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The Navy is planning and exploring a Vertical Short Takeoff and Landing (VSTOL) aircraft program which could change its approach to providing and using sea-based aircraft in power projection and sea control functions. A transition to an all VSTOL sea-based air fleet is expected from 1991-2000. This could result in smaller deck aircraft carriers and the dispersal of manned tactical aircraft. Findings/Conclusions: In the current program, the Navy is studying operational concepts to demonstrate the capabilities of current and future ship and aircraft combinations. Several considerations could limit program development. If VSTOL aircraft are not available during the transition period, in which both VSTOL and conventional aircraft would be operating off large deck carriers, there would be pressures to retain conventional aircraft. There are questions of whether the costs for development of VSTOL can be met while meeting current sea-based air fleet needs. The degree of VSTOL implementation will be determined by the effectiveness of dispersion of aircraft on a larger number of ship platforms. Assessments are being made of the degree of reliability, maintainability, and availability which can be achieved by VSTOL. Development depends on technological advancement which is being assessed for risk, needs, and status. There is a question of whether the acquisition strategy planned for the program complies with Office of Management and Budget (OMB) policies. Recommendations: During future appropriation hearings on Navy tactical aircraft programs, the Congress should fully consider matters relating to reliability, maintainability, availability, effectiveness of dispersion, the state of technology, and acquisition strategy. The Secretary of Defense should: give priority attention to whether the operational concepts being proposed for VSTOL are realistic and cost effective, determine whether the advances in technology necessary to develop VSTOL are reasonable and can be achieved before the scheduled full-scale development decision, and resolve the question of

compliance with regard to OMB Circular A-109 early in the VSTOL program. (MTW)

5501

REPORT TO THE CONGRESS

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

Status Of The Navy's Vertical Short Takeoff and Landing Aircraft

The Navy is planning and exploring a Vertical Short Takeoff and Landing (VSTOL) aircraft program that could change the complexion of Naval aviation at sea. The program, as envisioned, will begin replacing conventional takeoff and landing aircraft with VSTOL aircraft during the 1991 to 2000 time frame.

VSTOL decisions will affect the Navy's entire sea-based aircraft program. New operational concepts are being explored and technology needs are being assessed for VSTOL. Development costs alone are estimated in the billions. Nonetheless, the Navy's acquisition strategy does not appear to comply fully with Office of Management and Budget policies for buying major systems.

PSAD-78-61

FEBRUARY 23, 1978

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

B-163058

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

This report presents our views on the major issues of Navy's Vertical Short Take-off and Landing Aircraft. A draft of this report was reviewed by agency officials associated with the program and their comments are incorporated as appropriate.

For the past several years we have annually reported to the Congress on the status of selected major weapons systems. This report is one of a series of reports that we are furnishing this year to the Congress for its use in reviewing fiscal year 1979 requests for funds.

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).

We are sending copies of this report to the Acting Director, Office of Management and Budget, and the Secretary of Defense.

Comptroller General
of the United States

D I G E S T

The Navy is embarking on a VSTOL aircraft program which could change its approach to providing and using sea-based aircraft in power projection and sea control functions. The Navy's plan to transition to an all VSTOL sea-based air fleet will afford maximum flexibility in aircraft carrier design that could result in smaller deck aircraft carriers and disperse manned tactical aircraft throughout the broad spectrum of fleet surface combatants.

In the current VSTOL program, the Navy is studying operational concepts to demonstrate the capabilities of current and future ship and aircraft combinations. The program is in concept formulation and has been influenced by such subjects as force composition; dispersion; reliability, maintainability, and availability; technology; and funding. Limitations in any one of these subjects could lead to the demise of the program. Specifically:

--During the transition to VSTOL, both VSTOL and conventional aircraft can be expected to be operating off large deck carriers. The temptation to propagate that configuration would be great. In contrast, there could be a strong case to retain conventional aircraft with their capabilities, if VSTOL is not available as planned. (See ch. 2.)

