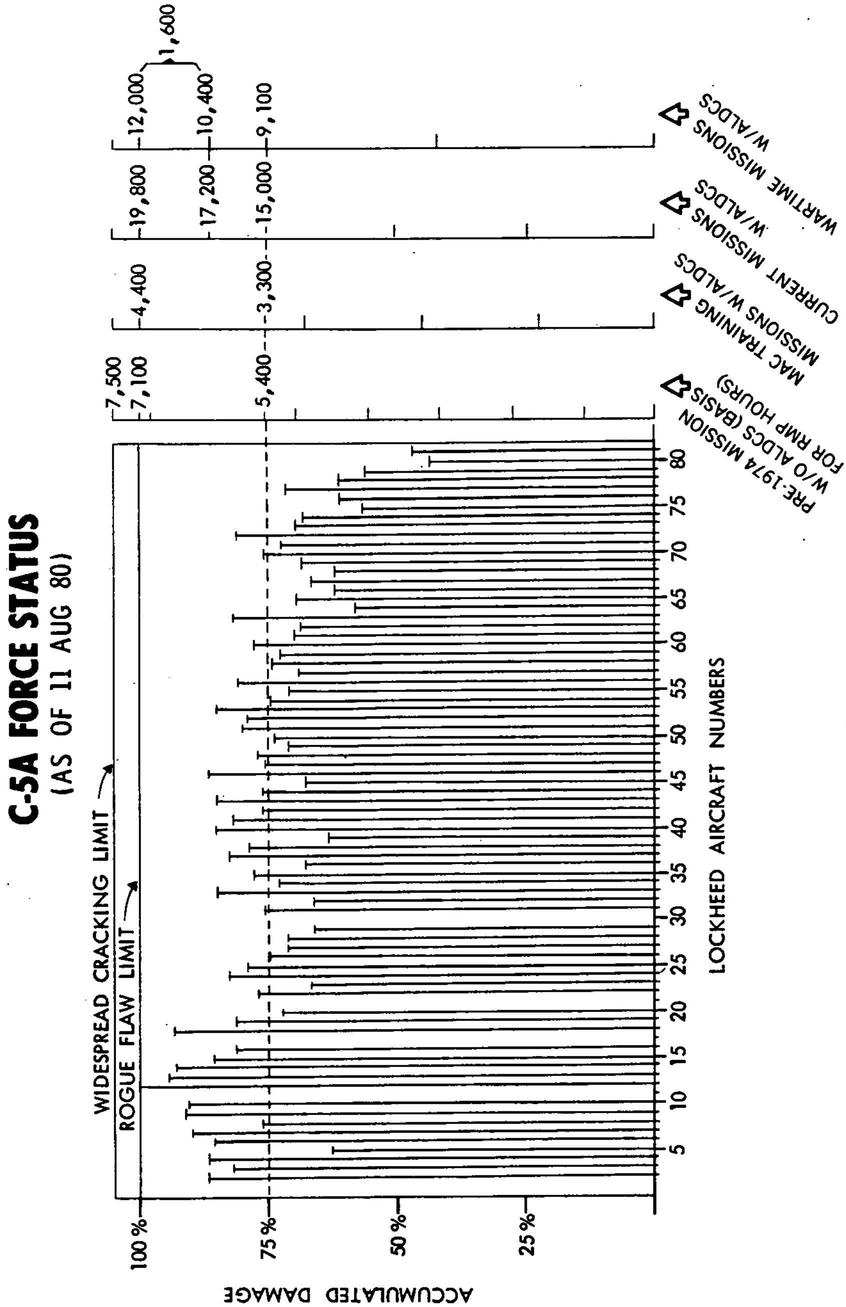
Let me begin by laying out the technical problem as I see it. What we are concerned with is predicting the "safe lifetime" of the C–5 aircraft. The number of hours that can safely be flown in any aircraft is determined by two factors: The design of the aircraft and the way in which it is used.

The fundamental structural design of the C–5 is similar to that of the C–141, a remarkably trouble-free airplane. The C–141 success shows that the C–5's fundamental design concept is sound. The reason we have a problem is that the implementation of that design concept was unsatisfactory in one respect. Quite simply, the material used to fabricate the wings is too thin. The Committee is very familiar with the decisions taken 13 to 15 years ago which resulted in this thin material being used for the wing planks. Some of these decisions were reached by the government and others by the contractor involved, the Lockheed Georgia Company. The problem we face today as a consequence of these decisions is to deal with the situation at hand to make certain that the C–5 aircraft force remains a useful weapon system for a period of time which is consistent with our requirements for national security. To understand the situation we face, it is necessary to become familiar with some technical details which I propose to describe this morning as quickly and as simply as I can.

When metals are placed under prolonged repeated stress in aircraft structures, they crack. These cracks occur at those places where such stresses are concentrated. In the case of the C–5 wing, the stress concentrations of greatest concern to us occur in the wing planks, around the holes for the fasteners that connect the planks to one another and to the rest of the wing's structure. There are 125,000 holes of this kind in the wing of each C–5 aircraft and somewhere between 30,000 and 40,000 fastener holes are in regions of the wing where stresses are high. There are cracks which occur in these holes, and they will propagate and grow through the structure in such a way that the wing will ultimately fail when the cracks reach a size which we call "critical." The problem is to calculate the time that it takes these cracks to grow to the point where they become "critical."

Two separate techniques which are well understood in the technical community have been used to calculate the "safe life" of the C–5 aircraft due to the growth of cracks in these fastener holes. The first technique assumes that there are a small number of very serious initial defects which have been introduced into the structure during manufacture. These defects are called "rogue flaws" and the size of the rogue flaw assumed is taken from prior experience with other aircraft. Teardown inspections of many aircraft have been conducted in the years that we have been flying and the size assumed for rogue flaws in the C–5 is based on the cumulative experience we have with aircraft such as the KC–135, the C–141, the B–52, the F–4 and many others. For the C–5 lifetime calculation, as you know, it has been assumed that the size of the rogue flaw that eventually leads to a critical crack is 0.05 inches. Calculations of how long it would take such a flaw to become a critical crack are based on cyclic tests of the materials involved to stress levels inherent in the aircraft's structural design. I will shortly discuss the results of these calculations for the C–5. The safe limit which currently defines the lifetime of the C–5 was calculated using this technique.

A second and parallel technique used to calculate the safe life of the C–5 depends on an assessment of the widespread cracking which has been found to exist in the C–5 wing. Even if the manufacturing process were perfect, and the possibility of rogue flaw could therefore be ignored, there would still be cracks in the



fastener holes. These defects are a result of the natural condition of the metal after it is prepared. These natural defects are very much smaller than rogue flaws that have been assumed; being on the average something of the order of 0.003 inches deep for the structural material that was used on the C–5 aircraft. While they are smaller and therefore would take longer to grow to critical crack size, there are many more of these than the assumed rogue flaws. Non-destructive testing methods used on the two original structural test articles of the C-5 wing revealed the presence of widespread cracking which had grown from the initial condition of small flaws. The teardown inspection of the operational aircraft conducted under the Structural Information Enhancement Program (SIEP) revealed that the wing was in an advanced state of widespread cracking. We therefore have actual evidence that widespread cracking is occurring in the C-5 wing. The physical effect of widespread cracking is to weaken the overall structure so that an initial failure caused by a foreign object or perhaps an engine fire—incidents that would normally not be catastrophic—can be catastrophic in an aircraft whose structure has been weakened by widespread cracking.

These methods of calculating the accumulated damage, if you will, in a structure that has been under stress are accepted by the technical community.

I said at the beginning of this description that the lifetime of an aircraft also depends on the way in which it is used. Obviously, if the aircraft is used sparingly, it will last a long time and if it is used heavily in a manner which taxes the structure, then cracking damage accumulates much more quickly. I have a chart which I think depicts the C-5 situation as clearly as possible and it is attached to this testimony. The chart shows the state of the accumulated damage on the C-5 aircraft fleet and depicts the different methods of using the remaining life of the aircraft. On the left side of the chart (that is, on the vertical axis), I have plotted the accumulated damage in the C-5 wing as we know it to be today. The state of each of the aircraft in the C-5 force is represented by a line with a short tick mark at the top. The damage represented by the length of these lines is determined in the case of widespread cracking from the experimental evidence that we obtained when the wing of the operational aircraft was dismantled and examined. In the case of the rogue flaw, it is based on the calculation I have already described. It is important to remember that the mechanism of crack growth is the same in either case and, therefore, one line suffices to describe the accumulated damage due to either cause in the aircraft wing.

On the right side of the graph, I have shown a number of time scales. The first time scale represents the lifetime of the airplane if it is flown according to what is called "the representative mission profile." The representative mission profile is most easily described as the way in which the C-5 force was flown during the year 1973. In the numerous studies that have been done of the C-5 aircraft, it is this time scale that has been used to describe the lifetime of the aircraft. In other words, it is the basis of the C-5 standard flight hour, even though we no longer fly aircraft in the same manner as we did in 1973. As you can see from the horizontal lines all the way across the chart, the safe limit of the aircraft in terms of representative mission profile hours is 7100 hours calculated according to rogue flaw method and 7500 hours from the method of widespread cracking. I want to return to these numbers a little later because it is very important to understand why they are indeed credible. I would like at this time, however, to continue to make the point I have started which is that the lifetime of an airplane depends on how it is used.

The second vertical line on the chart shows the time scale appropriate for an even harsher mission than I have just talked about, one which the Military Airlift Command calls its training mission. The lifetime shown here is obtained on any aircraft the Military Airlift Command uses full time to train crews as we currently do. This training mission includes low altitude maneuvers, some practice aerial refueling and practice landings and takeoffs. In that case, the structure of the specific aircraft involved is damaged much more rapidly. For this training mission profile, the rogue flaw limit calculation gives a flying life of approximately 4,000 hours and, as always, the widespread cracking calculation yields a result which is slightly larger. The point is that there are valid peacetime training requirements which consume the remaining lifetime of the C-5's very much more rapidly than the average mission. In fact, the training mission whose effects are evident here is really not entirely adequate to provide our crews the high level of proficiency that would be required in wartime. We have cut back in order to cut down on the wing damage that such a training program would entail. By the way, I should add that this column and the next two take into account the existence of the active load alleviation system that has been installed on the airplane.

The third vertical line on the right side of the chart, shows what the lifetime of the aircraft would have been had it been used the way we fly it today during its entire life. We have installed an active load alleviation system on the airplanes that reduces the stresses on the wings. Also, we fly the aircraft under what is called a restricted mission profile. I have already mentioned that we do not train as we think we should. We do not use full payloads under normal circumstances on our cargo missions and generally we restrict the C–5's maneuvering envelope. We do not refuel the aircraft in flight unless we absolutely have to and we do not land or takeoff from short runways. It must be recognized that while these restrictions limit the military capability of the C–5, they do have the effect of greatly lengthening the C–5's lifetime. As you can see, the safe life of the aircraft on this scale, calculated according to the rogue flaw method, is approximately 19,800 hours and the widespread crack limit is slightly higher. Under current conditions, the lifetime remaining on any of the aircraft in the C–5 force can be obtained by drawing a line from the top of each of the status lines for the aircraft over to this scale and then measuring how many hours are left. As you can see with the current flight restrictions, the average C–5 has approximately 5,000 flight hours remaining for use before the safe limit is reached. At the current rate of flying, which is approximately 750 hours per year per airplane, it will take five or six years to reach the safe limit for the average C–5.

Finally, let me get to the most important time scale on this chart, and this is the one that represents how the aircraft would be used during some likely military contingencies for which we must make plans. If we have to deploy large forces overseas and to supply and support them, then the aircraft life would be used at the rate shown in the last line on the right hand side of chart. Six months of such service would consume 1,650 hours on the scale. I have shown that by a bracket which is plotted down from the rogue flaw limit line, and I will explain why in a moment. This scale is based on the kind of war that we would fight in Europe. We have used this contingency here only because we have studied it more thoroughly than many other contingencies we could face around the world. I am sure, however, that if we were to deploy a force to the Middle East to meet a threat in the Persian Gulf area, then similar usage arguments would apply. As you can see, if the aircraft are flown according to a wartime mission during their entire lifetimes, the safe life of the aircraft would be approximately 12,000 hours. What we are interested in, of course, is the lifetime remaining on each aircraft, and as you can see from the chart, the average of the force could be flown on the wartime mission profile for something like 3,000 hours or approximately one year. You can see from the individual aircraft plots on the left that we already have several C–5's which would have to be grounded during the contingency. If the contingency occurred three years from now, after the force had accumulated roughly another 2,000 hours on the peacetime scale, a major portion of the C–5 force would have to be grounded in the course of the contingency.

That fact is what is behind the urgency of getting on with the wing modification program now and that is why it is supported by the Chairman of the Joint Chiefs of Staff, the Secretary of Defense, the Administration and the Armed Services Committees on both houses of the Congress. What I am saying, Mr. Chairman, is that we are in a position today with respect to the C–5 force that we must continue appropriations for the production of the wing modification now in order to avoid the situation where a large fraction of the C–5 force may have to be grounded during a conflict in the future. As a responsible public official with a certain responsibility for our national defense posture, I could not regard such a situation as tolerable.

Let me now return to the question of whether the lines that indicate the safe life of the airplane on this chart—the two horizontal lines—are for the rogue flaw calculation and the other for widespread cracking—are actually correct. It has been said many times in testimony before this Committee that the determination of the number of hours which constitute the safe limit of the airplane is a matter which involves some subjective judgment. This is correct, and it is therefore very important to understand the qualifications of the people that have collectively rendered the judgments which have caused us to decide on the wing modification program. The Air Force in the last decade has conducted five major studies of the C–5 aircraft, none of which have recommended a safety limit significantly different from those shown here. Approximately 200 people who are expert in the fields of structural mechanics and structural engineering have been involved in these five study efforts. Seven members of the groups belong to the National Academy of Engineering which, as you know, is the body that represents the most distinguished engineering talent in the United States. They are Professor Holt Ashley of Stanford University, Dr. Raymond Bisplinghoff, then of the Massachusetts Institute of Technology and later of the National Science Foundation, Dr. Alfred E. Eggers of the National Aeronautics and Space Administration and later the National Science Foundation, Mr. Willis Hawkins of the Lockheed Corporation, Mr. Ira G. Hedrick of the Grumman Aircraft Corporation, Professor Robert Loewg of the Rensselaer Polytechnic Institute and Mr. F. A. Cleveland of the Lockheed Corporation.

These gentlemen represent the finest talent in this field that can be obtained in this country. I know all of them well and have worked closely with some of them for over two decades. I am a member of the National Academy of Engineering myself, so I know the qualifications people must have in order to be selected. Mr. Chairman, I find it inconceivable that any one of these gentlemen could be misled either by a technical presentation or a technical report that was in any way dishonest or incorrect. We came to the modification decision on the basis of the collective judgment of people such as these, rendered over many years on the basis of an ever growing body of evidence and experience with the C–5 aircraft. I have every reason personally to rely on that collective judgment and no reason at all to distrust it.

Mr. Chairman, what you and Dr. Paris are recommending is another study to look at the C–5 wing situation. I understand that you have already asked the Office of Technology Assessment to conduct such a study. As Secretary of the Air Force, I do not have any control over whether the Office of Technology Assessment does such a study. That is between you Mr. Chairman and that office. But, as Secretary of the Air Force, I must make up my mind as to what to recommend to the Secretary of Defense and the Administration and to the Armed Services and Appropriations Committee of the Congress with regard to the wing modification program—pending the results of any study by the Office of Technology Assessment. I am assuming that to be credible, such a study would have to be based on work at least as thorough as that done in previous studies and I assume that an independent review by the Office of Technology Assessment would take at least two years. It would also, of course, have to be conducted by a group that is at least as qualified as the groups which have already looked into this matter.

Mr. Chairman, I would like to tell you that I have made up my mind on what to recommend and I would like to describe to you the process I went through in doing so. In looking at the situation, I am faced with two possibilities with regard to the lifetime of the C–5. One view is supported by a consensus of highly qualified technical people, the other by one individual expert, Dr. Paul Paris. Faced with that situation, I know the chance that the consensus view is correct is much greater than that the individual's view is correct. Nonetheless, I must deal somehow with the fact that the opposite might be the case. When we are dealing with aircraft lifetimes there are risks associated with acting as if the consensus view is correct and different risks associated with acting if the individual were correct. For instance, if Dr. Paris were claiming that the C–5 lifetime were less than the consensus claims, I would perceive two grave risks which I would have to balance. When the C–5 fleet reaches the lower limit, that claimed by the individual, I would have to either act in accordance with his warning by grounding the aircraft (over the protest of the consensus opinion that I was therefore unnecessarily risking national security) or I could continue to fly the fleet (over the individual's protest that I was thereby unnecessarily risking the lives of the people who fly and fly on the aircraft). I cannot now tell you how I would decide: the prudent course in such a situation is by no means clear.

Fortunately, I am not facing the situation I have just described. On the contrary, what we have here is Dr. Paris implying that the C–5's lifetime is greater than that claimed by the consensus of all other technical experts, and the alternative risks are therefore quite different. In this case I could recommend a delay in the modification program while another study is conducted (over the protest of consensus view that I was thereby risking national security unnecessarily) or I could continue the modification program (over the protests of Dr. Paris that I was improving the C–5 fleet either prematurely or unnecessarily, at some costs in money). The prudent choice is as clear to me in this case as it is unclear in the other. If I go along with the view of the consensus of experts, that is, that the wing modification program must continue during any further study, the worst outcome is an unnecessarily improved airlift fleet at a dollar cost that is known. If I go along with the recommendation of Dr. Paris, the worst outcome is an inability to successfully support a military contingency, and incalculable costs in lives, territory and freedom could result. Mr. Chairman, I really see no choice but to proceed with the wing modification even if a new study of the C–5 is conducted. This is the recommendation that I would have to make to the Secretary of Defense. Let me repeat here that I do not think any such study will appreciably change the results you see on this chart.

Let me now turn to a final matter which we need to understand. It has been suggested that there may be less expensive ways of extending the lifetime of the C–5 aircraft than the program that the Air Force has undertaken—the so called "H Mod." The essential point of the Air Force program is to replace the portions of the wing which contain thin planks with corresponding portions containing thicker planks of a similar material. The wing would be put together according to the same design concept used initially. As I have already said, we know the design is sound for two reasons. First, it is exactly the same method that was used on the C–141 aircraft, which has been very successful and very safe. Second, the full-scale test article of the new portions of the C–5 wing recently successfully completed a full lifetime of testing with none of the difficulties experienced with the original wing.

It has been postulated that instead of using new wing sections built from thicker materials, we might be able to simply drill out some portion of the fastener holes in the present wing to a larger diameter, in such a way as to eliminate the cracks that we know are in these holes. Mr. Chairman, there are two reasons for *not* adopting the latter procedures. First, in order to be really sure that all the cracks are gone, one would have to drill the holes to a diameter which is so large, given the current state of the aircraft fleet, that one would risk other damage mechanisms, such as the tear limit, in many of these holes. A second, and if possible more important consideration, is that drilling out the holes would not solve the fundamental difficulty with the airplane, which is that the wing planks are too thin. Finally, with respect to cost, it has been asserted that drilling out the holes on the existing planks would be very much cheaper than the modification we are undertaking. This argument depends completely on how many holes would have to be drilled out. If 40,000 holes on each airplane have to be drilled out—and the teardown of the flight aircraft indicated that this could well be the case—then the cost of the H Mod and of the drilling method are roughly the same. Remember that much of the cost of modifying the aircraft is not so much in materials or even in drilling the holes but in disassembling and reassembling and then retesting and rechecking each airplane.

It has also been asserted that we do not need to build a lifetime of 30,000 hours into the airplane given the likelihood that the C–5 may need to be replaced at the end of this century in any event. In the first place, it is not at all self-evident that the C–5 will need to be replaced. The trend toward extending aircraft lifetimes is very clear. The B–52, the KC–135 and C–130 are all well into their third decade of service already, with no firm replacement plans for any of them. Moreover, to retain contingency capability with the C–5 force even through the end of the century, at 750 flight hours per year, will require an additional 15,000 hours of flying which is simply not available. The peacetime scale on the chart shows that only 2,000 hours of such service is available across the force before we begin to lose contingency capability. The figure of 30,000 hours for the lifetime extension has been chosen because it has been shown that the rest of the C–5 structure has roughly 30,000 more flying hours available on it. It makes sense, therefore, to bring the wing up to the same standard, particularly as the cost difference between getting 15,000 additional hours and 30,000 is negligible. Then, at the end of the century, we would have the option of updating the C–5, if necessary, in avionics and propulsion rather than replacing it entirely. The pace of technology in the area of airframe improvements is not great, and there is no reason to feel that the C–5 will need to be replaced at that point merely on the basis that its aerodynamically sound airframe would somehow by then be technically obsolete. For all these reasons, I feel that the wing modification is a wise and prudent choice from an economic viewpoint.