--The total estimated cost for VSTOL is not yet fully known, but development will cost billions. The issue could be whether Defense can afford the VSTOL program and continue to provide for the Navy's current sea-based air fleet needs. (See ch. 2.)

--Dispersion of aircraft on a larger number of surface ship platforms, the Navy claims, enhances flexibility and reduces force vulnerability. Dispersion is of prime importance to the VSTOL program. How effectively it can be achieved may determine the degree to which VSTOL is ultimately implemented. (See ch. 3.)

--Reliability, maintainability, and availability needs for VSTOL are critical to its usefulness. The potential for achieving increases is being assessed by the Navy, and large increases over the current experience for sea-based aircraft must be achieved. Reliability and maintainability must be high because aircraft will be dispersed on platforms having limited logistic support. (See ch. 4.)

--Technology needs are considerable and the risk is high because advances must be made in the state of the art for primary aircraft systems and for mission specific equipment. Design of a new aircraft concept, as could be expected at this state of development, has many technological unknowns. The Navy is building on its ongoing technology efforts and current and prior industry efforts in assessing technology risk, needs, and status. (See ch. 4.)

--Defense is committed to complying with Office of Management and Budget Circular A-109 for the VSTOL program, which establishes the policies to be followed by executive branch agencies in the acquisition of major systems. (See app. III.) There is a question, however, of whether the acquisition strategy planned for the program complies with the new policies. Defense has stated that its current strategy is preliminary and does not reflect the final position. (See ch. 5.)

CONCLUSIONS AND RECOMMENDATIONS

The matters addressed above will affect the effective and timely progression of the VSTOL program.

GAO believes that because VSTOL is such a substantial departure from the Navy's current operational philosophy, it is going to require new operational concepts that will put a greater premium on reliability, maintainability, and availability. Operational concepts, e.g., how effectively can dispersion be achieved?, need to be developed and evaluated. At the same time, significant advances in technology are needed to reduce the high risk to low risk by the time the full-scale development decision is made in 1985. In addition, aspects of the VSTOL program acquisition strategy may not be in compliance with OMB Circular A-109.

GAO recommends that the Congress fully consider these matters during future appropriation hearings on Navy tactical aircraft programs. Further, GAO recommends that the Secretary of Defense

--give priority attention to whether the operational concepts being proposed for VSTOL are realistic and cost effective. Of particular importance is whether VSTOL can be effectively dispersed,

--determine whether the advances in technology necessary to develop VSTOL are reasonable and can be achieved prior to the scheduled full-scale development decision, and

--resolve the question of compliance with regard to OMB Circular A-109 early in the VSTOL program.

AGENCY COMMENTS

A draft of the report was reviewed by agency officials associated with the management of the program and their comments have been incorporated as appropriate.

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ABBREVIATIONS

CNO	Chief of Naval Operations
CTOL	Conventional takeoff and landing
DOD	Department of Defense
MDT	Mean downtime
MENS	Mission element need statement
MFHBF	Mean flight hours between failures
MTBM	Mean time between maintenance
MNS	Mission need statement
OFPP	Office of Federal Procurement Policy
OMB	Office of Management and Budget
OSD	Office of the Secretary of Defense
SHP	Shafted horsepower
VSTOL	Vertical and Short Takeoff and Landing

CHAPTER 1

INTRODUCTION

The Navy's mission is to conduct prompt and sustained combat operations at sea supporting U.S. national interests. To fulfill its mission, Navy has two basic functions--sea control and power projection--which are closely interrelated and involve the use of aircraft, surface ships, and submarines and their weapons. To carry out its functions and fulfill its mission in the face of expanded multidimensional threats, Navy's force structure considers a war-fighting balance to cope with coordinated air, surface, and submarine threats in any theater. Sea-based, manned aircraft represent an element of Navy's capabilities to counter multidimensional threats and to carry out other required warfare tasks.

Sea-based aircraft have allowed naval force tactical commanders to expand their surveillance of sea and airspace to ranges beyond the limitations of ship-based sensors. Aircraft have allowed the engagement of enemy naval forces at sea and targets ashore beyond the range of direct threats to friendly force ships. Sea-based aircraft have allowed fast reaction and massing of force against rapidly developing enemy threats. They have produced significant enlargement of the naval forces' sea-control area of influence.

VSTOL AIRCRAFT

Recognizing the advantages and use of sea-based, manned, tactical aircraft over the recent years, the Navy has maintained a continual effort to develop high performance military aircraft that operate from platforms other than aircraft carrier in order to apply the advantages of sea-based air fleet across a broader spectrum of Navy ships. Also, aircraft operating from different types of surface combatants enhance the individual mission effectiveness of those types of ships.

Following explorations into the technical feasibility and operational use of VSTOL aircraft, the Navy decided to change its sea-based air fleet to VSTOL aircraft beginning in 1990 to 2000 provided that the feasibility of the VSTOL concept is validated. Navy preliminary planning identified two basic types of VSTOL aircraft to fulfill many future Navy/Marine Corps requirements--the subsonic multimission

aircraft designated Type A and a supersonic high performance aircraft designated Type B. This report addresses the advanced VSTOL Type A program. The AV-8 (Harrier) and the ongoing helicopter programs are not considered.

PROGRAM STATUS AND PLANS

The VSTOL program's acquisition cycle has four phases--concept formulation, validation, full-scale development, and production. Concept formulation began early in 1977 after initial approval of the Type A VSTOL mission need statement. After the Navy issued a request for information, industry participation in developing the Type A VSTOL program began. The Navy is assessing many ideas from the responses to the information request. It will use this assessment, together with the work being done in-house and the concept analysis work being done to prepare a request for design study proposals, to be issued in spring 1978. After evaluating the responses, Navy plans to award design study contracts 1/ that are anticipated for completion by 1979. The Navy plans to conclude the concept formulation stage by awarding competitive contracts to develop prototype models.

The prototype development begins the validation phase, which would result in the prototype systems' flyoff tests early in 1983 to validate performance and define what will be included in the contract for the next stage. The Navy's plan is to conclude the flyoff tests and contract definition phase, thus making 1986 the technology cutoff for engineering development and the beginning of full-scale development. An initial operational capability date in the early 1990s depends on timely completion of development and initial production efforts.

SCOPE OF REVIEW

We interviewed officials regarding technology development matters in the Office of the Secretary of Defense and the Department of the Navy and reviewed records pertinent to planning and implementing the VSTOL concept.

We conducted interviews with DOD and Office of Federal Procurement Policy officials regarding Federal procurement policy as applied to the VSTOL development program.

1/Additional discussion is included in ch. 5.

We made the review at the:

Office of the Secretary of Defense:

Deputy Under Secretary of Defense for Research and Engineering, Washington, D.C.

Department of the Navy:

Office of the Chief of Naval Operations, Washington, D.C.

Naval Air Systems Command, Washington, D.C.

Naval Air Development Center, Warminster, Pennsylvania

Office of Management and Budget:

Office of Federal Procurement Policy, Washington, D.C.

CHAPTER 2

EVOLUTION OF VSTOL AND SEA-BASED AIRCRAFT FORCE COMPOSITION IMPLICATIONS

Because of limited deck space on surface combatants other than aircraft carriers, VSTOL aircraft have always been attractive to the Navy. Efforts to foster VSTOL development met with inconclusive results until 1976 when technological developments indicated that the VSTOL concept appeared feasible and that a concerted development effort could be undertaken. A transition plan was established for phasing in VSTOL, as each current type of sea-based conventional aircraft reached the end of its service life.

The transition to VSTOL has force-composition implications that could be advantageous or detrimental to the sea-based aircraft program. Specifically, both VSTOL and conventional aircraft could be found in the Navy's sea-based air fleet at the same time resulting in a sea-based air and ship fleet much larger than the present one. The temptation to propagate that configuration would be great. In contrast, if VSTOL is not available as scheduled, advanced conventional aircraft could easily become the sea-based aircraft program.