Mr. Chairman, I am very grateful for the opportunity that you have given me here to discuss this very important matter. Before I close, I would like to note that it is my considered technical judgment—and I have been involved in many similar technical issues in this field in the past—that the Air Force has taken the correct technical course in adopting the proposed modification program, and that the judgments that have been made in deciding on that course are unbiased, technically sound, and prudent from the point of view of flight safety. Accordingly, I am most gratified with the support shown for the program in the Congress during the recently completed authorization process and I would like to enter a plea with you and the other members of the Appropriations Committee that the proposed modification program of the C–5 wing be maintained. Mr. Chairman, my colleagues and I are ready to answer any questions that you and the other members of the Committee might have.

RESPONSE OF HON. HANS M. MARK TO STATEMENTS IN PAUL C. PARIS' LETTER TO SENATOR PROXMIRE

Dr. Paris. "If I am not mistaken, I am the only person so deeply involved whose livelihood does not depend on Lockheed or USAF sources. Thus . . . less biased than others with similar qualifications and knowledge of the technical issues."

AF Comment. From the first indications of difficulty with the C–5 wing, the Air Force recognized the need to assure that the information on which it acted was objective—and would be seen to be objective. It therefore went to extraordinary lengths to insure such objectivity in the C–5 wing analyses by—among other things—employing in key positions on all committees and boards investigating the problem a number of qualified experts whose institutional backgrounds and permanent positions were with neither the Air Force nor Lockheed.

Some of the eminent individuals who have contributed to and reviewed the analyses and recommendations on the C–5 wing are Dr. James McCarthy of NASA, Prof. Holt Ashley of Stanford, Dr. James W. Mar of MIT, Mr. William C. Dietz of General Dynamics and Mr. Charles Tiffany (who prior to his Air Force employment and again by the time the SIEP study was completed, was associated with the Boeing Aircraft Corp.).

The interposition of the Scientific Advisory Board in many of these reviews, including the most recent (SIEP), was a further means of insuring that the information and recommendation which reached Air Force decisionmakers were both technically sound and clearly objective. The very purpose of the SAB is to keep the Air Force from fooling itself on issues like this one. Apart from expertise, the stock in trade of SAB members and of all the individuals listed above is objectivity. They make their livings by finding the truth and describing what they have found to those who might prefer that reality be less harsh. Both the Air Force and—we are sure—Lockheed would have preferred that the C–5 wing be found to be better than it has turned out to be. Only the credibility of the evidence (and of those who have produced it) have forced the Air Force to conclude that the wing modification is necessary.

Dr. Paris. "First, I would like to compliment the House Appropriations Committee Surveys and Investigation Staff for their perceptive report! . . ."

AF Comment. Those responsible for the S&I report, Mr. Paul F. Dinsmore, Jr., and Mr. Robert W. Catlin, Jr., of the House Appropriations Committee Staff, are undoubtedly perceptive. However, a review of the issues in the S&I report indicates that they were largely drawn from the 1977 RAND Report which was based on information available in the 1975–76 time frame. The Air Force's official response to the S&I report, which draws on new information gathered and new analyses done during 1978 and 1979 by SIEP, details the report's inaccuracies.

Dr. Paris. "As a member of the SIEP Steering committee, we were told to address the question of safety up to the then current safety limit of 8,000 hours but not to go beyond that task."

AF Comment. The SIEP was not asked to develop modification alternatives for extending the life of the C–5 beyond the safety limit. However, as one of its 10 tasks, the SIEP was directed to rigorously reexamine that safety limit, which it did on the basis of all data previously available and new information which it developed through (1) teardown of the left wing of a high-time C–5 and (2) significant numbers of additional physical tests to even more precisely determine the properties of the materials from which the C–5 wing is built. The SIEP concluded that this physical evidence, subjected to the most modern analytical techniques, dictated a smaller safety limit figure be established—7100 Representative Mission Profile (RMP) hours.

The SIEP was also directed to assess the risks attendant to flying beyond the safety limit (whatever it turned out to be) without wing modification, either on the basis of "proof" testing the wings on individual aircraft as they reached the limit or on the basis of intensified inspections of the wing problem using the best crack inspection techniques and instrumentation which are currently available. They concluded that flying beyond the wing's safety limit without modification is not a practical, safe alternative.

Dr. Paris. "An implication of the Rand report was that the limit might be raised considerably."

AF Comment. The statement about the report having this implication is true, but the 1977 Rand report was based on data available in the 1975–1976 time frame. The more extensive evidence developed and analyzed during 1978 and 1979 by SIEP showed this implication to be groundless.

Dr. Paris. "The Rand report was thus a valid basis for establishing a higher service-life goal. . . ."

AF Comment. The 1977 Rand report reviewed the evidence then available and questioned whether that evidence allowed one to reach a conclusion as to the safe service life of the unmodified C–5. The Rand Report, explored the implications of several possible service life goals, but refrained from recommending any particular one. It did conclude that the H-mod is the most cost effective way of reaching the 30,000 hour goal already established by the Air Force (which it also questioned). The Rand report's whole tenor was that the capability represented by the C–5 force would have to be replaced when such goals had been reached.

The report also speculated on whether the C–5's safety limit might be found to be higher (than 8,000 hours on the basis of additional evidence. The SIEP and SAB, on the basis of significantly more complete evidence, gathered during 1978 and 1979, concluded that the safe service life of unmodified aircraft was lower rather than higher than had been previously thought.

The Rand report also postulated modification options less extensive than the H-mod. SIEP data obtained during the teardown of a high-time C–5 whose wing had received several earlier modifications showed that only minor extensions of lifetime could be obtained through such modification techniques, e.g., new cracking was found around holes which has been cleaned up and had had oversize fastener installed during earlier work. In fact, the largest crack found during the teardown was located at such a reworked hole.

Dr. Paris. "However, when the 7,100 hour number was presented during the final SAB review of the structural Information Enhancement Program, it was without explanation to my satisfaction . . . when the 7,100 hour safety limit number was presented, we (Mr. Tiffany and Dr. Paris) exchanged indications of surprise and acknowledgement that neither of us had heard the number before nor had we anticipated such a change. Now, does this sound like each factor in the rogue flow safety limit was reviewed with the Steering Committee to their full satisfaction and agreement? Indeed, all of the numbers I heard at the final SAB committee meeting were new and as far as I know completely unreviewed by the steering Committee. . . ."

AF Comment. Numbers new to Dr. Paris and Mr. Tiffany had, in fact, been reviewed at the 12–13 July 79 SIEP Steering Committee review of the SIEP findings. Mr. Tiffany, after an extensive personal review of the data presented to the SAB, found he concurred with the 7,100 RMP wing life limit, and, at the SAB's request, helped draft the final SAB report.

After reading Dr. Paris' letter, Mr. Tiffany wrote a note to HQ MAC in which he states:

"What Paris says about me missing several steering group meetings and being unaware of the 7,100 hour safety limit prior to the last SAB meeting is true. However, I did satisfy myself that the reduction from 8,000 to 7,100 RMP hours is justified, and my views are adequately expressed in the final SAB report signed by Ashley."

Dr. Paris. "Indeed that reduced number (7,100 hours) and the treatment of ALDCS (Active Lift Distribution Control System) effects are complex. . . . The effects of the use of ALDCS were viewed as inconsequential at the time of the establishment of the 8,000 (hour) number. But it appears ALDCS is quite effective. . . . The effects of the ALDCS were not incorporated into the 7,100 hour number, instead it was put into the 'tracking program,' i.e., the usage hours attributed to individual aircraft is reduced by it. . . . That explains why the wing teardown airplane had only 6,700 hours instead of 8,000 hours the Air Force was aiming at, i.e., apparently the ALDCS had added 1,300 hours of life to a high time airplane, where it only came to be used late in life. On lower time aircraft, it would add significantly more life than 1,300 hours."

AF Comments. This is indeed a complicated matter, and these statements reflect (understandable) confusion about the meaning of the numbers they contain.

One of the tasks of SIEP was to recommend a practical individual aircraft tracking procedure which would yield equivalent hour information compatible with the fracture mechanics analysis techniques used to define the safety limit. Until that was accomplished (and it was accomplished under SIEP), each aircraft was tracked under the earlier system which yielded equivalent hour information compatible with "fatigue" methodology. The safety limit under the fatigue methodology had been 8,000 hours, and the then-current tracking system showed that the fatigue hours on the aircraft torn down for SIEP were very close to that limit. The teardown result indicated that the aircraft had, under the new (i.e., fracture mechanics) methodology, incurred 6,700 equivalent hours. A further result of SIEP was that the safety limit based on fracture mechanics was 7,100 hours. Hence, the aircraft was found to be within six percent of the new safety limit.

All actual flight data on other C–5 aircraft has since been reviewed under the new methodology. The new equivalent useage assigned to some aircraft is less than the old; however, that assigned to others is greater. On a force-wide basis, the effects of all these findings was to make the wing modification schedule a matter of more urgency; however, they did not require a revision in the overall timing of the modification.

The Air Force expected ALDCS to have a significant effect on wing life, and we are pleased that SIEP showed that effect to be even greater than we had anticipated. These ALDCS effects can be handled in a number of mathematically equivalent ways. As is acknowledged in the letter, we are accounting for them in the tracking program rather than by incorporating them into the safety limit figure. Since the number of hours which can be actually flown by the C–5 force is independent of the accounting system used, the choice of system was based on administrative considerations.

Dr. Paris. "Consequently, though the 7,100 hour number appears to indicate even less (remaining service life) than the old 8,000 hour number, if the actual effects of ALDCS were included, the 8,000 hour number has been raised in terms of actual equivalent flying hours for each airplane (in terms of the same basis as the 8,000 hour number, it is my own estimate that it might be as high as 12,000 to 14,000 hours)."

AF Comment. The term "actual equivalent flying hours" is confusing. The limit is expressed in equivalent flying hours—more precisely, representative mission profile (RMP) hours. If what is meant is that actual C–5 flight hours available (under current peacetime use) are greater than the number of RMP hours remaining, the Air Force agrees. The wing modification schedule and the restrictions we have placed on C–5 use take account of that fact (and also take account of the way in which ALDCS has affected the RMP/actual flying hour ratio).

If, on the other hand, this is a speculation that because of ALDCS 12–14,000 hours of RMP time might be achievable with the present wing, we cannot agree. The SIEP showed such speculation to be groundless.

Dr. Paris. Therefore, though it might casually appear otherwise, a firm basis exists for postulating a much longer service life in the C–5A fleet. . . .

AF Comment. Others involved, including many no less qualified that the letter's author, are satisfied that the long series of studies of the C–5 wing, culminating in the SIEP study and the SAB report, have provided an objective basis for the corrective action we are taking through the wing mod program. This is not just a majority view, but a unanimous (less one) conclusion, reached by people who demanded compelling evidence before reaching it. One of those individuals (Mr. Tiffany), after reading Dr. Paris' letter, reacted, in part, as follows:

"I think Paul is mixed up on several points in this letter. . . . I do not share the view that still another study should be performed. In spite of all the studies performed during the past 5–10 years, the safety limit has not significantly changed."

Dr. Paris. "As a member of the SIEP Steering Committee, I frequently asked whether the fuselage, empennage, etc., of the C–5A would last another 30,000 hours after wing modification. . . . A suggestion that it might be relevant to perform safety limit calculations consistent with those used to establish wing life was simply dismissed."

AF Comment. One can only surmise that a failure in communication is involved here since such non-wing safety-limit calculations were actually performed by SIEP, which had been directed to calculate safety limits for the fuselage and empennage on the same basis as those for the wing. This evaluation included a complete review of earlier C–5A fatigue test results and new material fracture properties testing.

Ninety-one potential problem areas on the fuselage and empennage were screened for reevaluation under SIEP, despite the fact that the empennage had earlier been successfully fatigue tested to four lifetimes and the fuselage had already successfully been through almost three lifetimes of pressurization cycles. Six critical points on the fuselage and three critical points on the empennage were then analyzed using the new fracture mechanics methodology. On this basis, the safety limit for non-wing structure was found to be 46,900 hours. The results were discussed at the final SIEP Steering Committee meeting and at the SAB review.

Dr. Paris. "In one day, the SAB members, no matter how eminent, could not examine the background of the data given at the briefings."

AF Comment. SAB members were chosen for their objectivity and their familiarity with the general subject matter. To allow proper preparation for the meeting, each SAB member was provided advance background material which included objectives, previous briefings, summary papers, task summaries, and relevant questions. The SAB meeting referred to was a two-day formal session; since Dr. Paris left before lunchtime on the first day, he missed, and apparently is unaware of, the full day of probing discussion that followed the day of presentations. Moreover, between the meeting in August and the report publication in November, individual SAB members applied additional effort to their task, generally at their own expense.

Biography of Hon. Hans M. Mark

Dr. Hans M. Mark became Secretary of the Air Force in July 1979. Prior to his appointment, Dr. Mark was Under Secretary of the Air Force.

Born on June 17, 1929, in Mannheim, Germany, Dr. Mark came to the United States in 1940 and became a U.S. citizen in 1945. He earned a bachelor of arts in physics at the University of California, Berkeley, in 1951 and his doctorate in physics in 1954 from the Massachusetts Institute of Technology.

Active in teaching since 1952, Dr. Mark taught courses in physics and engineering at Boston University, the Massachusetts Institute of Technology, the University of California at Berkeley and Davis, and Stanford University. Concurrently, he was active in research and held a number of administrative appointments. Following completion of his graduate studies, Dr. Mark remained at the Massachusetts Institute of Technology as a research associate and acting head of the Neutron Physics Group, Laboratory for Nuclear Science, until 1955. He then returned to the University of California as a research physicist at the Berkeley campus and at the Lawrence Radiation Laboratory in Livermore, where he served until 1958.

After two years (1958–1960) as an assistant professor of physics at the Massachusetts Institute of Technology, Dr. Mark returned to the Lawrence Radiation Laboratory in Livermore to continue physics research and to head the Laboratory's Experimental Physics Division (1960–1964). During that period he was an associate professor (1961–1966) and then professor of nuclear engineering (1966–1969) at the University of California's Berkeley campus. He served as chairman of the Department of Nuclear Engineering and administrator of the Berkeley Research Reactor from 1964 to 1969.

In 1969 Dr. Mark accepted the position of director of the Ames Research Center of the National Aeronautics and Space Administration. As director he managed the Center's research and applications efforts in aeronautics, space science, life science and space technology. He also continued his association with the academic community, first as a lecturer in applied science at the University of California, Davis campus, from 1969 to 1973 and since 1973 as a consulting professor of engineering at Stanford University.

Dr. Mark has also been a consultant to government, industry, and business. He served as a consultant for, among others, the Institute for Defense Analyses (1958–1961); the National Science Foundation (1966–1969); the U.S. Air Force Scientific Advisory Board (1969–1976); the Vice President of the United States (1974–1976); The President's Advisory Group on Science and Technology (1975–1976) and the Defense Science Board (since 1975).

Dr. Mark has written extensively; his articles have appeared in a number of professional and technical journals. He also coauthored a volume on "Experiments in Modern Physics," served as co-editor of "The Properties of Matter Under Unusual Conditions," and was a co-author of "Power and Security."

His major scientific accomplishments include contributions to the precise determination of the wave lengths of nuclear gamma rays, the development of X-ray astronomy, various fields of nuclear instrumentation and the development of more accurate atomic wave functions.

Dr. Mark is a member of Tau Beta Pi, Sigma Xi, Phi Beta Kappa and the National Academy of Engineering. He is a fellow of the American Physical Society and the American Institute of Aeronautics and Astronautics. He also belongs to a number of other professional associations including the American Nuclear Society, the American Geophysical Union, the American Association of University Professors and the Society for Engineering Sciences, of which he was a director from 1972 to 1976. Dr. Mark holds an honorary doctorate of science conferred in 1978 by Florida Institute of Technology.

Dr. Mark is married to the former Marion G. Thorpe. They have two children, Jane and Rufus.

Senator PROXMIRE. Thank you very much, Secretary Mark. You have certainly given us substantial information which we are grateful to you for getting. We plan to turn that over to the OTA for an independent assessment.

Before getting into that matter, I want to ask you about the other important issues raised in the letter I sent inviting your testimony. Have you considered the possibility that when this plane was built the wings were intentionally weakened and the life of the aircraft intentionally shortened? In other words, could the C–5A be a case of planned obsolescence?

Secretary MARK. Mr. Chairman, I have looked into that question. What we are facing here, sir, is a situation where the knowledge in this field—the field of fracture mechanics and aircraft structures—has progressed as time has passed. When the decision was made to use thinner wing planks for the lower wings, it was felt that the material chosen and the thickness selected would support the then-predicted lifetime.

It was discovered later on during the tests that were made on the aircraft early on that this was not the case, and——

Senator PROXMIRE. Let me just interrupt. Were there any studies done to support that belief?

Secretary MARK. I believe, sir, that the belief was based on what was then the best technical information available in the field of fracture mechanics.

Senator PROXMIRE. Any analysis? Any written studies of any kind?

Secretary MARK. Does any other gentleman at the table know that? Mr. Tiffany.

Mr. TIFFANY. Yes; as I understand it, the engineers at Lockheed did recognize that it would be an extremely difficult task to achieve this life goal with the high stress levels in the wing; in other words, with the thinner wing. However, they also introduced some other things like taper lock fasteners, which they thought would enhance the life of the airplane.

Senator PROXMIRE. Did Lockheed do any studies, or did the Air Force do any studies? Did they make any effort to analyze what the effect may be?

Mr. TIFFANY. They did do small specimen type testing, laboratory-type testing, with these fasteners, which gave some hope that perhaps the wing would make the 30,000 hours.

Senator PROXMIRE. Is that all they did?

Mr. TIFFANY. I don't know. I wasn't with Lockheed at that time.

Senator PROXMIRE. You don't know whether the study was made or not?

Secretary MARK. Mr. Chairman, let me provide that answer for the record.

Senator PROXMIRE. I would appreciate that. Any idea you can give us to indicate the basis on which they had made that reduction.

[The following information was subsequently supplied for the record:]

STUDIES AND BASIS FOR WEIGHT REMOVAL

Lockheed Georgia Co. has stated that their decision to reduce wing weight was supported by a program of specimen testing and analysis consistent with the time constraints imposed by the high degree of concurrency in the C-5 program. The Total Package Procedure Contract did not require Lockheed to furnish the government with reports of the studies on which this and other design decisions were made, and they did not furnish such reports. Under the contract, the government's means of validating the adequacy of the design was by seeing the results of actual test and evaluation, which became available subsequent to entry into the production process.

However, the Air Force C-5A Systems Program Office (SPO) could and did express concern about the design approach being taken by Lockheed. Early in 1967, a group formed at the Aeronautical Systems Division of the Air Force Systems Command conducted a technical review of engineering progress at the "75 percent Design Release Point." This group noted that the C-5A design was an extremely refined one, in which each element was required to perform very close to design limits. The group concluded, nevertheless, that no "break-through" in technology was required in order for the C-5A to successfully meet its performance specifications, and that there was a high probability that all range, payload and take-off requirements would be met.

Senator PROXMIRE. Do you know whether Lockheed engineers and management understood that reducing the weight of the wings by 10,000 pounds or more would shorten the service life by a factor of four or more?

Secretary MARK. Again, sir, I can't personally answer that question, but I can get a reply for you. Professor Mar has it——

Senator PROXMIRE. Mr. Mar.

Mr. MAR. Sir, Lockheed Co. realized that in order to get the performance required of the C-5A, they had to use higher stresses than they had ever used in any other airplane.

Now, to compensate for that, they were dependent upon improving the quality of fabrication as well as the use of the taper locks which Mr. Tiffany mentioned. The fatigue tests from 1969 through 1974 showed that their manufacturing did not pull up the quality as they had expected, and that the taper locks could not give them the desired improvement.

Senator PROXMIRE. In other words, they produced it with a lesser quality.

Mr. MAR. They were hoping for a better quality, and their manufacturing did not give them that quality.

Senator PROXMIRE. The result was actually, in fact, a poorer quality?

Mr. MAR. Yes—well, equal to what they had before, but not sufficient for the C-5A mission.

Senator PROXMIRE. Can you tell us how much gross weight was taken out of the wings by milling down the planks?

Mr. MAR. Well, if you compare a like airplane—the 747 is about the same gross weight as the C-5A—and the difference in wing weight is about 8,000 pounds. Now, I am not aware of extensive chemical milling. This is the first I've heard of that.

Mr. TIFFANY. I believe it was mechanically milled.

Senator PROXMIRE. Is there another way that the weight was thinned out?

Mr. MAR. They came up with a design, and the basic wing planks are made by purchasing extrusions and then these are milled by Avco, in which about 8 percent of the raw material is thrown away as chips.

Senator PROXMIRE. Lockheed informed our staff last Friday in Marietta that the wings were chemically milled.

Mr. MAR. I'm afraid I did not realize that.

Senator PROXMIRE. Can you state the period of time in which the weight was removed? How long did it take? Weeks? Months?

Mr. MAR. Oh, the design was changed in about 1967 or 1968, because the performance of the airplane was found to be lacking. At that time, Lockheed had to introduce a very drastic weight reduction program.

Senator PROXMIRE. I wonder, Mr. Secretary, if you can get this. I realize this is some time ago. You've been in the Air Force long after these things happened, but if you could determine these things for us, we would appreciate it very much.

Secretary MARK. May I have the question again, please, sir? I didn't quite get it.

Senator PROXMIRE. Yes; one is: Can you say how much gross weight was taken out of the wings by milling down the planks; and, second, can you state the period of time during which this weight was removed?

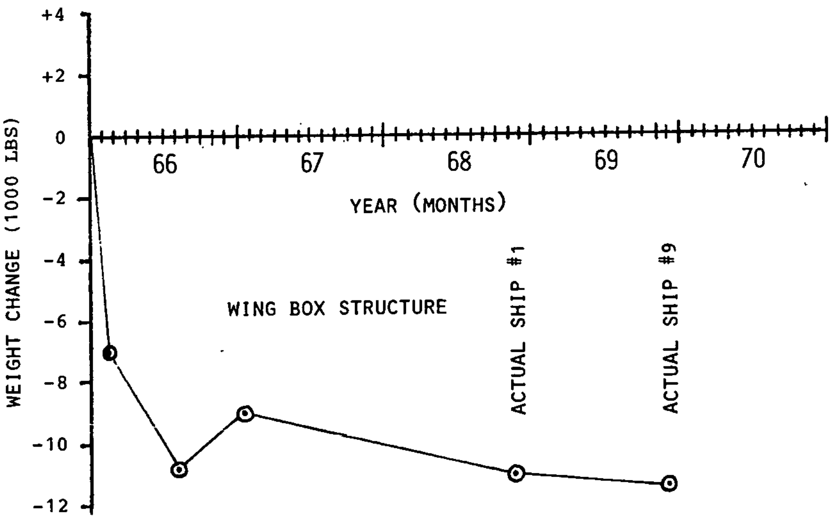
Secretary MARK. Yes, we can do that.

[The following information was subsequently supplied for the record:]

The weight decreases for the five wing structural boxes are shown on the accompanying chart. The majority of the reduction of nearly 11,000 pounds occurred within the first year of the contract.

C-5A WING WEIGHT CHANGES

- DEC 65 BASELINE -



SOURCE: LG1US54-1-1,-2-2

Senator PROXMIRE. How many Air Force employees were assigned in 1966–67 to administer the contract and monitor the C–5A program at the Lockheed plant at Marietta, Ga.? Also at the systems program office at Wright Patterson, and at the Pentagon.

It was a big program. We'd like to know how many were involved there.

Secretary MARK. I'll get you that answer for the record. I'm sure there were some hundred people or more involved. I can get you that for the record, though.

[The following information was subsequently supplied for the record:]

AIR FORCE MANNING FOR THE C–5A PROGRAM

An average of 150 Air Force employees were assigned to the C–5 SPO at Wright Patterson AFB, Ohio, in the 1966 to 1967 time frame. About 10 percent of these personnel were directly involved in the structural engineering aspects of the wing design.

During the same period, an average of 202 personnel were assigned to the AFPRO at Air Force Plant No. 6, where the C–130, C–141 and C–5 were built. The majority of these AFPRO personnel were then involved in C–141 and C–130 production line operations (throughout this period, Air Force Plant No. 6 activity on the C–5A included only engineering design and initial tooling manufacturing operations; assembly of the first prototype aircraft began in January 1967).

Manning in the office of primary responsibility at Air Force Headquarters in the Pentagon included 11 officers, one of whom devoted his full time to the C–5A program. Other officers within the Headquarters, e.g., Operations, Logistics, Plans, maintained cognizance of the program.

Senator PROXMIRE. Do you believe the Air Force knew or had reason to know during this period that thinning down the wing supports by 10,000 pounds or more would increase wing stress—in effect, weaken the wings and shorten the service life?

Secretary MARK. As I've already said, sir, the decision reached then was based on what I understand to be the best technical knowledge, and the feeling was, by carefully building the airplane, one could, in fact, preserve a service lifetime.

Senator PROXMIRE. Did the Air Force take any steps during that period to prevent Lockheed from weakening the wings, or protecting, or using a technique that would assure the strongest possible results?

Secretary MARK. I believe, sir, the Air Force took a position at the time that the contractor had to meet the payload and the landing field length specifications, and it was up to him to solve the problem.

Senator PROXMIRE. In your opinion, did the Air Force approve the decision to thin out the wing planks? Or did it express concern about the action while Lockheed continued taking weight out?

Secretary MARK. I believe the Air Force reviewed the decision. I am not sure that the contract at the time was written in such a way that approval was necessary. I have Mr. Harvey Gordon here. Harvey, do you remember how that happened?

Senator PROXMIRE. Will you identify yourself for the record?

Mr. GORDON. My name is Harvey Gordon. I am the Deputy for Acquisition in the Office of the Secretary.

Senator PROXMIRE. Let me ask you the question again, sir, so you will understand it. The question is: Did the Air Force approve the decision to thin out wing planks, or did it express concern about the action while Lockheed continued taking weight out?

Mr. GORDON. I can answer the first question. No; we did not approve the decision to lighten the weight.

Senator PROXMIRE. The second question is: Did it express concern about the action?

Mr. GORDON. I do not know, because that transpired prior to my presence in the Air Force.

Senator PROXMIRE. Mr. Secretary, my staff was told by the C-5 SPO office at Wright Patterson that Gen. Guy Townsend, who headed up that office in the 1965-67 period, wrote at least two letters to Lockheed in February 1967, expressing concern about the large amount of weight taken out of the wings. As recently as yesterday, the staff was assured copies of these letters would be made available to the subcommittee for this hearing. The Air Force gave us some materials this morning, but omitted the letters we requested and were promised.

Are you familiar with those letters?

Secretary MARK. No, sir. But I will certainly look and see if I can get them for you.

[The following information was subsequently supplied for the record:]

BRIG. GEN. GUY TOWNSEND LETTERS

The letters from General Townsend, the C-5A System Program Director, are provided as requested.

DEPARTMENT OF THE AIR FORCE,
HEADQUARTERS, AERONAUTICAL SYSTEMS DIVISION (AFSC),
Wright-Patterson Air Force Base, Ohio, January 5, 1967.

Subject: Briefings made to C-5A SPO personnel.
To: AFPRO.
In turn: Lockheed-Georgia Co.

1. Reference is made to briefings made to C-5A SPO representatives on 5 Dec 66 at the Lockheed-Georgia Company and at the C-5A SPO on 6 Dec 66 and 4 Jan 67.

2. The SPO wishes to express its appreciation for your highly informative briefings. However, there are a number of areas that we feel additional clarification is in order. One in particular that is of major concern is the weight problem since it affects so many performance elements. Mr. Gibson's portion of the presentation gave the impression that some of the initial C-5As would not fully meet the requirements of the contract, particularly in the area of guaranteed weight. These comments gravely concerned us and we would like to have additional information in this area, such as number of vehicles that may be affected, degree of degradation, etc.

3. Your attention is invited to Part XII of the contract (Correction of Deficiencies). Cat I & II test aircraft are to be refurbished to operational configuration prior to tendering to the Government for acceptance. We envision the task associated with taking out excess weight in the basic structure could be a problem of considerable magnitude.

We are therefore very much interested in your plans for refurbishing these aircraft so they will meet all the requirements of the contract. We are also concerned as to whether or not the initial 16 aircraft that are to be delivered to MAC are to meet all of the contractual requirements. In connection with these aircraft your attention is invited to Part XXXVIII of the contract (Liquidated Damages). This provision of the contract provides that in the event the contractor shall fail to deliver aircraft which are acceptable to the Government by the last day of the month in which each of said aircraft is scheduled for delivery, the contractor shall pay to the Government the amount of $12,000 for each day that delivery of each of said aircraft shall be delayed beyond the last day of the month in which each of the aircraft is scheduled for delivery. The Government's position in this regard can be essentially stated as follows. Where the contract sets the standard of performance on the basis of quality (contract specification requirements and guarantee) and time (schedule requirements) it cannot be said that the contract has been performed to, as to time, unless it has simultaneously been performed to as to required quality. Therefore, aircraft that do not meet all of the requirements of the contract cannot be considered acceptable for the purpose of meeting the provisions of the Liquidated Damages clause of the contract.

4. Although the comments set forth above are primarily directed toward a potential weight problem, it is not to be construed that we are not equally concerned about all of the requirements and guarantees provided for in the contract. In view thereof and in the interest of precluding a potential problem at the time the aircraft are presented to the Government for acceptance, your comments are clarification in the specific area referred to in paragraph 2 are requested.

GUY M. TOWNSEND, Col. USAF,
System Program Director,
C–5A System Program Office,
(For the Commander).

DEPARTMENT OF THE AIR FORCE,
HEADQUARTERS, AERONAUTICAL SYSTEMS DIVISION (AFSC),
Wright Patterson Air Force Base, Ohio, January 13, 1967.

Subject: Contract AF33(657)-15053, C–5A program; air vehicle performance requirements.
To: AFPRO.
In turn: Lockheed-Georgia Co.

1. Reference is made to C–54 SPO letter dated 5 January 1967, subject, "Briefings made to C–5A SPO Personnel."

2. Contractor personnel, in presenting C–5A program status on 4 January 1967, admitted to the possibility that certain performance requirements may not be met in the delivered air vehicles. On the basis of certain missions selected by the contractor, it was shown that some parameters, such as weight-empty, take-off distance, landing distance and initial cruise altitude, may fail to meet requirements because the contractor was having difficulty in achieving the target values of weight, lift and drag which he had established as necessary to provide the required performance. Contractor personnel also stated that range/payload performance was considered to be paramount, and that other performance parameters may be degraded in order to meet the range/payload requirements.

3. The contactor is reminded that all performance requirements for all contractual missions in the System Specification and Air Vehicle Specification are to be met. In those instances where one requirement is stated in combination with others, the interdependence of all the requirements in the combination must be considered in determining the value of each parameter.

4. It appears that the contractor has not put enough emphasis on the possible deficiencies in take-off, approach and landing performance. These can severely limit the range/payload productivity which might otherwise be achievable. The SPO has not observed a contractor sense of urgency or management emphasis in the airport performance area comparable to that in the weight control and cruise drag areas.

5. It is noted that the contractor's estimates of maximum lift coefficient in the take-off and landing configurations are below his target values. To date a model which reasonably simulates the total, current configuration has not been tasted in a wind tunnel. The contractor's current estimates of CLMAX are based on analysis of several tests of different components and configurations. The SPO is of the opinion that the contractor was too optimisitc in the consolidation and analysis of these data; and feels that additional analysis and test effort are required to substantiate the likelihood of adequate improvement in the high lift performance demonstrated thus far. For example, results of recent tests of flap design changes indicate a degradation of the lift coefficient achieved in other tests of the leading edge slat design. A possible explanation is that a change in circulation due to flap reconfiguration has "detuned" the slat-to-wing relationship. The SPO knows of no current contractor effort to investigate this possibility and determine the magnitude of the configuration changes required to "re-tune" the slat-wing combination. If anything more than minor modification to reposition the existing shapes is required, the probability of economically achieving the target lift coefficients on schedule will be significantly degraded.

6. In view of the C–5A procurement concept, which emphasizes complete compliance with all contractual requirements, including aerodynamic performance, in all air vehicles at the time of delivery, it behoves the contractor to address all areas where confidence that performance requirements will be met on schedule has not been rationally demonstrated. The advantages of applying an adequate quantity and quality of resources for this purpose should be obvious to the contractor, in view of the possible consequences should be the contract provisions not be met as were previously outlined in the referenced SPO letter.

7. It is requested that comments to this letter be included in your reply to the referenced SPO letter. Specific comments are desired regarding the program for determining the high lift capability and the planned alternate approach if the contractor's expressed hopes do not materialize.

GUY M. TOWNSEND, Col. USAF,
System Program Director,
C–5A System Program Office.

Secretary MARK. Let me say, sir, there is no question on my part that any documents of this kind you want, you can have.

Senator PROXMIRE. I want to make sure I understand that. Will you direct the SPO at Wright Patterson to provide copies of the letters to the committee?

Secretary MARK. Yes, sir.

Senator PROXMIRE. Thank you. Will you cooperate with the committee and permit the staff to examine the C–5A file at the SPO's office, or wherever the Air Force may have documentation of the C–5A program?

Secretary MARK. I believe we have done that.

Senator PROXMIRE. Well, the question, of course, is, Will you continue to be cooperative?

Secretary MARK. Sure.

Senator PROXMIRE. Can you explain why the Air Force is refusing to give us copies of General Townsend's correspondence?

Secretary MARK. I'm not sure we refused to give them to you formally.

Senator PROXMIRE. That's what our best information is. If the Air Force had no authority to prevent Lockheed from redesigning the plane and reducing the weight, the strength of the wings under the total package procurement type of contract then in force, what were all the Air Force employees with C–5A responsibilities doing at the Lockheed plant and at Wright Patterson and at the Pentagon?

Secretary MARK. Well, sir, I wasn't there, but I can tell you that the administration of a program of this kind is a complex matter, and I am sure that the manning questions that you ask can be answered.

Senator PROXMIRE. Of course I raise that because it seems to me that the critical point is getting a quality plane, and a plane that would stand up, a plane that wouldn't be weakened by changes in the design. It would seem to me that that would have an absolute top priority.

To your knowledge, has the Air Force ever investigated the C–5A program to determine the answers to these questions?

Secretary MARK. Mr. Chairman, there is one thing I know for certain, and that is that the C–5A program is the most investigated program around.

And I think that——

Senator PROXMIRE. Well, let me be a little more specific. Did they investigate the decision to take the weight out, and who was responsible for that?

Secretary MARK. Sure. You know, as I said in my testimony, Mr. Chairman, I am again looking at this thing from the point of view of someone who was in the business at the time, but not directly involved with this program.

I think the problem we have here is the result of decisions that were taken both by the Government and by the contractor. I know that in my own experience, when I have been confronted with a similar situation where a contractor cannot quite meet the specifications that he originally promised to meet, we have usually taken the course of negotiating a new set of specifications with the contractor.

This was not done here.

Senator PROXMIRE. Who was responsible? What Air Force official was responsible for committing them to do this?

Secretary MARK. I really don't know, sir. This was 15 years ago.

Senator PROXMIRE. Don't you agree it's important to know the answers?

For example, Robert Ormsby, who is now president of Lockheed Georgia, was an engineer during much of the history of the C-5A, and was vice president for engineering. Would you have approved awarding the contract to fix the wings to Lockheed if you knew it knowingly shortened the life of the plane by weakening the wings?

Secretary MARK. I don't think there's any evidence that Lockheed has knowingly shortened the life of the airplane.

Senator PROXMIRE. That's the question; that's what we want to know.

Secretary MARK. Yes; that's what I say, there's no evidence available to me that leds me to that conclusion.

Senator PROXMIRE. My time is up. I have a few more questions, but I will yield to Congressman Wylie.

Representative WYLIE. Thank you, Mr. Chairman.

Mr. Secretary, I have noticed that Mr. Holt Ashley of Stanford played a key part in much of the C-5 wing evaluations. Do you know if he's familiar with Mr. Paris' concern?

Secretary MARK. Yes, sir. I have had several conversations with Professor Ashley on this subject in the last month. Unfortunately, he's out of the country. He did write me a letter, which I would be very happy to submit to the subcommittee for the record.

Representative WYLIE. May I ask that letter be submitted for the record?

Senator PROXMIRE. Without objection, so ordered.

[The following information was subsequently supplied for the record:]

The letter from Mr. Ashley is provided as requested.

STANFORD UNIVERSITY,
DEPARTMENT OF AERONAUTICS AND ASTRONAUTICS,
Stanford, Calif., August 20, 1980.

Hon. HANS MARK,
Secretary of the Air Force,
The Pentagon, Washington, D.C.

DEAR HANS: During our telephone conversation on August 19th you requested me to write you concerning the decision to proceed immediately with the "H-Mod" structural improvement program for the C-5A wing and specifically to comment on a letter from Dr. Paul C. Paris to Senator William Proxmire, dated July 28, 1980, and proposing steps that would delay this vitally necessary program even further.

I do not believe it would be useful for me to discuss every point made in the Paris letter or to review for you the November 1979 Special Report of an S.A.B. Committee on the C–5A Structural Information Enhancement Program (of which I was chairman). The latter is a public document, as are the reports of literally dozens of earlier advisory groups which examined the C–5A structure. I was, incidentally, a member of at least five of these earlier groups, I chaired the S.A.B. Aerospace Vehicles Panel for several years, and I feel I know as much about this airplane as nearly anyone who did not work at Lockheed Georgia Co., during its development.

In my judgment the facts which override any minor differences of opinion on technical issues are the nation's obvious need for long-range airlift capacity in the next 20 years, the central role of the C–5A force in supplying that capacity, and the conviction of military leaders that a safe operating lifetime of 30,000 hours is required of every airplane in that force. It would appear that we have enough experience with both large military and commercial vehicles to know they are quite likely to be flown a great deal longer than original estimates. In the face of these facts, it seems relatively inconsequential to me whether the safe structural or "rogue flaw" limit on the C–5A inner wing panels is 7,100 representative-mission-profile (RMP) hours, or 8,160 RMP hours (the 1977 USAF and Lockheed estimates), or the 12,000 to 14,000 hours that "it might be as high as" according to Dr. Paris' letter. Incidentally, I recall a figure of 10–12,000 hours from the RAND Report.

In my view the 1979 S.A.B. Report's conclusion that "a firm commitment . . . to the Wing Modification Program can be delayed no longer" is more valid today than it was a year ago. Section II of that report lays out the key circumstances quite effectively. Once it has become obvious that a step like this is necessary—and quite independently of political considerations or recriminations about past mistakes of others (we all make mistakes)—the only consequence of further delay is that the cost goes up.

Minor disagreements about technical matters are a fact of engineering life. The ones we are faced with here relate to the discipline of fracture mechanics, which is even today a notoriously inexact one compared to most other structural design methodologies although a great improvement over classical fatigue methods, where the military services traditionally applied a "scatter factor" of four to life estimates as a margin for error. Over a period of years, the Lockheed and Aeronautical Systems Division procedures by which the C–5A rogue flaw limit was calculated received very careful scrutiny by numerous review groups, of which the Independent Review Team, and the Steering Committee of the S.I.E.P. (referred to by Dr. Paris) are just good examples. The 7,100 RMP hour figure reported in 1979 was obtained from minor changes to a Lockheed methodology well understood by everyone on my committee. These changes related mainly to the introduction of additional test data, and they were fully explained at our August 13–14 meeting.

Dr. Paris refers briefly to the teardown inspection of one wing from high-time airplane 680214, whose results were also described at the 1979 meeting. He failed to mention that the key structural elements were independently examined by teams from USAF Flight Dynamics Laboratory, from Southwest Research Institute and from Lockheed. With no disagreements among anyone involved, Lockheed reported the discovery of 1243 verified cracks in this one specimen. 838 of these cracks were judged to show significant signs of growth. These findings were definitely consistent with the 7,100 RMP hour safe-life estimate and were perhaps the most compelling factor in the committee's endorsement of the Mod-H program.

If things like this bothered me, I would be most disturbed by Dr. Paris' statements about "bias in judgment" on the part of Air Force advisors. No informed individual is completely free of bias. But I know of no airplane structure that has been more thoroughly examined than the C–5A wing by groups made up of experts from differing backgrounds and organizations. Not only do biases tend to be revealed by the interplay that occurs in such activities, but it is remarkable how weaknesses or technical errors in the work of a manufacturer are pinpointed by the hard questioning that goes on. No one would challenge the fracture mechanics expertise of Dr. Paris. That field is certainly not a specialty of mine, although my experience in aeronautical structures and structural dynamics goes back quite a few years. On the other hand. Mr. Charles F. Tiffany of Boeing Wichita, who was on my committee and most prior C–5A review groups, was more responsible than any other person in the world for the effective introduction of fracture mechanics into the design of military aircraft for repeated loads. He is one of the most tough-minded, independent engineers I ever met; I recommend him to you as an outstandingly well-informed advisor on these issues. Like myself, he is another person deeply involved with them "whose livelihood does not depend on Lockheed or USAF sources."

Finally, it is worth recalling that Dr. Paris was an invited participant at the August 13–14, 1979, committee meetings. As chairman, I personally requested that he regard himself just like a regular member and ask questions at any time. His questioning most certainly would not have disrupted our proceedings but would have been very helpful to us. Instead, he chose to walk out early on the first day and refused to reply to efforts at contacting him in his hotel and the Atlanta airport. This behavior looks to me like that of a disgruntled individual who resents having others disagree with him, and I must say the timing and tone of his letter to Senator Proxmire tend to reinforce that judgment.

With my warmest personal regards, let me ask you to call on me for any other assistance I can give consistent with my August 23 to October 11 trip to Bangalore and Göttingen.

Cordially yours,

HOLT ASHLEY,
Professor, Departments of Aeronautics/Astronautics and Mechanical Engineering.

Representative WYLIE. What alternative system or backup planning, if any, does the Air Force have for meeting our needs for an airlift for NATO contingencies if we don't go ahead with the C–5 repair program?

Secretary MARK. Mr. Wylie, the Air Force has no other airplane that can do what the C–5 can do. And as I have already said, it is precisely the possibility that we may have to use this airplane under conditions that are very much harsher than we fly it today that gives me the sense of urgency to proceed with the wing modification program.

Representative WYLIE. According to testimony which was developed at our last hearing from Mr. Paris, a consultant who has worked for both the Air Force and the Rand Corp., the Rand report indicates many of the options for repairing the C–5 are less than half of the cost that the Air Force is asking for repair.

Are you persuaded that these options have been fully explored?

Secretary MARK. Mr. Wylie, I have studied the Rand report and looked at the other options. There are two considerations in answering your question. One is that the other option, which is essentially to keep the same planks but to drill out the holes so that one gets rid of the cracks, has been considered. We made an estimate of the number of holes we would have to drill out. We looked at the possible savings. Our basic conclusion was that we probably would have to drill out so many holes that the cost of taking the airplane apart and putting it together again and retesting it and rechecking would be roughly equivalent to replacing the planks with new ones, which is what the H modification really is.

So one argument was that it was not at all clear to us that the cost would really be very much smaller. More important, perhaps, is the fact that if you took that method to fix the airplanes, you would not fix the fundamental problem, which is the boost planks are too thin. And those two reasons, sir, were the reasons why we elected to go with what is called the H modification program.

Representative WYLIE. It has been suggested that we should re-review this modification and re-evaluate it. How long would a review of the C–5 evaluation take to be truly meaningful?

Secretary MARK. Well, as I said in my testimony, sir, I believe that a meaningful study at the same depth as the ones that have been conducted previously—and by that I mean a review of the data taken during the teardown and so on—I would say from beginning to end it would take about 2 years.

Representative WYLIE. Yes; you did say that in your testimony.

Now, looking at your time chart up there, you say we have only 5 or 6 years of flying time left if we don't modify the wing, is that right?

Secretary MARK. Mr. Wylie, sir, flying time under the current operating conditions; that is, under benign peacetime operating conditions.

Representative WYLIE. And if we did get into a military conflict, the flying time would be much less?

Secretary MARK. We would have approximately 1 year of service left on the airplanes if we operate them under the conditions we foresee in a military contingency.

Representative WYLIE. Now, I have a real concern about this, and I know this may be a leading question as far as you are concerned. But can our Nation really stand such a decrease in capability right now?

Secretary MARK. I don't think so, sir. I think that the threat of the decrease in capability, the threat that we may have to ground a large fraction of the C–5 force in the event of a military contingency is sufficiently serious that I consider it to be intolerable.

Representative WYLIE. What if we stop funding the repair program during the review?

Secretary MARK. Well, if you had to stop funding it during a review, then in 2 years we would accumulate another 1,500 or so flying hours under current conditions, so you would go further up on that chart. And then you see, if in 2 years we elected to go ahead with the wing modification and at the same time had a contingency in 2 years, we would have to ground the C–5 fleet. It would not be useful during a contingency.

Representative WYLIE. What is wrong with going ahead with the work while a review is underway?

Secretary MARK. Sir, as I have said, I have no control over a review that might be initiated by the Office of Technology Assessment, and I would state again that I don't think anything different would be learned out of a new review. But the one thing I know with absolute certainty is that we should not stop the wing modification while such a review is conducted.

Representative WYLIE. Is it fair to say, Mr. Secretary, that your advisers on the C–5 wing life came up with answers that you would have preferred not to hear?

Secretary MARK. That, sir, is a fair statement. It would certainly be very much better both for the Air Force and for the country if the original estimates made by the engineers who designed the C–5 were correct.

Representative WYLIE. And their conclusion was that the wing life was limited and that the wing has to be fixed?

Secretary MARK. That's right.

Representative WYLIE. Now, Mr. Tiffany, Mr. Paris told us last week that there was an instance of a key Air Force man who was being misled by data which were developed during SIEP. Do you have any reason to believe that that might be the fact?

Mr. TIFFANY. No; I have no evidence that they have been misled. I've got upset numerous times with Lockheed during the course of the past 10 years. I have no evidence, no reason to believe that they intentionally withheld any information from me or gave me false information. To the best of my knowledge, I've never transmitted any bad information within the Air Force or the Department of Defense.

Representative WYLIE. Were you here when Mr. Paris was testifying last week?

Mr. TIFFANY. No; I was not. I have read his testimony.

Representative WYLIE. You have read his testimony and he did refer to you as having been misled.

Mr. TIFFANY. I don't feel I have been misled.

Representative WYLIE. You don't feel you've been misled.

Based on the SIEP data, did they recommend grounding the C–5 at the present time or at a later date?

Mr. TIFFANY. I'm not sure I understand the question.

Representative WYLIE. I was trying to develop this for Mr. Paris. He recommended that the C–5 be grounded immediately. Then he said he did not recommend that the C–5 be grounded, and the SIEP data didn't recommend that the airplane be grounded either. Now, did the SIEP data recommend that the airplane be grounded?

Mr. TIFFANY. No; it did not.

Representative WYLIE. And therefore it recommended that we would have to go ahead with the repairs on it, and it did not recommend that the C–5 be grounded at a later date either, did it?

Mr. TIFFANY. No; it did not.

[The following note of clarification on the above response was subsequently supplied for the record:]

As aircraft attained the SIEP safety limit (7,100 hours), it does imply corrective actions would be required and these actions could include grounding.

Representative WYLIE. OK. Do you feel that there was adequate supervision of Lockheed during the SIEP review or the SIEP effort?

Mr. TIFFANY. Yes; I feel so. We assigned Mr. Wood full time at the Lockheed plant to supervise the activities as the technical director from the Air Force. And I have a lot of respect for Howard. He digs into all the problems down there, and I think he did.

Representative WYLIE. Mr. Secretary, according to calculations which were presented at our last hearing by Mr. Paris, if the airplane were flown according to its original design missions, it would last less than 30,000 hours. Now, as I understand it, that mission requirement has been relaxed, giving the plane a somewhat longer life expectancy. And you did testify to that in your testimony.

Secretary MARK. Yes, sir.

Representative WYLIE. But even after taking this into consideration, don't you think, in light of the plane's 30,000-hour design goal, that the taxpayer has been a partner to a very poor deal?

Secretary MARK. Mr. Wylie, I am a taxpayer myself. So I worry about the kind of deals that the Government makes. We tired to do something when we built the C–5 that was a major technical step. The C–5 at the time it was designed was the largest airplane ever built—by a factor of two. It was the first to use high bypass ratio fan engines. It was a risky proposition.

I think what happened, sir, is that neither the Government nor the contractor really understood how risky the technical factors really were, and I'm saying that now with 20–20 hindsight, so it's easy for me to say. But in terms of the capability that the Nation was given by the existence of these airplanes for airlift overseas, the taxpayer got an excellent deal.

In terms of the technical troubles that were introduced by a series of decisions with which we are all familiar, there has been a problem, and the taxpayer was perhaps not told in the beginning how much it would really cost to introduce this new technology because none of us really knew. I think we were overoptimistic.

Representative WYLIE. Thank you very much, Mr. Chairman.

Senator PROXMIRE. Secretary Mark, how do you justify awarding sole-source R. & D. contracts to Lockheed, making it virtually impossible for other firms to bid on the wing repairs, and then on top of that awarding the production contract to Lockheed to fix its own mistake?

Secretary MARK. I think the award of the sole-source R. & D. contract, Mr. Chairman, was based essentially on the consideration that, to get a rapid and accurate answer, one had to go to the manufacturer.

Senator PROXMIRE. That locks the Air Force into a production contract.

Secretary MARK. No, sir. I should add that the R. & D. contract, I think, was awarded with no fee, if I remember correctly, or at least a very small fee, anticipating that perhaps this would become a question.

Senator PROXMIRE. Wouldn't that make it impossible for other firms to bid in the future on the production?

Secretary MARK. No, sir, not necessarily. I have in the past in my own experience, for example, had one aerospace firm do an R. & D. contract, then another one do the production.

Senator PROXMIRE. Well, A, the other firms didn't bid; and, B, that's why they said they didn't bid.

Secretary MARK. I believe, sir—and I know in fact—that solicitations were made of other firms.

Senator PROXMIRE. And what bids did you get from those?

Secretary MARK. We got no other bids.

Senator PROXMIRE. None?

Secretary MARK. That is correct in this case. I can give you examples, sir, if you will, of cases where one firm did an R. & D. contract, and then another one got the contract. That is not an unusual event.

Senator PROXMIRE. In this case, the R. & D. was given to Lockheed and the other firms felt they were locked out.

Secretary MARK. No, sir; we had no prior knowledge——

Senator PROXMIRE. That's what they said.

Secretary MARK [continuing]. That the other firms said they were locked out when we gave the R. & D. contract to Lockheed.

Senator PROXMIRE. How do you justify giving Lockheed $140 million in profits on the wing-repair contract, their own mistake? They made the mistake. Then they made $140 million out of their mistake.

Secretary MARK. Well, sir, let me first of all say that it is yet to be determined that they will make $140 million. Because in order to do that they must perform the wing modification according to the specifications that we have given them. If they fail to do that, they won't make the profit.

Now let me talk about the considerations that went into drawing up the production contract the way we did. The wing modification program was subject to intense scrutiny in the systems command and in the Air Force secretariat. And after a series of discussions, it was decided that the best approach would be to devise a contract that had two important provisions in it, so that we could be more certain of the costs than we normally are.

One was that we restructured the usual inflationary escalation clauses, so that one couldn't play games with those numbers; and the other was that we asked the contractor to guarantee that he would fix any and all things that went wrong during the test program. It was decided that if the contractor would be willing to accept these risks——

Senator PROXMIRE. That was only during the test program. If they failed after the test program, what——

Secretary MARK. No, sir. It is the production contract that has these features in it.

Senator PROXMIRE. I misunderstood you, then. I thought you said during the test program.

Secretary MARK. No, sir. I'm talking about the production contract. And the fee was determined because the contractor was willing to accept these risks.

[The following expanded remarks on the above response were subsequently supplied for the record:]

What I was referring to was the connection between the test program and the production contract. The test program is designed to discover deficiencies and develop any necessary design fixes. Lockheed is required to incorporate into the modified aircraft all design changes shown to be necessary during the first 45,000 hours of experience with the test article, as well as any found to be necessary during tht first 1,000 hours of the flight test aircraft's history, and the first 5,000 hours accumulated by the group of modified aircraft we receive back during the first year of deliveries.

Senator PROXMIRE. Now, what's the current cost estimate to fix the wings under the H-mod. plan?

Secretary MARK. About $1.4 billion.

Senator PROXMIRE. That includes the amount already spent on R. & D.?

Secretary MARK. I do not know. I'm not exactly sure.

Senator PROXMIRE. What was the amount again?

Secretary MARK. The R. & D. contract, I think, was $30 or $40 million. I'm not sure of that.

Senator PROXMIRE. $1.4 billion, and you're not sure whether——

Secretary MARK. $1.4 billion is the production contract. I think the R. & D. contract was very small compared to that, $30 or $40 million.

Senator PROXMIRE. For the record, would you find out what the total figure is?

Secretary MARK. Yes; I will.

[The following information was subsequently supplied for the record:]

TOTAL FIGURES FOR THE C–5A WING MODIFICATION PROGRAM

The basic RDT&E contract for the design phase with Lockheed-Georgia Co. has a negotiated price of $37.2 million. This value excludes a projected underrun of $3.6 million. A test and evaluation phase which was an option to the basic contract was exercised in 1977 which has a negotiated price of $108 million. The total value of both phases of the RDT&E contract is $145.2 million. It extends from design initiation in 1975 through completion of all testing in 1985. In addition to the design and test efforts, this contract resulted in the fabrication and installation of new wing structural components on one C–5 aircraft.

The basic production contract with Lockheed-Georgia Co. was consummated in July 1980 with a negotiated price of $1,240 million. This is a Fixed-Price-Incentive-Firm contract with a 50/50 share line, 120 percent ceiling and a 13.8 percent profit. The contract covers the fabrication and installation of the remaining 76 sets of new wings. The contract extends through 1987.

The total value of the C–5A wing modification program contracts with Lockheed-Georgia Co., is $1,385.2 million. The total Air Force funding requirements, which include allowances for other government costs, engineering change proposals, spares, etc., are estimated at $1,507.6 million. This amount covers the full term of the program from fiscal year 1976 through fiscal year 1987.

Senator PROXMIRE. What assurance does the taxpayer have that if the new wings fail to last 30,000 hours, the Government will not spend additional amounts to fix them? Is it correct that Lockheed has guaranteed the performance of the production models for only the first 5,000 hours of use?

Secretary MARK. I'm not sure of the provision. Harvey, do you know the answer?

What is the actual specific guarantee?

Mr. GORDON. The specific guarantee in the production contract by Lockheed is 45,000 hours.

Secretary MARK. 45,000 hours.

Senator PROXMIRE. If they failed at any time short of that, then what's the Government's recourse? Lockheed would fix them for free?

Mr. GORDON. Any defect [inaudible], Lockheed would retrofit a modification, and the modification kits and the installation within the existing contract prices. Also, for each aircraft which is delivered after the completion of a flight test program, the guarantee extends for 12 months with respect to each individual aircraft that is designed with manufacturing defects.

Senator PROXMIRE. Well, then, it's a 12-month guarantee? It's only a 12-month guarantee? That's less than Chrysler.

Mr. GORDON. The 12-month guarantee covers all defects on delivered aircraft. The 45,000 hours applies to design deficiencies in the structure of the aircraft.

Senator PROXMIRE. That means 45,000 hours of actual flying, is that right?

Mr. GORDON. 45,000 hours on the airframe for structural defects.

Senator PROXMIRE. Actual flight of each wing?

Mr. GORDON. Yes, sir.

[The following expanded remarks on the above response were subsequently supplied for the record:]

The intent of the warranty provisions is on keeping things from going wrong. The warranties in the modification contracts are of two different types, one on the basic design and the other on the contractor's adherence to that design and to quality manufacture throughout the program. The second of these points is addressed by the 12-month warranty I mentioned, which gives us a full year after delivery of each aircraft to turn up any quality discrepencies which might create a problem for that particular aircraft. With regard to the basic design—which affects all the aircraft—a different warranty applies. At 12 hours per day, flight testing the wing for 45,000 hours would take roughly 10 years. That makes the ground test program most important, since our objective is to uncover and to get Lockheed to correct any design discrepencies just as soon as possible. Under that program, a wing we call the "test article" is cycled repeatedly through stresses equivalent to those it would experience in flight, but at greatly accelerated rates. It was just this kind of testing that gave the early indications of the problems with the original wing, and this is the standard way in which the lifetimes of new aircraft structures are demonstrated. Under its design warranty, Lockheed must correct on its modification kits, as well as on any aircraft already modified, any discrepency in design which the first 45,000 hours of this test show to be necessary. Since the test has passed its 40,000th hour with no major design discrepencies turning up, we have a lot of confidence in the design. Nevertheless, there are also similar warranties that cover any design problems we find during the ongoing flight test program and during the first year of operations with modified aircraft—roughly 6,000 flying hours in all. Financial arrangements depend on the type of discrepency and on where in the program it appears but, generally speaking, corrective action under these warranties would reduce Lockheed's profit.

Senator PROXMIRE. Will you send us copies of that guarantee, so we can have those copies?

Mr. GORDON. Send you copies of the contract provision?

Senator PROXMIRE. That's correct.

[The following information was subsequently supplied for the record:]

Copies of the six contract provisions that apply to warranty coverage are provided as requested. The Special Provisions with the "J" designator are part of the RDT&E contract (F33657-75-C-0178) and the Special Provisions with the "H" designator are part of the Production contract (F33657-80-C-0001).

J-17 CORRECTION OF DEFICIENCIES

The Contractor's sole obligation regarding correction of deficiencies revealed in the performance of the 45,000 cyclic test hours (CTH) of fatigue testing required by Item 0012 hereof, shall be as provided herein. General Provision A-5, entitled "Inspection of Supplies and Correction of Defects" shall not be applicable to said Item 0012 effort. The Contractor shall have no other correction of deficiency obligation in regard to any other aspect of the fatigue testing required under Item 0012.

a. *Definitions*

Notwithstanding anything to the contrary in this contract, the following definitions shall be controlling:

(1) "Deficiency—0 through 30,000 CTH." During the performance of the first 30,000 cyclic test hours of the fatigue test program conducted under Item 0012 hereof, a "deficiency" means and is limited to: (1) a crack detected by visual means in the redesigned wing boxes; and (2) the said crack requires corrective action as determined by the evaluation contained in paragraph 3.4.3.1 of the Statement of Work as amended (also referred to as Attachment Nr. 7), in order

that (a) the affected principal structural element(s) will sustain its share of limit static load times 150% at the completion of the first 30,000 cyclic test hours; and (b) the wing box will meet functional requirements as defined below; and (3) notification of which, in either case ((a) or (b)), is provided by the Government or the Contractor within the period specified in paragraph b. (2) below. This definition of deficiency shall not affect or be affected by the inspection program defined in Volume IV of LG78BR0216, C–5 Structural Test Plan, X991 Wing Fatigue Test, dated 1 Nov 1979.

(2) "Deficiency—30,001 through 45,000 CTH." During the performance of the 30,001 to 45,000 cyclic test hours of the fatigue test program conducted under Item 0012 hereof, a "deficiency" means and is limited to: (1) a crack detected by visual means in the redesigned wing boxes; and (2) the said crack requires corrective action as determined by the evaluation contained in paragraph 3.4.3.1 of the Statement of Work, as amended (also referred to as Attachment Nr. 7) in order for the wing box to sustain limit static load at the completion of 60,000 CTH; and (3) notification of which is provided by either the Government or the Contractor within the period specified in paragraph b. (2) below. This definition of deficiency shall not affect or be affected by the inspection program defined in Volume IV of LG78BR0216 C–5 Structural Test Plan, X991 Wing Fatigue Test, dated 1 Nov 79.

(3) "Functional Requirements" means that there shall be no crack of sufficient length in the wing boxes that would result in the leakage of fuel through the exterior surface of the wing boxes.

(4) "Principal Structural Element" means any member of the wing boxes, identified by the Wing Modification Drawing System (as assembled under Top Kit Drawing 4W09000), as Category 1 or Category 2 structure.

(5) "Visual" means apparent to the human eye using a proper light source but without the use of any supplemental aids or devices, except that for sandwiched structure it may be supplemented with X-ray.

(6) "Correction" means any and all action necessary to eliminate any and all deficiencies in the test articles including investigative effort, design of the correction for the test articles, unscheduled strain surveys, component testing, and all design and engineering effort required to properly define fleet production and retrofit kits and revision to all affected data; provided, however, that Contractor's obligation hereunder shall not extend to those supplies and services furnished, or to be furnished, under other contracts, including those contemplated by Special Provisions J–20 and J–21 hereof.

b. *General*

(1) Except as provided herein, the rights and remedies of the Government provided in this clause:

(a) Shall not be affected in any way by any other provision under this contract concerning the conclusiveness of inspection and acceptance; and

(b) are in addition to and do not limit any rights afforded to the Government by any other clause of this contract.

(2) This clause shall apply only to those deficiencies, the notification of which shall be provided by either the Government or the Contractor within the time frame commencing with the start of cyclic testing and ending with 45,000 CTH, or 16 July 1981, or Government termination of cyclic testing, whichever occurs first, and in accordance with the notification procedures in paragraph c. below. Failure of the Government to comply with said notification procedures as regards a particular deficiency detected by the Government shall terminate any obligations on the part of Contractor under this contract with respect to such deficiency and the results thereof.

(3) The Contractor shall not be responsible under this clause for the correction of deficiencies in Government furnished property, except for deficiencies in installation, unless the contractor is obligated under this contract to perform any modifications or other work on such property. In that event, the contractor shall be responsible for correction of deficiencies to the extent of such modications or other work. All Government property selected by the Contractor for incorporation in the fabrication of the center, inner or outer wing boxes under this contract which was procured by the Government from the Contractor under another contract or contracts (including but not limited to Contract F33657–74–C–0214) shall not be considered Government furnished property for the purposes of this paragraph (3), and the Contractor shall be responsible for correction of "deficiencies" in such property.

(4) In the event the Government elects to terminate the fatigue testing, as a result of a deficiency at or subsequent to the accomplishment of 45,001 CTH, it shall be for the convenience of the Government without limiting the rights of the parties regarding termination during the period from 0–45,000 CTH of fatigue testing.

c. Deficiencies

(1) Notification Procedure and Recommendation for Correction. If the Contracting Officer determines that a deficiency exists in any of the center, inner, or outer wing box kits, whether or not accepted by the Government under the contract, he shall promptly notify the Contractor of the deficiency in writing, within fifteen (15) calendar days of discovery of such deficiency, but in any event within the period specified in paragraph b.(2) above. Upon timely notification of the existence of such a deficiency, the Contractor shall promptly conduct a preliminary investigation and submit, in writing, to the Contracting Officer his recommendation for corrective actions, together with supporting information in sufficient detail for the Contracting Officers to determine what corrective action, if any, shall be undertaken. If the Contractor independently determines a deficiency exists, the Contracts Organization shall notify the Government (office of C–5 Project Engineer and the office of C–5 Project Manager) by phone within one working day, with written notice to be submitted to the above Contracting Officers by telecopier transmission within three working days and promptly thereafter the Contractor shall conduct a perliminary investigation and submit in writing, to the said Contracting Officers, his recommendation for corrective actions, together with supporting information in sufficient detail for the said Contracting Officers to determine what corrective action, if any, shall be undertaken. For deficiencies detected during the period 30,001 through 45,000 CTH, such information shall include the estimated cost of such recommended corrective action. Notice by either party shall be by separate identifiable communication entitled "Notice of Deficiency" and such writing must pertain exlusively to the deficiency. No other method or form of notice from one party to the other of a deficiency under this clause shall be binding on the parties.

(2) Direction to Contractor Concerning Correction of Deficiencies Within thirty (30) calendar days after receipt of the Contractor's recommendations for corrective action and supporting information, the aforesaid Contracting Officers shall give the Contractor written direction, as provided hereinafter, not to correct, to correct, or partially correct said deficiency which direction shall not be inconsistent as regards impact on the configuration of the aircraft, within a reasonable time at the Contractor's facility. Failure to provide such written direction within the thirty (30 days shall constitute a waiver of any rights in respect of such deficiency, and the consequences thereof, under both contracts and Contractor shall be relieved of any obligations in respect thereto.

(3) Correction of Deficiencies by Contractor.

The Contractor shall promptly comply with any timely written direction by the Contracting Officers to correct or partially correct a deficiency as follows:

(a) Deficiencies During 0–30,000 CTH or Period Ending 6 October 1980.

For the purposes of this paragraph, this period shall end with the completion of 30,000 CTH or 6 October 1980, whichever occurs first. The Contracting Officer shall provide written direction regarding correction, at no increase in fixed fee for the CPFF portion of this contract and at no increase in fee amounts for the CPIF portion of this contract, provided, however, the target cost (but not the target fee) of the CPIF portion of this contract shall be increased only by the amount of "standby costs" (defined in Attachment Mr. 10 thereto), if any, associated with the correction of a deficiency.

(b) Deficiencies During 30,001 to 45,000 CTH or Period Ending 16 July 1981.

For the purposes of this paragraph, this period begins with 30,001 CTH or 7 October 1980, whichever is earlier, and ends with completion of 45,000 CTH, or 16 July 1981, or Government termination of the fatigue testing, whichever occurs first. Contract adjustments for correction of deficiencies shall be in accordance with Special Provision J–2(c) hereof.

(c) All other costs and procedures associated with the incorporation of the redesign into the modified aircraft or aircraft to be modified under Contract F33657–80–C–0001 and other supplies and services required thereunder shall be treated in accordance with Special Provision H–43 thereof.

(4) Modification of Contract with Respect to Any Uncorrected Deficiencies. In the event of timely notice of a decision not to correct or only to partially correct, the Contractor shall promptly submit a technical proposal to amend the contract to permit acceptance of the affected supplies or services in accordance with the revised requirements; provided, however, the Government shall not be entitled to any adjustment of target cost and fee amounts of this contract or Contract F33657–80–C–0001 as a result thereof.

d. *Extension in time for performance*

(1) During the First 30,000 CTH of Fatigue Testing or Period Ending 6 October 1980.

In no event shall the Government be responsible for extensions or delays in the scheduled deliveries or period of performance under this contract as a result of the Contractor's obligations to correct deficiencies during the performance of the first 30,000 CTH or until 6 October 1980 (whichever is earlier) nor shall there be any adjustment of the delivery schedule or period of performance as a result of such correction of deficiencies, except as may be agreed to by the Government in a supplemental agreement.

(2) During the period 30,001 through 45,000 CTH of Fatigue Testing or Period Ending 16 July 1981,

The contract modification issued by the Contracting Officer regarding correction during the period 30,001 through 45,000 CTH of fatigue testing or 16 July 1981 (whichever is earlier) shall provide for a mutually acceptable schedule adjustment.

e. *Failure to correct*

If the Contractor fails to proceed with reasonable promptness to correct deficiencies under this contract, the Government (1) may by contract, or otherwise, correct such deficiencies and charge to the Contractor any increased cost occasioned the Government thereby, or may reduce any incentive fee payable under this contract (or require repayment of any incentive fee theretofore paid) in such amount as may be equitable under the circumstances, or (2) may terminate this contract for default as provided in the clause of this contract entitled "Termination." Failure to agree to the amount of any such increased cost to be charged to the Contractor or to such reduction in or repayment of the incentive fee, or adjustments pursuant to the "Termination" clause shall be a dispute within the meaning of the clause of this contract entitled "Disputes."

f. *Correction of deficient replacements and reperformance*

Any supplies or parts thereof corrected or furnished in replacement and any services reperformed pursuant to this clause shall also be subject to all the provisions of the clause to the same extent as supplies or services initially provided or performed; provided, however, that unless otherwise mutually agreed to, Contractor shall not be obligated to reperform any testing of any such supplies or parts thereof and any services.

g. *Allowability and allocation of costs*

Allowable costs for correction of deficiencies shall be allocated to the line item of this contract under which the supplies or services being corrected were initially supplied or were to be supplied (e.g., redesign effort would be allocated to Item 0001). The allowability of costs incurred hereunder shall be determined as provided in the General Provisions hereof entitled "Allowable Cost, Fixed Fee and Payment" and "Allowable Cost, Incentive Fee and Payment." Also refer to paragraph c.(3)(c) hereof for treatment of other costs.

h. *Consequential damages and exclusion of warranties*

In no event shall the Contractor be liable for any consequential damages resulting from "deficiencies," and it is agreed that there are no warranties, express or implied, including, without limitation, any implied warranties of merchantability and "fitness for a particular purpose."

J–19—Flight Test Aircraft Warranty

The parties understand and agree that Contractor's sole obligations regarding defects discovered in the modification of the flight test aircraft, within the scope of the wing modification program, shall be provided in General Provision A–5 as implemented herein.

a. The period if time specified in paragraph (b) of said General Provision is changed from "6 months" to "twelve (12) months" which shall be calculated from the date of the DD–250 evidencing the Government's acceptance of the deinstrumented flight test aircraft pursuant to Contract Line Item No. 0010 or accumulation of 1000 total flight hours by the test aircraft (including Contract Line Item 0010), whichever occurs first. The initial notice regarding a defect shall be provided in writing by the Contracting Officer of Contract F33657–75–C–0178, or by the Contractor if independently discovered, within 15 days of discovery. Within fifteen (15) days of the initial notice, the said Contracting Officer shall provide in writing such particulars as may be reasonably necessary to notify the Contractor of the nature of the defect and to substantiate its warranty claim.

The Contractor shall submit to the Contracting Officers of Contract F33657–80–C–0001, and this contract, within thirty (30) days from receipt or giving of the intial notice, his recommendation for corrective actions (including any disagreement with the Government's notice), together with supporting information in sufficient detail for the Contracting Officers to determine what corrective action, if any, shall be undertaken. Within thirty (30) days after receipt of the Contractor's recommendations for corrective action and adequate supporting information, the Contracting Officers shall give the Contractor written notice not to correct, to correct or partially correct said defect which direction shall not be inconsistent as regards impact on the configuration of the aircraft. Unless otherwise mutually agreed to in writing, failure by the Government to comply with this paragraph shall terminate any obligation for that particular defect which Contractor shall have in regard to the affected aircraft under both contracts.

b. General Provision A–5 shall be applicable, subject to this provision, to fabrication and installation of redesigned wing boxes in the flight test aircraft. Furthermore, the phrase ". . . or otherwise not in conformity with the requirements of this contract" contained in paragraph (b) of A–5 shall include all failures to comply with the Statement of Work as amended (also referred to as "Attachment 1"). A fatigue crack detected in said redesigned wing boxes shall constitute a defect hereunder provided it meets the criteria and definitions set forth in paragraph a.(1) of Special Provision J–17 hereof, except that notification requirements and procedures shall be in accordance with and subject to this Special Provision J–19.

c. Corrective action shall include, as appropriate, an obligation by the Contractor to provide all design and engineering effort required to properly define fleet production, mission flight simulators, trainers, and all applicable retrofit kits and revision to all affected data: Provided, however, that Contractor's obligation hereunder shall not extend to those supplies or services furnished, or to be furnished, under other contracts, including those contemplated by Special Provisions J–20 and J–21 hereof. Incorporation of such changes into Phases III and IV of the C–5 Wing Modification Program shall be accomplished in accordance with the provisions of the contract for said phases.

d. Any supplies or parts corrected or furnished in replacement and any services reperformed by Contractor pursuant to this clause shall also be subject to all the provisions of this clause to the same extent as supplies or services initially provided or performed; provided that the period for giving notice shall expire six (6) months following the delivery thereof to the Government or expiration of this warranty clause, whichever is later. Unless otherwise mutually agreed to, Contractor shall not be obligated to reperform any previous testing of any such supplies or parts thereof and any services; except that the Contractor will perform only those tests, which are mutually agreed to as being required to verify the adequacy of repairs to said supplies or parts thereof and any services.

e. The Government shall be responsible for and bear the expense of delivery of the defective or nonconforming supplies or parts thereof to Contractor's facility for correction and the return thereof.

f. The parties agree that the corrective action for each defect in the flight test aircraft not in excess of 200 man-hours shall be accomplished by the Government and Contractor shall have no obligation in regard thereto, except for providing retrofit hardware, data, and technical support as appropriate. In the event the Government is unable to accomplish such corrective action, the Contractor shall perform same in accordance with written direction of the Contracting Officer hereunder which will be consistent with this clause including paragraph m., and the clauses referenced therein. Contractor makes no warranty with respect to workmanship or materials furnished by the Government. In calculating said 200 man hours, there shall be excluded all preliminary or preparatory activity (such as defueling, purging of tanks, etc.) relating to accomplishment of the correction providing the total span time does not exceed 7 calendar days. Corrective action to the flight test aircraft in excess of 200 man hours shall be accomplished by Contractor in accordance with the written direction of the Contracting Officer hereunder which shall be consistent with this clause including paragraph m. and the clauses referenced therein.

g. It is understood and agreed that the flight test aircraft will be flown by the Government within the design operating limits applicable to postmodification operation as specified in the Contractor's C–5A Wing Modification 100 percent Strength Summary and Operating Restrictions Report LGIUS 45–1–3, dated 31 March 1979 (including revisions A and B) and that the aircraft will be maintained by the Government in accordance with all applicable Technical Orders and Air Force directives. In the event that the Government deviates from any of these requirements without the prior consent of Contractor, this warranty shall terminate and Contractor shall have no further obligation hereunder.

h. Normal wear and tear and need for regular overhaul shall not constitute a defect or nonconformance under this warranty.

i. After 180 days from MD–250 of the Flight Test Aircraft, Contractor shall not be subject to the refault procedures contained in the General Provision hereof entitled "Termination" as a result of the coverage provided hereunder, except for a failure to correct as directed by the Contracting Officer.

j. Paragraph (d) of General Provision A–5 is inoperative for the purposes of this clause.

k. General:

(1) Except as otherwise provided herein, the rights and remedies of the Government provided in this clause:

(*a*) Shall not be affected in any way by any other provision of this contract concerning the conclusiveness of inspection and acceptance; and

(*b*) are in addition to and do not limit any rights afforded to the Government by any other clause of this contract.

(2) This clause shall apply to those defects discovered by either the Government or the Contractor.

(3) The Contractor shall not be responsible under this clause for the correction of defects in Government furnished property, except for defects in installation, unless the Contractor performs or is obligated to perform under this contract any modifications or other work on such property. In that event, the Contractor shall be responsible for correction of defects to the extent of such modifications or other work.

(4) The Contractor shall not be responsible under this clause for the correction of defects caused by the Government, except that in no event will any inspections, approvals, concurrences, authorizations, reviews or coordinations by the Government, if otherwise performed in accordance with this contract, be construed to relieve the Contractor of its obligations under this clause.

l. In no event shall the Contractor be liable for any consequential damages resulting from defects and it is agreed that, there are no warranties, express or implied, including, without limitations any implied warranties of merchantability and "fitness for a particular purpose." Furthermore, it is understood and agreed that this warranty does not constitute a service life guarantee or an agreement to modify the flight test aircraft or components to confirm to new developments hereafter occurring in the state of airframe design and manufacturing art.

m. Allowable costs for correction of defects shall be allocated to the line item of this contract under which the supplies or service being corrected were initially supplied or were to be supplied (e.g., redesign effort would be allocated to Item 0001). The allowability of costs incurred hereunder shall be determined as provided in the General Provisions hereof entitled "Allowable Cost, Fixed Fee and Payment" and "Allowable Cost, Incentive Fee and Payment" and as provided in Special Provision J–2 hereof. All other costs and procedures associated with the incorporation of the redesign into the modified aircraft or aircraft to be modified under Contract F33657–80–C–0001 and other supplies and services required thereunder shall be in accordance with Special Provision H–43 thereof.

n. Any failure to agree hereunder shall be subject to the General Provision hereof entitled "Disputes."

SECTION H

43. PRICE ADJUSTMENT—PRODUCTION MODIFICATION RESULTING FROM DEFICIENCIES/DEFECTS

1. Notwithstanding any other provision of this contract, the parties understand and agree that the sole obligation of he Contractor regarding correction of deficiencies/defects resulting from Special Provisions 17 entitled "Correction of Deficiencies" and 19 entitled "Flight Test Aircraft Warranty" of Contract F33657–75–C–0178 and Special Provision 44 entitled "Flying Hour Design Warranty" shall be as stated therein and that Contractor's warranty related obligations under this contract are limited to production corrections (and related effort as stated herein). Furthermore, that the parties will, pursuant to this clause, share in the costs incurred or to be incurred resulting from the incorporation of such corrections into modified aircraft or aircraft to be modified, including related effort. Excluded herefrom are those costs of corrections which are subject to Special Provision 2(c) of Contract F33657–75–C–0178.

2. The correction effort referenced in Paragraph 1 above to be performed under this contract shall be subject to the following conditions:

a. All corrective actions shall be incorporated by the Contractor in the most cost effective manner during production; otherwise correction shall be accomplished by Contractor providing retrofits for installation by the Government, which installation shall be at Government expense, subject to the 220 man-hour criteria specified in Special Provision 19 of Contract F33657–C–0178 and Special Provision 44 (Flying Hour Design Warranty) of this contract. In the event the Government is unable to accomplish the corrective action, the Contractor shall perform same in accordance with this written direction of the Contracting Officer consistent with this clause and applicable provisions referenced in Paragraph 1 hereof. All Contractor costs incurred or to be incurred as a result of the preceding shall be treated under this contract as provided in Paragraph 3 below, subject to the following conditions:

(1) Such costs shall include those related to the receipt, maintenance and redelivery of aircraft returned to Contractor's facility at Marietta, Georgia or costs (excluding salaries, which shall be allowable in accordance with the Incentive Price Revision clause hereof) of dispatching Contractor field teams as directed by the cognizant Contracting Officer.

(2) The Government shall be responsible for and bear the expense of delivery of defective supplies or parts thereof to Contractor's facility for correction and the return thereof.

(3) Additionally, all Contrator costs, incurred or to be incurred for receipt, maintenance and redelivery of aircraft returned to Contractor's facility at Marietta, Georgia or dispatch of Contractor field teams (excluding salaries, which shall be allowable in accordance with the Incentive Price Revision clause hereof) pursuant to Special Provision 45 entitled "Material and Workmanship Warranty: Redesigned Wing Boxes and Disturbed Systems" shall be treated in accordance with paragraph 3 below. All other costs of correction required by said clause shall be treated as provided therein.

(4) Those costs incurred or to be incurred by Contractor under this contract as a result of incorporating corrections resulting from deficiencies/defects detected or discovered under Special Provisions 17 or 19 of Contract F33657–75–C–0178 shall be treated in accordance with paragraph 3 hereof.

(5) All effort and resultant costs associated with production and retrofit engineering, including design and correction of test articles and revision to all affected data will be under and treated in accordance with Special Provision 2(c) of Contract F33657–75–C–0178.

3. All costs incurred or to be incurred as a result of incorporating corrections into modified aircraft or aircraft to be modified, including related effort, shall be treated in accordance with the following formula under this contract:

a. Within the first cumulative total of $40,000,000 ($0 to 40 million) total negotiated costs incurred or to be incurred under this contract for corrective action, there shall be no adjustment to the target cost, target profit or target price; except that the ceiling price shall be increased by 100 percent of the total negotiated value of the effort.

b. Contractor's sharing of the negotiated costs is limited to and shall be determined on the basis of the cumulative amount of $40 million of total cost incurred or to be incurred for correction of deficiencies/defects. The cumulative amounts is to be determined by adding all of the negotiated costs for each corrective action up to a total of $40 million. Contractor will share in the $40 million as provided herein. After the cumulative amount of $40 million is reached, Contractor shall have no obligation hereunder. Any corrective action thereafter shall be in accordance with the General Provision hereof entitled "Changes"; the target cost, target price and ceiling price shall be adjusted in an amount equal to the negotiated cost of the corrective effort, with no adjustment to the target profit.

c. The costs of correction under this contract resulting from deficiencies detected in the fatigue test article during the period specified in Special Provision 17, paragraph c. (3)(a) of Contract F33657-75-C-0178, shall be accomplished within the target costs of this contract. Such costs shall be treated as cost incurred, or to be incurred, for the purpose of negotiating the total final negotiated cost under the incentive price revision clauses of this contract. In all other respects, such corrective action shall be subject to all other terms and conditions of this provision.

Those costs of correction under this contract resulting from deficiencies detected in the fatigue test article during the period specified in said Special Provision 17, paragraph c. (3)(b), shall be treated and shared in accordance with the formula stated above and be subject to all other terms and conditions of this provision.

4. The following example demonstrates the operation of the above formula: Assume a corrective action with a total negotiated cost of $250,000 which includes design, engineering, tooling and fix of the test articles of Contract F33657-75-C-0178 in the amount of $50,000.

	$250,000
Design, engineering, tooling and fix of test articles under F33657-75-	(50,000)
	20,000

Using this assumption, the following example demonstrates the operation of the formula:

Within the first $40 million (cumulative production contract corrective cost from $0 to $40 million).

Target cost adjustment	$0
Target price adjustment	0
Ceiling price adjustment at 100 percent	[1] 200,000

[1] Subsequently treated per the incentive price revision clause hereof.

5. The total cost of all corrective actions hereunder shall be allowable cost under this contract, except for normal DAR Section 15 unallowables. Furthermore, the costs of correction shall be treated as a cost incurred or to be incurred for the purpose of negotiating the total final price under the incentive price revision clause of this contract.

6. All delivery schedules affected by any corrective action hereunder shall be adjusted.

7. In the event of a deficiency/defect as provided in Special Provisions 17 and 19 of Contract F33657-75-C-0178 which the cognizant Contracting Officer elects to only partially correct or not to correct hereunder, except as provided in paragraph 3 above, no other adjustments in contract terms and conditions, targets or prices shall be made under this contract and Contractor shall be relieved of all liability in connection therewith.

8. Any termination of this contract as a result of a failure by the Contractor to perform the requirements of Contract F33657-75-C-0178 shall be pursuant to the General Provision hereof entitled "Termination for Convenience of the Government"; however, this does not affect the rights of the parties regarding the requirements of this contract.

44. FLYING HOUR DESIGN WARRANTY

1. The parties understand and agree that the design requirements related to the wing boxes to be fabricated and installed under this contract are a requirement of Contract F333657-75-C-0178. In order to provide for the correction of design defects which may be discovered within the scope of the modification effort under this contract, the following provisions shall be applicable and constitute Contractor's sole obligation regarding such defects:

a. The Government shall have twelve (12) months from DD-250 of the first aircraft modified hereunder or the accumulation of the first 5,000 cumulative flying hours on the fleet of those aircraft modified hereunder, whichever occurs first, in which to notify Contractor of any design defects (failure to comply with the design requirements of the Statement of Work, as amended, also referred to as "Attachment 1", of Contract F33357-75-C-0178). Solely for the purposes of this clause, the General Provision hereof entitled "Inspection" shall be applicable during the same period of time specified herein. Upon completion of the said period, regardless of the length of time each of the modified aircraft has been accepted hereunder, the period of time for providing notice of defects under the said General Provision shall revert to the times specified therein, but in no event any later than time of acceptance (DD-250) of each modified aircraft. At the completion of the period of coverage of this clause, the design requirements of Contract F33657-75-C-0178 shall be excluded from any further coverage under this contract.

b. A fatigue crack detected in the redesigned wing boxes of any aircraft modified hereunder shall constitute a defect hereunder provided it meets the criteria and definitions set forth in paragraph a. (1) of Special Provision 17 of Contract F33657-75-C-0178, except that notification requirements and procedures shall be in accordance with and subject to this Special Provision 44.

c. All corrective design effort shall be performed under Contract F33657-75-C-0178 and includes an obligation by the Contractor to provide all design and engineering effort required to properly define fleet production, mission flight simulators, trainers, and all applicable retrofit kits and revision to all affected data.

d. Allowable costs for effort in paragraph (c) above shall be allocated to the line item of Contract F33657-75-C-0178 under which the supplies or services being corrected were initially supplied or were to be supplied or to its succeeding contract (e.g., redesign effort would be allocated to Item 0001). The allowability of such costs shall be determined as provided in the General Provisions of Contract F33657-75-C-0178 entitled "Allowable Cost, Fixed Fee and Payment" and "Allowable Cost, Incentive Fee and Payment" and as provided in Special Provision 2 thereof. All other costs and procedures associated with the incorporation of the redesign into the modified aircraft or aircraft to be modified under this contract and other supplies and services required hereunder shall be in accordance with Special Provision 43 hereof.

e. (1) The initial notice regarding a design defect shall be provided in writing by the Contracting Officer of Contract F33657-75-C-0178 or by the Contractor, if independently discovered, within fifteen (15) days of discovery. Within fifteen (15) days of the initial notice, the said Contracting Officer shall provide in writing such particulars as may be reasonably necessary to notify the Contractor of the nature of the defect and to substantiate its warranty claim. The Contractor shall submit to the Contracting Officers of Contract F33657-75-C-0178 and this contract, within thirty (30) days from receipt or giving of the initial notice, his recommendation for corrective actions (including any disagreement with the Government's notice), together with supporting information in sufficient detail for the Contracting Officers to determine what corrective action, if any shall be undertaken. Within thirty (30) days after receipt of the Contractor's recommendations for corrective action and adequate supporting information, the Contracting Officers shall give the Contractor written notice not to correct, to correct or partially correct said defect which direction shall not be inconsistent as regards impact on the configuration of the aircraft. Unless otherwise mutually agreed to in writing, failure by the Government to comply with this paragraph shall terminate any obligation for that particular defect which Contractor shall have in regard to the affected aircraft under both contracts.

(2) For Inspection Clause defects, all the above notification requirements and procedures shall apply, except that the Cognizant Contracting Officer shall be the contracting officer of this contract.

f. Any supplies or parts or parts thereof corrected or furnished in replacement and any services reperformed by Contractor pursuant to this clause shall also be subject to all the provisions of this clause to the same extent as supplies or services initially provided or performed; provided that the period for giving notice shall expire six (6) months following the redelivery thereof to the Government or expiration of this warranty clause, whichever is later. Unless otherwise mutually agreed to, Contractor shall not be obligated to reperform any previous testing of any such supplies or parts thereof and any services; except that the Contractor will perform only those tests which are mutually agreed to as being required to verify the adequacy of repairs to said supplies or parts thereof and any services.

g. The Government shall be responsible for and bear the expense of delivery of the defective or nonconforming supplies or parts thereof to Contractor's facility for correction and the return thereof.

h. The parties agree that the corrective action for each defect in modified aircraft not in excess of 200 man hours per aircraft shall be accomplished by the Government and Contractor shall have no obligation in regard thereto, except for providing retrofit hardware, data, and technical support as appropriate. In the event the Government is unable to accomplish such corrective action, the Contractor shall perform same in accordance with the written direction of the Contracting Officer, hereunder which shall be consistent with this clause including subparagraph d and the clauses referenced therein. Contractor makes no warranty with respect to workmanship or materials furnished by the Government. In calculating said 200 man hours, there shall be excluded all preparatory activity (such as defueling, purging of tanks, etc.) relating to accomplishment of the correction, providing the total span time does not exceed 7 calendar days. Corrective action to the modified aircraft in excess of 200 man hours shall be accomplished by Contractor in accordance with the written direction of the Contracting Officer, hereunder which shall be consistent with subparagraph d and the clauses referenced therein.

i. It is understood and agreed that the modified aircraft will be flown by the Government within the design operating limits applicable to postmodification operation as specified in the Contractor's C-5A Wing Modification 100 percent Strength Summary and Operating Restrictions Report LGIUS 45-1-3, dated 31 March 1979 (including Revisions A and B) and that the aircraft will be maintained by the Government in accordance with all applicable Technical Orders and Air Force directives. In the event that the Government deviates from either of these requirements without the prior consent of Contractor, this warranty shall terminate as to the affected aircraft and Contractor shall have no further obligation hereunder as regards such aircraft.

j. Contractor shall not be subject to the General Provision hereof entitled "Default" as a result of the coverage provided hereunder, except for a failure to correct as directed by the Contracting Officer. Furthermore, Contractor shall be entitled to an equitable adjustment in the delivery schedules of this contract pursuant to the General Provision hereof entitled "Changes" for any schedule slippage caused by compliance with this clause.

k. Normal wear and tear and need, for regular overhaul shall not constitute a defect or nonconformance under this warranty.

l. *General*

(1) Except as otherwise provided herein, the rights and remedies of the Government provided in this clause:

(a) Shall not be affected in any way by any other provision of this contract concerning the conclusiveness of inspection and acceptance; and

(b) are in addition to and do not limit any rights afforded to the Government by any other clause of this contract.

(2) This clause shall apply to those defects discovered by either the Government or the Contractor.

(3) The Contractor shall not be responsible under this clause for the correction of defects in Government furnished property, except for defects in installation, unless the Contractor performs or is obligated to perform under this contract any modifications or other work on such property. In that event, the Contractor shall be responsible for correction of defects to the extent of such modifications or other work.

(4) The Contractor shall not be responsible under this clause for the correction of defects caused by the Government, except that in no event will any inspections, approvals, concurrences, authorizations, reviews or coordinations by the Government, if otherwise performed in accordance with this contract, be construed to relieve the Contractor of its obligations under this clause.

m. In no event shall the Contractor be liable for any consequential damages resulting from defects, and it is agreed that there are no warranties, express or implied, including without limitation any implied warranties of merchantability and "fitness for a particular purpose." Furthermore, it is understood and agreed that this warranty does not constitute a service life guarantee or an agreement to modify the modified aircraft or components or aircraft and components to be modified to conform to new developments hereafter occurring in the state of airframe design and manufacturing art.

n. Any failures to agree hereunder shall be subject to the General Provision hereof entitled "Disputes."

45. MATERIAL AND WORKMANSHIP WARRANTY: REDESIGNED WING BOXES AND DISTURBED SYSTEMS

The parties understand and agree that the applicability of the General Provision entitled "Inspection" is as provided therein and in Special Provision 44 entitled "Flying Hour Design Warranty" and that the Inspection provision does not, after the period stated in the "Flying Hour Design Warranty," provide any coverage after DD-250 acceptance of each aircraft, except as provided in subparagraph (d) of the said General Provision. To provide the Government with coverage for defects in material and workmanship after the period stated above, the Contractor agrees to provide the coverage stated herein and the Government agrees that such coverage shall constitute Contractor's sole obligation regarding such defects. Furthermore, it is agreed that said coverage does not extend to the design requirements of Contract F33657-75-C-0178, or any other requirements of this contract.

a. *Period of coverage*

The coverage of this clause shall commence upon the expiration of the "Inspection" clause coverage provided in Special Provision 44 entitled "Flying Hour Design Warranty," provided, however, that to the extent any of the modified aircraft delivered during the period of time specified in said Special Provision have not received at least 12 months of coverage for defects in material and workmanship under the General Provision entitled "Inspection," then the coverage provided herein shall provide such coverage up to a total of 12 months. This coverage shall not run concurrently therewith, but is intended to provide an aggregate of the 12 months of materials and workmanship coverage for each said aircraft. Materials and workmanship coverage for all other aircraft shall be as stated herein.

b. The following definitions shall apply:

(1) Acceptance: The word "acceptance" as used herein means the execution of the Acceptance Block and signing of a Form DD-250 by the authorized Government representative.

(2) Supplies: The word "supplies" as used herein means the modified aircraft, including and limited to the modified ALDCS computer, the redesigned wing boxes, and its immediate interfacing or attachment portions of aircraft systems disturbed as a result of the wing modification.

c. Notwithstanding inspection and acceptance by the Government of the supplies furnished under the contract or any provision of this contract concerning the conclusiveness thereof, the Contractor warrants that at the time of acceptance all such supplies will be free from defects in material or workmanship provided the defect existed at the time of acceptance of the modified aircraft, excluding normal wear, tear and deterioration.

d. The Contracting Officer shall give written notice to the Contractor of any breach of the warranties in paragraph c. of this clause within twelve (12) months after acceptance of each modified aircraft, and in no event later than fifteen (15) days after discovery of such defect; provided, however, that this notice shall only be effective regarding the individual modified aircraft accepted and shall not extend to those modified aircraft accepted more than twelve (12) months.

e. Within a reasonable time, but not later than fifteen (15) days, after such notice, the Contracting Officer may either:

(1) by written direction consistent with (2) or (3) below, require the prompt correction or replacement of any supplies or parts thereof on the modified aircraft that do not conform with the material and workmanship requirements of this contract within the meaning of paragraph c. of this clause; or

(2) by written direction require the furnishing of supplies or parts thereof for Government installation, which installation shall be at Government expense, in which event the Government shall not be entitled to an equitable adjustment in the contract price; or

(3) by written direction require the correction or replacement to be made to the aircraft which shall be returned to Contractor's facility at Marietta, Georgia or be corrected by a Contractor field team; or

(4) retain such supplies, whereupon the contract price thereof shall be reduced by an amount equitable under the circumstances and the Contractor shall promptly make appropriate repayment.

In the event of direction pursuant to (3) above, the Government shall be responsible for and bear the expense of delivery of the aircraft to Contractor for correction and the return thereof. Treatment of costs related to the field teams and aircraft receipt, maintenance, and redelivery shall be in accordance with Special Provision 43 hereof.

f. If the Contractor does not agree as to his responsibility to correct or replace the supplies delivered, he shall nevertheless proceed in accordance with the written direction issued by the Contracting Officer under paragraph e. In the event it is later determined that such supplies were not defective within the provisions of this clause, the contract price and schedule shall be equitably adjusted.

g. Any supplies or parts thereof corrected or furnished in replacement pursuant to this clause shall also be subject to all the provisions of this clause.

h. It is understood and agreed that the modified aircraft will be flown by the Government within the design operating limits applicable to postmodification operation as specified in the Contractor's C–5A Wing Modification 100% Strength Summary and Operating Restrictions Report LGIUS 45–1–3, dated 31 March 1979 (including Revisions A and B), and that the aircraft will be maintained by the Government in accordance with all applicable Technical Orders and Air Force directives. In the event that the Government deviates from either of these requirements without the prior consent of Contractor, this warranty shall terminate as to the affected aircraft and Contractor shall have no further obligation hereunder as regards such aircraft.

i. The Contractor shall not be responsible under this clause for the correction of defects in Government furnished property, except for defects in installation, unless the Contractor performs or is obligated to perform under this contract any modifications or other work on such property. In that event, the Contractor shall be responsible for correction of defects in material and workmanship to the extent of such modifications or other work.

j. Failure to agree upon any determination to be made under this clause shall be a dispute within the meaning of the "Disputes" clause of this contract.

k. Except as provided herein, the rights and remedies of the Government provided in this clause are in additon to, and do not limit any rights afforded the Government by any other clause of this contract.

l. In no event shall the Contractor be liable for any consequential damages resulting from defects and it is agreed that there are no warranties, express or implied, including, without limitation, any implied warranties of merchantability and "fitness for a particular purpose." Furthermore, it is agreed that this warranty is not an agreement to modify the modified aircraft or components or aircraft and components to be modified to conform to new developments hereafter occurring in the state of airframe design and manufacturing art.

m. Except as otherwise provided herein, and in Special Provision 43 hereof, prior to the establishment of the total final price, the cost of replacement or correction shall be treated as a cost incurred, or to be incurred, for the purpose of negotiating the total final negotiated cost under the incentive price revision clause of this contract.

—

1. The above-numbered contract is modified as set forth below at no change in contract price:

(a) Paragraph 17 entitled "Correction of Deficiencies—This Contract" of section J is hereby deleted in its entirety and the attached Paragraph J.17 entitled "Correction of Deficiencies" substituted in lieu thereof.

(b) Paragraph 19 entitled "Correction of Deficiencies—Follow-On Contracts" of section J is hereby deleted in its entirety and the attached Paragraph J.19 entitled "Flight Test Aircraft Warranty" substituted in lieu thereof.

(c) Paragraph 2 entitled "Target Cost and Target Fee for Options 1, 2 and 3" of section J is hereby revised by adding the following subparagraph (c):

"(c) Price Adjustments for Corrections of Deficiencies/Defects.

"1. The purpose of this subparagraph (c) is to acknowledge: (1) Contractor's obligation to correct deficiencies as provided in Special Provisions J.17 entitled

'Correction of Deficiencies' and J.19 entitled 'Flight Test Aircraft Warranty' hereof and to correct design defects pursuant to the 'Flying Hour Design Warranty' clause of Contract F33657–80–C–0001; and (2) Government's obligation to reimburse Contractor for such effort under this contract, except for that effort which is to be treated under Contract F33657–80–C–0001.

"2. The parties understand and agree that it is intended that all allowable costs for correction of deficiencies/defects shall be allocated to the line item of this contract under which the supplies or services being corrected were initially supplied or were to be supplied (e.g., redesign effort would be allocated to Line Item 0001). The costs to be treated hereunder are those incurred or to be incurred by the Contractor which are associated with effort in the following categories:

"a. Costs of correcting deficiencies in the test articles and related supplies and service pursuant to Special Provision J.17.

"b. Costs of correcting defects in the flight test aircraft and related supplies and services pursuant to Special Provision J.19;

"c. Costs of correcting design defects pursuant to the Flying Hour Design Warranty of Contract F33657–80–C–0001, including without limitation those costs related to design and engineering effort required to properly define fleet production, mission flight simulators, trainers, applicable retrofit kits and revision to all affected data.

"d. All other correction costs of the same type originally required under Contract F33657–75–C–0178 whether or not specifically identified above.

"3. Costs to be treated under this contract are further subject to the following conditions:

"a. If any doubt exists as to whether a cost associated with such corrective effort is chargeable to this contract, it shall be resolved by the Contracting Officer who will generally give preference to this contract and the line item to which it is most closely related (e.g., Design, Tooling, Data, Testing). The Contractor shall advise the Contracting Officer of any disagreement within fifteen (15) Contractor working days from the receipt of Contracting Officer's resolution. If the parties are thereafter unable to agree it shall be subject to the General Provision entitled 'Disputes'.

"b. Allowability of such costs shall be determined by this subparagraph J.2(c) and the General Provisions hereof entitled 'Allowable Cost, Fixed Fee and Payment' and 'Allowable Cost, Incentive Fee and Payment.'

"4. The treatment o f all other costs and procedures associated with the incorporation of the redesign efforts specified in paragraph 2 above into the modified aircraft or aircraft to be modified under Contract F33657–80–C–0001 and other supplies and services required thereunder shall be treated under that contract in accordance with Special Provision H.43 thereof.

"5. Costs to be charged to this contract shall be treated as follows:

"a. Costs of correction of deficiencies detected in the Fatigue Test Article during the period stated in paragraph c.(3) (a) of Special Provision J.17 shall be treated as stated therein, including increasing the estimated cost contained in Paragraph J.1 of the CPFF portion of this contract. The target cost (but not the target fee) of the CPIF portion of this contract shall be increased only by the amount of 'standby costs,' if any, incurred or associated with the correction. During the period specified in paragraph c. (3)(b) thereof, the Contractor shall be entitled to an increase in the estimated cost set forth in Paragraph J.1 hereof by the amount of the negotiated cost of the correction. The amount of the fixed fee contained in Paragraph J.1 shall be increased by 3.07% of the negotiated cost. Likewise, the costs incurred or to be incurred for effort otherwise subject to Paragraph J.2(a) shall be treated on a CPFF basis. An estimated cost shall be established based on the negotiated cost (including standby costs) of each correction and a fixed fee of 3.077 of the negotiated cost. This CPF arrangement shall be excluded from the CPIF determination arrangement or sharing formula.

"b. Costs of correction of defects in the flight test aircraft shall be treated in accordance with General Provision A.5 hereof, except that costs of correcting defects for which notice is received by Contractor after the first 180 days of coverage of Special Provision J.19 hereof shall be treated as follows:

"(1) Effort subject to Paragraph J.1: The estimated cost set forth therein shall be increased by the amount of the negotiated cost of the correction and the fixed fee increased by 3.07% of the negotiated cost.

"(2) Effort subject to Paragraph J.2: Notwithstanding that Paragraph J.2 is a CPIF arrangement, the parties agree that the cost incurred or to be incurred will be treated as though it were a CPFF arrangement. An estimated cost shall be established based on the negotiated cost of each correction and a fixed fee of 3.07% of the negotiated cost. This CPFF arrangement shall be excluded from the CPIF determination arrangement or sharing formula.

"c. Costs of correction of design defects pursuant to the Flying Hour Design Warranty of Contract F33657-80-C-0001 as described in paragraph 2.c. hereof shall be treated as follows hereunder:

"(1) Effort subject to Paragraph J.1: The estimated cost set forth therein shall be increased by the amount of the negotiated cost of the correction and the fixed fee increased by 3.07% of the negotiated cost.

"(2) Effort subject to Paragraph J.2: Costs hereunder shall be treated in the same manner as that specified in paragraph b. (2) hereof."

Senator PROXMIRE. Secretary Mark, is it correct that the Air Force, the U.S. Government, has agreed to contribute to settlement of lawsuit arising out of the C-5A accident in Saigon in 1975, and can you state how much it would cost the Government in total settlement costs?

Secretary MARK. Mr. Chairman, I don't know the answer to that question. As you know, there is litigation pending here, and I'd rather not talk about it.

Senator PROXMIRE. Why can't you talk about it?

Secretary MARK. Well, sir, because I think we're in a position where the Government may be liable to things that I say. And I don't know enough about it to really answer the question.

Senator PROXMIRE. Has the Air Force agreed to pay anything as yet?

Secretary MARK. As far as I know, we have not.

[The following expanded remarks on the above response were subsequently supplied for the record:]

There is a cost sharing agreement between Lockheed and the United States in those cases where the U.S. Government could conceivably be subject to liability. The agreement has been sealed by order of the court.

Senator PROXMIRE. You have not.

In your prepared statement, you mention rogue flaws and natural defects, both of which can cause significant wing cracks. Is it correct that many, if not most or all, of the rogue flaws were caused by poor workmanship, especially by errors made in the installation of the wing fasteners?

Secretary MARK. Mr. Chairman, the term "rogue flaw" is applied to a defect which is presumed to be present in all aircraft, and which has been found by many, many years of aircraft teardown. No rogue flaws were found—or nothing that was named as a rogue flaw was found in the teardown or in the inspection of the test articles of these aircraft. But that doesn't mean that they're not there.

Senator PROXMIRE. Well, would you agree——

Secretary MARK. Because manufacturing experience is that such rogue flaws exist and we must take into account that they do exist.

Senator PROXMIRE. No rogue flaws were found? None?

Secretary MARK. Experimentally, no rogue flaws were found. But remember that only a small sample of all the fastener holes in the fleet were sampled, and therefore that is not a priori——

Senator PROXMIRE. Does the SIEP teardown say that?

Secretary MARK. Yes, sir.

Senator PROXMIRE. Would you agree that poor quality workmanship at Lockheed contributed to the wing problem?

Secretary MARK. Poor quality workmanship was found during the SIEP teardown. If that was the sense of your question, I should have answered it that way. Nothing that could be ascribed in the technical sense as a rogue flaw was found during the teardown. And so, maybe I should clarify that——

Senator PROXMIRE. Let me just ask Mr. Tiffany if the rogue flaws were found in the SIEP teardown.

Mr. TIFFANY. No, sir.

Senator PROXMIRE. What assurances are there that Lockheed will exercise any better quality control this time than it did the first time?

Secretary MARK. I think, sir, that the purpose of modifying the wings so that one uses thicker planks is precisely to take the burden off the manufacturing quality, in order to assure safety. You see, the problem we have here, as Professor Mar said a little while ago, is that with the thinner panels, much more attention had to be paid to manufacturing quality in order to make sure that the structure was sound.

The thicker panels—I am confident that the current manufacturing techniques will be all right.

Senator PROXMIRE. In your prepared statement, you mentioned five major Air Force studies of the C–5A in the last decade. When the president of Lockheed testified, he said 11 different studies, not 5 but 11. Have you read Mr. Ormsby's testimony and can you explain the difference in the number of studies each of you are citing?

Secretary MARK. I believe so. The studies I referred to are the Air Force studies. If you like, I can enumerate them for you. They start out with the independent review team, which I believe Mr. McCarthy chaired. There was then an SAB study that went on in that time frame. The Rand Corp. did a study of the C–5 wing as a result of the general study that we asked them to do of airlift—of the whole airlift problem. And, of course, we had the SIEP review. Let's see, I left one out; the APEX, right.

Senator PROXMIRE. My time is up.

Secretary MARK. These are the five studies I was referring to. I believe there were also in-house studies at the Lockheed Corp. that Mr. Ormsby may have been talking about in his testimony.

Representative WYLIE. Thank you, Mr. Chairman. Now I would like to try to develop a better understanding of the flaws you say are in the plane.

In your testimony you say that the first technique assumes that there are a small number of very serious additional defects which have been introduced into the structure during the manufacture. These defects are called rogue flaws. But that was assumed, when the contract was awarded, that there would be rogue flaws, and you assumed that there are going to be rogue flaws in the manufacture of every airplane, not just the C–5?

Secretary MARK. That's correct, yes, sir.

Representative WYLIE. In this case, upon manufacture of the plane you found there were no rogue flaws. So your assumptions on that were not correct.

Secretary MARK. Congressman Wylie, may I please clarify that?

Representative WYLIE. I hoped you would.

Secretary MARK. This a very important point, the number of holes that have been inspected either by nondestructive testing methods or during teardown of the flight aircraft is very small compared to the total number of holes in the aircraft fleet. Let me give you the numbers.

Each C-5 aircraft has 125,000 fastener holes in the wing. We have roughly 77 to 80 airplanes. So we have 10 million holes, OK? During the inspection, I believe that the number of holes that was examined was something on the order of 10,000, perhaps less. I'm not sure.

Mr. WOOD. 40,000.

Representative WYLIE. 10 million holes?

Secretary MARK. 10 million holes in the entire fleet. Now, what the results say, that in those 40,000 holes that were examined, there were no rogue flaws found. But that doesn't mean that there aren't any rogue flaws in the 9,960,000 holes that weren't examined. And therefore we cannot draw the conclusion, Mr. Wylie, that on the basis of an examination for rogue flaws, of a small sample, that there aren't any.

Representative WYLIE. I'm not sure if I understand it more or less now. [Laughter.]

Secretary MARK. I'm sorry. We've only looked at a small sample.

Representative WYLIE. But you found no rogue flaws in those?

Secretary MARK. We found no rogue flaws in those. We know there is a certain frequency of rogue flaws. We know there's a probability that they have been. And based on the knowledge of that probability, we can draw the conclusion——

Representative WYLIE. How is the 30,000-hour figure arrived at for the life expectancy of the rest of the plane?

Secretary MARK. You mean the fuselage and the tail section?

Representative WYLIE. Yes.

Secretary MARK. Excluding the wing?

Representative WYLIE. Yes.

Secretary MARK. I think my methods were quite similar to the ones on the wings. Let me ask Mr. Wood to answer that question.

Mr. WOOD. As part of the SIEP study, the rest of the airplane was examined in the same manner as the wing was examined, in the same manner as the new wing is designed. It was assumed that there could be the likelihood of a rogue flaw occurring somewhere in that structure as well as the wing. The life, the projected lifetime in terms of hours that the airplane could be flown beyond the wing modification—in other words, the way the Air Force would operate once they had a new wing—were calculated to grow that rogue flaw to critical size. And as was previously testified, I believe the minimum number of hours for the rest of the airplane was approximately 46,000 hours.

Representative WYLIE. I think you might be right here. But if that figure of 30,000 hours was only an estimate and you had suggested that the rogue flaws that you have examined are only a small sample, it is prudent to invest up to $1.4 billion to extend the life of the wings for 30,000 hours?

Secretary MARK. Well, Mr. Wylie, may I try to ask you a question?

Representative WYLIE. I think you have answered that, but I think we need to clear that up here, since there is some confusion about how many rouge flaws there are in the plane.

Mr. MCCARTHY. Could I try, Congressman Wylie?

Representative WYLIE. Yes.

Mr. MCCARTHY. We estimated the life of the C–5 wing based on two different phenomenon. The first phenomenon that we talked about here is the rogue flaw. The rogue flaw is a very low probability of the event occurring. And based on experience with a number of Air Force airplanes, we chose 0.05 inch as a flaw that could get by the quality control procedures and the inspection procedures, both at the factory and the plant.

The other method, which is quite independent of the rogue flaw assumption, is that there are initial defects introduced into the fastener hole during the manufacturing process. This occurs during the manufacture of all airplanes, both commercial and military.

Now, the question is, What is the nature of the initial defects? After much tests and many analyses and many teardown inspections, where we traced the history of the cracks back to the initial manufacturing process, in some cases we chose 0.01 and in some cases 0.001 inch. And this is when widespread cracking occurs and that's an independent phenomenon, which is the reason there are two different safety limits, one based on rogue flaw and one based on widespread cracking.

So if the rogue flaw doesn't get you, the widespread cracking will. And incidentally, the widespread cracking was confirmed by the teardown inspection.

Representative WYLIE. Is it unusual for the manufacturer of a large Air Force airplane to do the studies or evaluate their own product?

Mr. TIFFANY. I can answer that, I think. No, it is not unusual. When I was working with the Air Force for about 8 years, they had similar type studies going on on numerous airplanes. We went back at this stage with the KC–135, B–52, T–38, C–141, C–130, a lot of different airplanes where we run what we call structural assessments almost identical to what we have done during the SIEP program.

These studies are geneally performed by—or they are always performed basically by the contractor, since they have all the intimate knowledge of the airplane and all the details. But in each case we do have, or did have, Air Force structural representation present, technical people to monitor the activities and in fact assist them in the performance of these studies.

Representative WYLIE. How do you maintain supervision and avoid biased conclusions?

Secretary MARK. Mr. Wvlie, may I add to that?

Representative WYLIE. Yes; of course.

Secretary MARK. What Mr. Tiffany said, of course, is absolutely correct with respect to the expertise of the contractors that needs to be brought into any such study. The Government, however, has several means of assuring that studies of this kind are indeed reviewed properly and then that the conclusions can be relied upon.

Let me outline the methods. One, of course, is that the Air Force itself maintains a considerable inhouse capability in the technology—in aircraft technology at the Aeronautical Systems Division at Wright Patterson AFB. Mr. Wood is a representative of that inhouse competence.

In addition, the Air Force very often asks NASA to conduct an independent review of its conclusions. I spent 8½ years working for

NASA and on numerous occasions I was asked by the Air Force to act as a technical consultant or a technical witness to the tests that they were conducting. And Mr. McCarthy, who is now the Director of NASA's Lewis Research Center, is acting in this capacity here.

Finally, the Air Force has the U.S. Air Force Scientific Advisory Board. I was a member of that body for some years. And it is made up of technical experts from all institutions. Professor Mar, I believe, is a member of the SAB. He is a professor at MIT. We select its members to provide us expertise in all the areas that the Air Force has an interest in, ranging from the human factors in the control of airplanes to the structural mechanics which we're talking about here.

There is an exceedingly thorough review process that we go through in order to assure ourselves that the products that we purchase with the taxpayers' money will be the best we can possibly make. And occasionally, sir, we make mistakes. I will not say that we don't. There is no question about it.

Representative Wylie. Thank you, Mr. Secretary.

I think, Mr. Chairman, you ought to be complimented. We have developed some very important information during these hearings.

Senator Proxmire. Thank you, Congressman Wylie, very much.

Secretary Mark, as you know, the staff has obtained copies of voluminous material in the SIEP report which was completed last year. Are you aware that the data in the SIEP report suggests the fuselage has significantly fewer than 30,000 more flying hours available on it?

Secretary Mark. I'm not aware of that. I don't think that's right. Would you comment on that, Mr. Wood?

Mr. Wood. I'm not familiar with that allegation. Can you tell us what you mean by "significantly more"?

Secretary Mark. Significantly more, significantly less.

Mr. Wood. Significantly less?

Senator Proxmire. I'm asking you whether or not you are aware of the data in the SIEP report that suggests that the fuselage doesn't have as much as 30,000 more flying hours available.

Mr. Wood. To my knowledge, the minimum number of hours that are in the SIEP report for available safe flight time hours available following the wing mod is on the order of 46,000.

Senator Proxmire. You're talking about the wings. I'm talking about the fuselage.

Mr. Wood. I'm talking about the rest of the airplane. Once the rest of the airplane is rewinged and goes into service, it then has available no less than 46,000 hours.

Senator Proxmire. Mr. Wood, would you be willing to talk to the staff, Mr. Kaufman, and Mr. Paris about this?

Mr. Wood. Yes.

Senator Proxmire. Let we show you the title page of one of the SIEP volumes. This title page under the Lockheed logo and Lockheed letterhead, I am going to ask Mr. Kaufman to show that to you. It says that it is submitted under an aircraft contract, shows that it was prepared by Lockheed, checked by Lockheed staff, and approved by Lockheed staff.

Is it correct that the SIEP study was done under an Air Force contract to Lockheed and that the analysis in the report was prepared by Lockheed employees?

Secretary MARK. Yes, sir. I thought we had just discussed it. The real point is not who does the study. The question is, how is it reviewed and who draws the conclusions from the study.

Senator PROXMIRE. Let me come to that question. And I want to show you the title page of one of the volumes of the independent laboratory analysis of the SIEP results done by the Southwest Research Institute. And I'm going to have that passed, too, to you.

Isn't it also correct that the Southwest Research Institute, which did the so-called independent analysis of Lockheed's findings, did so under a contract with Lockheed, was paid by Lockheed, and submitted its reports to Lockheed?

Secretary MARK. I believe, sir, that that was Air Force money that went through Lockheed as a contractual matter.

Senator PROXMIRE. Sure, but it was under the Lockheed Georgia Co. purchase order.

Mr. WOOD. That's correct. It was a Lockheed subcontract.

Senator PROXMIRE. Isn't it correct that the SIEP steering group was set up by the Air Force——

Secretary MARK. Excuse me, Mr. Chairman.

Mr. WOOD. The whole program was funded by the Air Force.

Secretary MARK. This was not Lockheed Co. money. This was Government money.

Senator PROXMIRE. Well, Lockheed selected the independent research group.

Secretary MARK. No, sir, the Air Force selected the independent research group. The decision to go with Southwest Research was a decision that was confirmed by the Air Force.

Senator PROXMIRE. Who made that decision?

Mr. WOOD. The decision was basically reviewed by the steering group, the group that oversaw the basic SIEP study. And they would have the power to approve that decision.

Senator PROXMIRE. Isn't it correct that the SIEP steering group was set up by the Air Force to review Lockheed's findings in the SIEP study, and that Mr. Paul Paris was the only member of the group who was not an employee of Lockheed or the Air Force? Is that right?

Mr. WOOD. That's correct, yes.

Senator PROXMIRE. And that's the group that made the selection of Southwest?

Mr. WOOD. That's correct.

Senator PROXMIRE. All right. Isn't it correct that Mr. Paris repeatedly requested access to Lockheed's raw data and to its methods of calculations during the 2-year period of the SIEP study, and he was consistently denied access to this information?

Mr. WOOD. Let me answer that, sir. To the best of my knowledge—and I was the onsite director and had access to all the data—I received two requests from Mr. Paris during the course of the program: One in late 1977 for data on the active lift of distribution control system. The Air Force provided him with reports, Lockheed reports on that system, at that time.

The second request came in 1979 prior to the April steering committee meeting, where Mr. Paris requested information on the cracking data from the teardown. The Air Force also provided Mr. Paris with information on those findings.

Senator PROXMIRE. I'm talking about Lockheed's raw data and methods of calculation. That's what he asked for. You say you got reports.

Mr. WOOD. The first set of data he asked for were reports and he got reports. He specifically asked for them by report number.

The second set of data was crack information in the raw form. We gave him crack data that was derived from the teardown, the list of the cracks and the size of the cracks.

Senator PROXMIRE. Now, here's a letter from Mr. Paris dated May 29, 1979, toward the end of the 2-year study, addressed to you, Howard Wood, who was then monitoring the SIEP study for the Air Force at Lockheed. In the letter, Mr. Paris requested information about the results of the teardown of the wing, a list of all cracks, identifying the location on the structure, size, shape, and evidence of growth. Let me repeat that—identifying their location, the location in the structure.

Isn't it correct that Mr. Wood in his reply of June 14, that you said he was still processing the data requested by Mr. Paris—you were still processing that data? Isn't it also correct that on July 6, 1979, Mr. Wood, you sent Mr. Paris three diagrams showing only a tiny portion of the type of information Mr. Paris had requested?

Mr. WOOD. May I see that letter, please?

The answer to the last part of your question, that we sent him the summary of crack data, is correct.

Senator PROXMIRE. We will send you the letter.

[The correspondence referred to, together with the minutes of the April 18, 1979, SIEP Steering Committee meeting, was subsequently supplied for the record:]

WASHINGTON UNIVERSITY IN ST. LOUIS,
CENTER FOR FRACTURE MECHANICS,
St. Louis, Mo., May 29, 1979.

Mr. HOWARD WOOD,
% Lockheed, Department 2601, Zone 52
Marietta, Ga.

DEAR HOWARD. I object very strongly to the untruthful nature of Item 3 of the minutes of the C5A–S.I.E.P. meeting of 18 April 1979 (dated May 8, 1979).

First, it was not agreed to have both Swift and Wilhem review the findings. It was agreed to have Swift visit Gelac to review the methodology in full detail. This obviously could not be done in a presentation type meeting of 12 people at CALAC.

Secondly, you state, "It was pointed out to Dr. Paris and others that it was ill-timed to begin to doubt the findings at this date". No one made any such statement to me! Furthermore, I have expressed doubts on the findings on single and dual panel residual strength findings each and every time they have come up in S.I.E.P. Steerling Group meetings. Therefore, if such a statement were made at the meeting (or is made now), I would have challenged it!

Another very basic reason that I challenge these results is that if these current findings are correct, then we have been deliberately misled in the past about single panel strength; indeed, in such a case, Lockheed is basically admitting that their design was not single component fail-safe. Moreover, the new wing design, which is basically the same configuration with stresses reduced 25%, is obviously subject to the same problems! As a consequence, I find that the results still smell "very fishy" to me, one way or the other, and remain to be explained, not just to me, but to the Air Force and others. I don't think the S.I.E.P. group can live with such inconsistancies.

Further, since we have found very little cracking in the lead C5A wing which has been torn down, it is obvious that some interests are motivated to find other things wrong with the current wing to justify retrofit. However, if we are discarding the control point 6 dual panel failure scenario, then we have also abandoned the 8,000 hour life limit on the current wing. A new full blown scenario is then needed to actually judge safety of the fleet. Thus, if these claims of low dual panel failure strength are to be used to motivate retrofit, then the S.I.E.P. Steering Group should insist in a new full failure scenario, and reassessment of the safety limit.

Finally, with respect to accepting the results of a review of the residual strength studies you state, "Paris agreed that if Swift and Wilhem concurred with the findings . . .". Now I deny this because if Wilhem was mentioned I definitely would have objected! Indeed, not only has Wilhem plagiarized my work in the past, as you well know, but he is from Northrup, which has provided the T–38, a well established example of lack of damage tolerance and/or residual strength. The lower wing skin trailing edge cracked residual strength problem has killed at least two crew members, since I sat in a meeting at Northrup and listened to why it should be allowed to continue to fly, regardless. Yes, my conscience is bothered by that sample of Northrup-Air Force mentality, so I am not about to accept a Northrup man's judgment on a particular of the C5A. Indeed, if we applied their judgments to the C5A wing in general, we wouldn't worry at all about the current wing! At any rate, Paris obviously did not agree to the conditions you stated.

Finally, I must question your motivation in making untrue statements which tend to portray my involvement in the S.I.E.P. Steering Group as "ill-timed", etc. If this is an attempt to inhibit my questions on S.I.E.P. results, then it is very misdirected! In the past, I have truly allowed many points of inconsistency in results to pass based on my confidence in your integrity and your close proximity to the work and understanding of the problem. If I lose my "faith" in your motivation, then I will have many more areas in which questions remain and the S.I.E.P. "findings" are yet to be rationally or fully established. Therefore, I request an explanation of these misstatements in Item 3 of the minutes.

What was your motivation anyway?

Since you have clearly not gotten one of our understandings at the past meeting portrayed correctly, I must also wonder about others. Please recall that at the past meeting, I requested that the Steering Committee be fully informed on the teardown results at the next meeting, either by providing results to us by mail before the meeting or by having a two day meeting. Moreover, specifically, a list of all cracks, identifying the explicit location of each in the structure, the size and shape, evidence of growth, etc. was requested so that we study it completely and thoroughly. (If there is any problem with providing this full list, then I for one, want at least a list of all the larger cracks found, for study before the final day of the next meeting.) Is this request still recalled?

Sincerely yours,

PAUL C. PARIS,
Professor of Mechanics,
Director, Center for Fracture Mechanics.

DEPARTMENT OF THE AIR FORCE,
AIR FORCE FLIGHT DYNAMICS LABORATORY,
Wright Patterson Air Force Base, Ohio, June 14, 1979.

Subject: Your letter dated 29 May 1979.

To: Washington University, Attn: Dr. P. C. Paris, Campus Box 1124, 405 Urbaner, St. Louis, Mo.

1. The minutes of the 18 April meeting were prepared using my notes but only after conferring with other Air Force attendees on the context of our discussions on Task 7. It is unfortunate that you do not recall my "speech" concerning the credibility of the residual strength findings; others did,

2. Your primary concern seems to be centered around the implication of inadequate single element fail safety in certain areas of the inner wing. I recall that Warren Stauffer supported this, citing that the 1972 IRT had in fact found portions of the lower surface to be marginal with regard to FAR fail safety. I don't feel "deliberately misled" about this issue. I had always heard (chiefly through discussions with Tiffany) that the C–5A had been designed to meet FAR

fail-safe requirements. I know the aircraft was never certified. I am not surprised by the recent SIEP results, nor is Lockheed. Furthermore I don't consider this to be the foremost issue concerning the safety of the C-5. The fact that the KC-135 has safely sustained single element failures has no bearing on the C-5A issue, as you well know.

3. I used the term "ill timed" in my address to the Steering Committee to emphasize that we had received the full support of the committee through all aspects of Task 7 and with no more backup data than you indicated to support your arguments, I did not feel it appropriate for you to discredit the SIEP results. I still feel that way.

4. The idea to discuss the final results with Swift and Wilhem was a good one since both had been involved in the early development of Task 7. Both were selected by the Air Force because of their expertise and both gave valuable guidance. We decided to convene at CALAC to keep time and travel requirements to a minimum. Swift and Wilhem donated their efforts to this activity.

5. Damage tolerance requirements for the new wing were met through the slow crack growth option of MIL-A-83444. I know of no fail safe requirements levied by the Air Force.

6. I don't understand the first paragraph on page 2 of your letter!

7. We intend to provide a summary of cracking data in advance of the next meeting. We still are in the process of sorting out types, sizes, locations, etc. I haven't forgotten my commitment.

HOWARD A. WOOD,
SIEP Technical Director.

LOCKHEED-GEORGIA CO.,
INTERDEPARTMENTAL COMMUNICATION.

To: Distribution:
Date: May 8, 1979.
From: H. A. Wood/R. L. Circle.
Subject: Minutes of 18 April 1979 steering committee meeting, C-5A structural information enhancement program (SIEP).

1. The SIEP Steering Committee met at Lockheed-Georgia on 18 April 1979 to review the interim status of Tasks 2 and 3 and the final results of Tasks 4 and 7. The meeting agenda and list of attendees is attached. Briefing material for Tasks 3, 4 and 7 were distributed at the meeting to all committee members. Material for Task 2 was not distributed.

2. *Task 2 summary.*—C. Brown reported the status of WING CAP as basically on schedule with approximately 80 percent of the Lockheed and AFML efforts and 100 percent of the Independent Laboratory, Southwest Research Institute (SWRI) program having been completed. Representatives from SWRI were in attendance. As in past meetings, all attendees were cautioned against drawing conclusions regarding the WING CAP results. Some concern was experienced over the significance of the limited sample taper-loc head protrusion data shown. As a follow-up to this concern, Lockheed offered to gather available test data on potential life benefit versus interference level. The total WING CAP head protrusion data sample will be more thoroughly reviewed, particularly with regard to distribution by structural location.

The extent of mechanical damage found in the teardown was of considerable interest to the committee; specifically, the fact that much of the damage had not initiated or grown cracks. Several committee members expressed the feeling that the C-5 mechanical damage story was not unusual and that order systems (e.g. KC-135) should be examined for comparison. SIEP plans to tabulate and summarize the mechanical damage aspects of WING CAP were explained to the Committee (orientation in the hole, etc.) and should help shed some light on why the damage did not propagate. It is planned to review the KC-135 teardown data to determine whether or not mechanical damage was recorded on that program. The possible origin of the "eyebrow" surface crack found during WING CAP and the KC-135 teardown was discussed with several speculative opinions being offered. It is felt the etching may have obscured any information regarding the origin, however, fatigue striations were noted in several of the eyebrow cracks, indicating their potential to propagate. This type of cracking was extensive on the KC-135.

Tom Cooper presented AFML findings to date for their portion of WING CAP. Since AFML is examining all panels previously looked at by Lockheed and SWRI, their findings should represent cracks missed by the other participants.

Findings of the Independent Lab (SWRI) were reviewed. For the 10% sample examined, the cracking found, location and type of cracking are in agreement with the Lockheed findings.

3. *Task 7—Dual panel failure analysis.*—The final results of Task 7 were presented including the final allowable strength data for the three wing locations and the flight restriction scenario and potential survivability estimates following a two panel failure. It was pointed out that the original task to perform a risk analysis of this condition was dropped since the minimum allowable stress was approximately equal to the 1g stress condition for current operating conditions and thus wing failure without further drastic flight restriction was certain following a dual panel failure. Dr. Paris questioned the validity of the Task 7 results on the basis of his past experience and his rough calculations. It was pointed out to Dr. Paris and others that the committee had been briefed on all technical aspects at previous meetings and that it was ill-timed to begin to doubt the findings at this stage. As a consequence of the Paris concern, it was agreed that the Task 7 results be reviewed with outside experts, specifically T. Swift, McDonnell-Douglas and D. Wilhem, Northrop. Paris agreed that if Swift and Wilhem concurred with the SIEP findings, then he would be satisfied. A meeting was subsequently held at CALAC with Swift and Wilhem to close this issue. The results of that meeting are attached to this report.

4. *Task 4—Fracture tracking development.*—The Committee concurred with all aspects of the proposed fracture tracking approach and the Lockheed recommendations.

5. *Task 3—Material property assessment.*—Lockheed presented the final crack growth rate data being developed as part of Task 3. Considerable discussion ensued over the amount of scatter exhibited between extrusions (± 2). This concern centered around whether or not the apparent scatter was partially due to test technique or due to true material variability. It is doubtful that this issue will ever be resolved since the data is largely spot checks at two growth rates (10^{-4} & 10^{-7}). It was pointed out that every effort was made to minimize test techique variability. It was agreed however that Lockheed and the Air Force would investigate this issue further.

6. Mr. Wood reviewed the tentative schedule of meetings on SIEP up to DSARC. A SAB review is scheduled for early August 1979. The final Steering Committee Meeting will be scheduled for July 1979.

H. A. Wood,
AF SIEP Technical Director.
R. L. Circle,
LGC Program Manager (SIEP).

Attachments: Meeting Agenda; List of Attendees; and Results of 30 April meeting, Task 7.

AGENDA.—SIEP STEERING COMMITTEE MEETING, APRIL 18, 1979

CONFERENCE ROOM "B"

8:30 a.m.
I. Introduction
Introductory Remarks—Wood/Circle
Overall Program Status—Circle
II. Task 2—WCAP Review—Brown
10:00 a.m.—Coffee Break
10:15 a.m.—Continue WCAP Review
12:00 Noon—Lunch
1:00 p.m.—III. Task 7—Dual Panel Failure Analysis—Conley
1:30 p.m.—IV. Task 4—Fracture Tracking Development System—Akins
3:00 p.m.—Coffee Break
3:15 p.m.—V. Task 3—Material Property Assessment—Conley
4:30 p.m.—VI. Adjourn

ATTENDEES—APRIL 18, 1979, SIEP MEETING, LOCKHEED-GEORGIA CO.

R. L. Circle, SIEP Program Manager, GELAC; 424–2813
H. A. Wood, AF SIEP Technical Director, AFFDL/FBE; 424–5876
J. L. Akins, GELAC; 424–3168

P. R. Barber, GELAC; 424–2813
J. E. Barclay, GELAC; 424–4471
F. M. Conley, GELAC; 424–3121
T. E. Disney, GELAC; 424–2240
R. D. Gilson, GELAC; 424–3969
S. A. Maddox, GELAC; 424–4985
S. C. Rogers, GELAC; 424–2077
J. L. Russ, GELAC; 424–3470
A. P. Shewmaker, GELAC; 424–2752
W. A. Stauffer, Lockheed-Califronia; (213) 847–5104
Moe Caldwell, AFPRO; 424–3137
Col. E. A. Chambers, Hq. USAF/RDQRA; AV 227–4185
T. D. Cooper, AFML/MXA; 785–2623
Maj. R. H. Doughty, Hq. USAF/RDQRA; AV 277–4185
Capt. Bill Heincker, Hq. MAC/LGMW; AV 638–4771
W. Hippenmeyer, Hq. AFLC/LOE; AV 787–2151
J. L. Hopkins, ASD/SD-28E; 5–3104
Capt. E. W. Howe, Hq. MAC/XPQAS; AV 638–3167
J. W. Lincoln, ASD/ENFS; AV 785–6879
J. R. Noyes, ASD/SD-28; 785–2591
Dr. Paul C. Paris, Wash. U./ASD/ENO; (314) 889–6044
Capt. D. R. Schneider, SA-ALC/MMSRE; AV 945–4524
Col. R. L. Scott, SA-ALC/MMS; AV 945–4316
O. L. Smithers, ASD/ENFSE; AV 785–2716
T. J. White, SA-ALC/MMSRE; AV 945–4525
C. J. Kerr, SWRI; (512) 684–5111
Joe Mayer, SWRI; (512) 684–5111

ATTACHMENT TO MINUTES OF APRIL 18, 1979, STEERING COMMITTEE MEETING, C-5 STRUCTURAL INFORMATION ENHANCEMENT PROGRAM (SIEP)

Subject: Results of 30 April meeting on Task 7 Dual Panel Residual Strength and Restriction Study.
Location: Lockheed-California Co.

ATTENDEES

Tom Swift, McDonnell-Douglas Aircraft
Dave Wilhem, Northrop
Stan Chu, CALAC
Ken Walker, CALAC
Roberto Contini, CALAC
Warren Stauffer, CALAC
Henry Simon, CALAC
Howard Wood, Air Force
Fred Conley, GELAC
Richard Circle, GELAC
Jim Russ, GELAC
Robert Wilkinson, GELAC

1. This meeting was convened as a result of the 18 April SIEP Steering Committee recommendation to review the Task 7 results with T. Swift, McDonnell-Douglas and D. Wilhem, Northrop. Both individuals are recognized experts in the area of residual strength prediction. Lockheed California personnel having knowledge in this area were also in attendance. Initial plans to conduct Task 7 had been presented to Swift and Wilhem in February 1978.

2. Lockheed presented Task 7 briefing charts previously shown to the Steering Committee. Backup material, analysis and test results were available as required. A thorough review was made of the assumptions, failure criteria, test results finite element modeling, etc. used to establish the dual panel strength allowables. Tests and analyses from Tasks 1 and 7 were reviewed in detail for the crack growth survivability aspects of the study.

3. Both Swift and Wilhem expressed the feeling that the basic approach was extremely sophisticated. These feelings were seconded by the CALAC attendees, in particular, R. Contini who performed dual panel analysis for the IRT. They concurred also that the allowable appeared reasonable for the type of construction, stress level and material involved. Concerning the survivability aspects,

Wilhem and Swift agreed with the SIEP findings that the prediction of small crack growth tends to be unconservative using current methods.

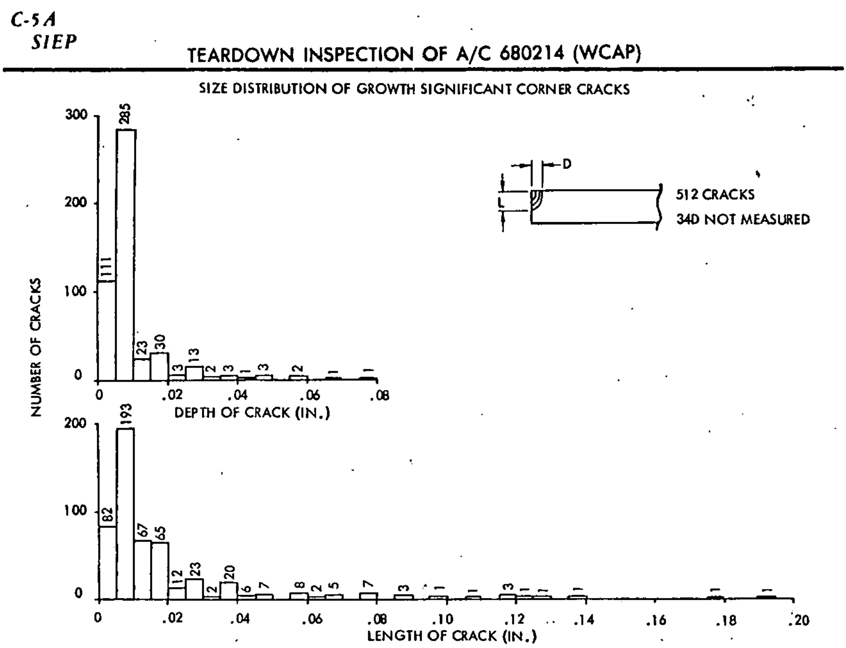
4. The subject of crack growth rate material variability was discussed at length. The attendees agreed that the SIEP observer scatter (±2) for extension to extrusion appeared reasonable, and was in fact largely due to material scatter. They felt that it would be difficult to quantify the contribution of test procedure to the overall scatter. SIEP will continue to study this problem as suggested by the Steering Committee on 18 April.

H. A. Wood,
AF SIEP Technical Director.
R. L. Circle,
LGC Program Manager (SIEP).

Date: July 6, 1979.
To: Washington University, Dr. P. C. Paris, Campus Box 1124, 405 Urbauer, St. Louis, Mo.
Subject: SIEP Cracking Data, A/C 680214.

1. Per your request, the subject data is forwarded for your review.
2. The evaluation of these and other teardown findings will be discussed at the 12–13 July Steering Committee Meeting.

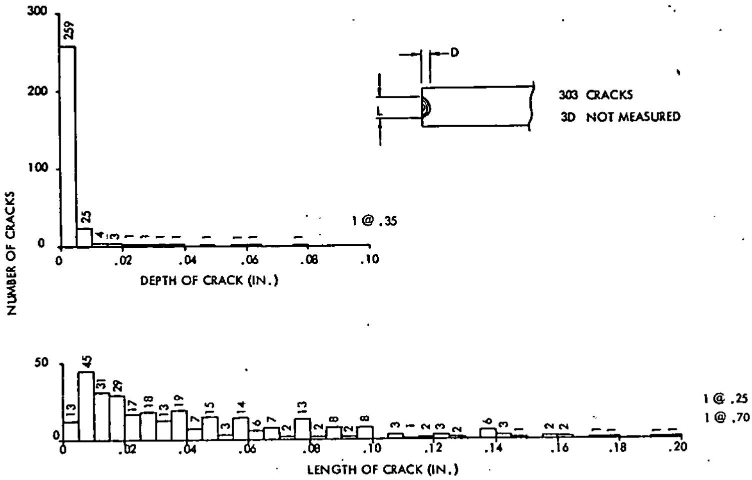
Howard A. Wood,
AF SIEP Technical Director.



C-5A
SIEP

TEARDOWN INSPECTION OF A/C 680214 (WCAP)

SIZE DISTRIBUTION OF GROWTH SIGNIFICANT HOLE WALL CRACKS



C-5A
SIEP

TEARDOWN INSPECTION OF A/C 680214 (WCAP)

CRACKING BY STRUCTURAL COMPONENTS
(ALL LABORATORIES)

	TOTAL CRACKS	CRACKS WITH GROWTH SIGNIFICANCE
SPANWISE SPLICE	253	154
BEAM CAP TO WEB	341	284
RIB CLIP TO PANEL RISER	90	70
RIB CLIP TO PANEL	61	35
RIB CLIP TO PANEL RISER (CENTER WING)	5	4
TRAILING/LEADING EDGE ATTACHMENT	72	36
CHORDWISE JOINTS	439	291
DOUBLER TO PANEL	21	11
PYLON RIB/PANEL	9	4
BEAM WEB TO STIFFENER	7	6
BEAM WEB TO DOUBLER	26	13
BEAM WEB TO FITTING	10	9
BEAM CAP TO STIFFENER	11	7
BEAM CAP TO FITTING	18	7
	1363	931

Senator PROXMIRE. See, it was the location of the cracks that Mr. Paris seems to have been concerned about, and that information of which he was critical was not provided.

Mr. WOOD. OK. Let me comment on that, please. We examined, as Mr. Mark said, in excess of 44,000 individual fastener holes and found upward to greater than 1,300 cracks. This entailed an extreme amount of bookkeeping as to the location and the size of cracks——

Senator PROXMIRE. Let me interrupt for a minute, Mr. Wood. I want to show you what I mean here. You sent three diagrams. This is the data that Mr. Paris requested. I would say there are probably 15 volumes of technical data here. This is the kind of information that Mr. Paris wanted.

Mr. WOOD. I will complete the testimony, if you please.

Senator PROXMIRE. Go ahead. I just wanted you to know what I was talking about.

Mr. WOOD. At the time that Mr. Paris requested the data, we had just completed the teardown. As I mentioned before, we had elaborate bookkeeping and recording procedures as to the locations, the types of cracks, and the sizes of cracks. All of this information for approximately 14 months, the length of the teardown, was kept at the Lockheed Corp. and was available to members of the steering committee at that period. We accumulated the data over that 14 months——

[The following expanded remarks on the above response were subsequently supplied for the record:]

The raw records were maintained in the room where the examinations were conducted. Duplicate records were kept in a special room also set up to display and review the findings.

Senator PROXMIRE. How was that made available?

Mr. WOOD. The steering committee, when they arrived at Lockheed or when they met during their regular meetings at Lockheed, had access to that room, and they were allowed to go down there and look at that data. It was not simply a matter of picking the data up and mailing it out.

At the time that Mr. Paris requested it, those reports had not been published or printed or even written.

Senator PROXMIRE. Could I ask Mr. Paris, who is in the room, to rise.

[Witness is sworn.]

TESTIMONY OF PAUL C. PARIS, DIRECTOR, CENTER FOR FRACTURE MECHANICS, UNIVERSITY OF WASHINGTON, SEATTLE, WASH.

Senator PROXMIRE. Mr. Paris, what's your response to Mr. Wood's statement about access to the data?

Mr. PARIS. If we had access to the data, I never knew it. I had asked from time to time to see it and was never told that we could go down——

Senator PROXMIRE. You say you asked to see the data. How about that room where Mr. Wood said you——

Mr. PARIS. I don't recall ever being told there was such a room.

Senator PROXMIRE. All right, sir.

Now, Secretary Mark, isn't it correct that none of the larger cracks found in the SIEP study are located in critical areas, the wing; and is this the reason why the information was kept away from Mr. Paris?

Secretary MARK. No, sir, as I already explained to Mr. Wylie in answering the question about the rogue flaw, the fact that one doesn't find things like that on a teardown doesn't mean they are not there on other aircraft in the fleet. The essential result of the SIEP study, the essential experimental result of the SIEP study, as I believe Mr. McCarthy has already said, was the discovery of the presence of a larger than anticipated degree of widespread cracking. And it was this fact that really led people to the conclusion that something would have to be done and something would have to be done quickly.

Senator PROXMIRE. Let me just ask you a couple of very general questions in conclusion. If you now reward Lockheed for their blunders, enabling them to make at least a potential profit—you say they may not make it, but they could make a profit of over $100 million—how will you ever convince other contractors that you're serious about getting true value for the taxpayer's money?

Secretary MARK. Mr. Chairman, I don't regard the wing modification program as a reward for Lockheed's blunders. I regard the wing modification program as something that we must do to maintain a military capability that we have.

Senator PROXMIRE. Wouldn't you view a $140 million profit as a nice reward?

Secretary MARK. I do not at the present time know, nor does Lockheed, what profit they will in fact make on this contract. What I know is that the Lockheed Corp. has not gained in terms of reputation in the aerospace industry through this whole 10-year episode. It is not something, Mr. Chairman, that they look upon with a great deal of satisfaction.

Now, as I have already said, I guess I haven't said, but I should say—that I sympathize with the effort to draw lessons from this, because it is the kind of thing that we really would like to avoid in the future. But I don't think that the contract we are talking about here is in any sense a reward.

Senator PROXMIRE. Secretary Mark, the last thing I could ever qualify for is a marriage counselor. But in marriages, as you know, often it's a lack of communication. People just won't talk to each other. If they would sit down and talk things out, I am told that people could solve their problems pretty well.

I think that occurred in the case of Ernest Fitzgerald, who is in my judgment an outstanding civil servant. He was given a great award as the best weapons analyst in the Air Force in 1967, before he committed truth before our committee. And after that he was alienated and seldom talked to.

Did it occur to you to talk to Mr. Paris and talk to him about his views? After all, there's a difference here, as you say, and you were very good in your comment about his outstanding ability. You didn't question that for a minute. But when did you last talk to him?

Secretary MARK. Mr. Chairman, I first met Mr. Paris, Professor Paris, this morning. I did read his letters to you. I read the Rand report, which——

Senator PROXMIRE. That's an astonishing statement. You just met him this morning?

Secretary MARK. Yes, sir.

Senator PROXMIRE. It seems to me that in view of his eminence, as you state, and the fact that he disagreed so strongly with you——

Secretary MARK. May I finish my comments, sir?

Senator PROXMIRE. All right.

Secretary MARK. I read the Rand report for which he was responsible in a technical sense. I have read his correspondence with you. I have no reason to quarrel with what he said. These are his statements. They are on the record. I have no reason to believe that he would be necessarily shaken by discussion with me. I took what he said at face value, and I believe he believes what he says. And I have no real reason to draw any other conclusion.

The question, sir, is what weight must I assign to what Professor Paris said, as opposed to what every other highly qualified technical expert has told me that we have asked.

Senator PROXMIRE. Supposing last year you had, on the basis of your judgment—and I think it's a proper judgment—of Mr. Paris' qualifications, if you believed that he meant what he said, it seems to me that the logical step would have been to order a study. That study would be completed by now, independent study.

Secretary MARK. No, sir. I believe that a new independent study would have to be done in the same depth, in the same thoroughness, as the SIEP study which we have already completed, which was completed at about that time. And so I would have a problem saying that we could complete a study in a few months. I don't think that's true.

Senator PROXMIRE. All right, sir. I think we have a hearing record which I think is quite clear. I want to thank you very, very much, Secretary Mark and gentlemen, for appearing here this morning to testify.

Secretary MARK. We appreciate the opportunity to appear, sir. Thank you.

Senator PROXMIRE. The subcommittee stands adjourned.

[Whereupon, at 11:35 a.m., the subcommittee adjourned, subject to the call of the Chair.]

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