The VSTOL program is experiencing delays during its first year, and funding constraints affect not only VSTOL but all sea-based aircraft programs. The VSTOL program is expected to cost billions of dollars. In view of the overall sea-based aircraft force level needs, the question of the affordability of VSTOL is raised.

EVOLUTION OF VSTOL

Exploration of the development of fixed-wing VSTOL aircraft has been a part of Navy's sea-based air efforts for about 25 years. According to the Navy, VSTOL's lack of success in its early attempts stems from the limited performance of VSTOL aircraft in comparison with their conventional takeoff and landing (CTOL) counterparts.

In an effort to force the design of higher performance VSTOL aircraft, the Navy, early in the 1970s, specified the need for a VSTOL version of a combination fighter/attack

aircraft. Several studies extending through 1974 explored different types of VSTOL aircraft.

In the spring of 1975, the Chief of Naval Operations (CNO) reviewed the status of VSTOL and its platform programs and concluded that the failure of VSTOL development was due primarily to the fact that it was competing for aviation program funds with land-based patrol and carrier aircraft. Further, the types of VSTOL aircraft, which technology could provide in the near term, were substantially less capable in performance than their CTOL counterparts. In the CNO's view, if VSTOL aircraft were to be introduced in any significant Navy role, it was clear that a new approach must be taken.

The CNO decided that the approach would be developing VSTOL aircraft to operate from all sea-based platforms, carriers (defined as ships which operate aircraft as a primary mission), or air-capable ships (defined as surface combatants which use aircraft to enhance their basic mission). Two primary advantages of this approach were identified:

Dispersion--Manned tactical aircraft could be expanded throughout the fleet enabling surface combatants to attain new self-contained capabilities in independent operations.

Flexibility--The design of future carriers could become more flexibile without the need for angled decks, catapults, and arresting gear. Further, carriers could be large or small and either nuclear or conventional.

In formulating the VSTOL concept, the Navy decided to achieve one of its long-term objectives, i.e., to reduce the different types of aircraft in the Navy and Marine Corps inventory. The benefits of such an achievement are self-evident.

The Navy has identified a full range of VSTOL aircraft types. The relationship of the two VSTOL types to the Navy's air warfare tasks is shown in appendix II.

In the spring of 1976, the VSTOL concept was proposed to the Secretary of Defense and the National Security Council; approval was given to proceed. The Navy had identified its most urgent shortfall in aircraft as (1) airborne

early warning, (2) antisubmarine warfare, (3) carrier onboard delivery, and (4) marine assault support. These needs fall into the Type A VSTOL category of missions, and current VSTOL development efforts are aimed at these needs. The fiscal year 1978 5-year development program shows research and development costs for that period of about $0.8 billion for the Type A development program and about $0.2 billion for related VSTOL technology support programs.

VSTOL TRANSITION PLAN

The CNO developed a plan to change the Navy's sea-based air fleet to a VSTOL force. The expected transition period is from 1991 to 2000.

Part of the approach to VSTOL's transition is to plan replacement of each current sea-based conventional aircraft at the end of its service life with a VSTOL aircraft. The replacement schedule for the current basic carrier aircraft is shown in table 1.

The CTOL aircraft fall into two basic categories; i.e., the subsonic, load-carrying, long-range aircraft and the high performance, supersonic aircraft for fighter attack and reconnaissance missions. The helicopter is another basic aircraft category. VSTOL aircraft would replace these three basic types.

On the ship side, one concept was that small VSTOL carriers only be phased in toward the end of the 1980 decade as special-purpose carriers of limited capability and missions. These carriers would supplement the large multipurpose carriers represented by today's large deck carriers (designated as CVs) and their future replacements.

These transition plans and the VSTOL development program have the following objectives:

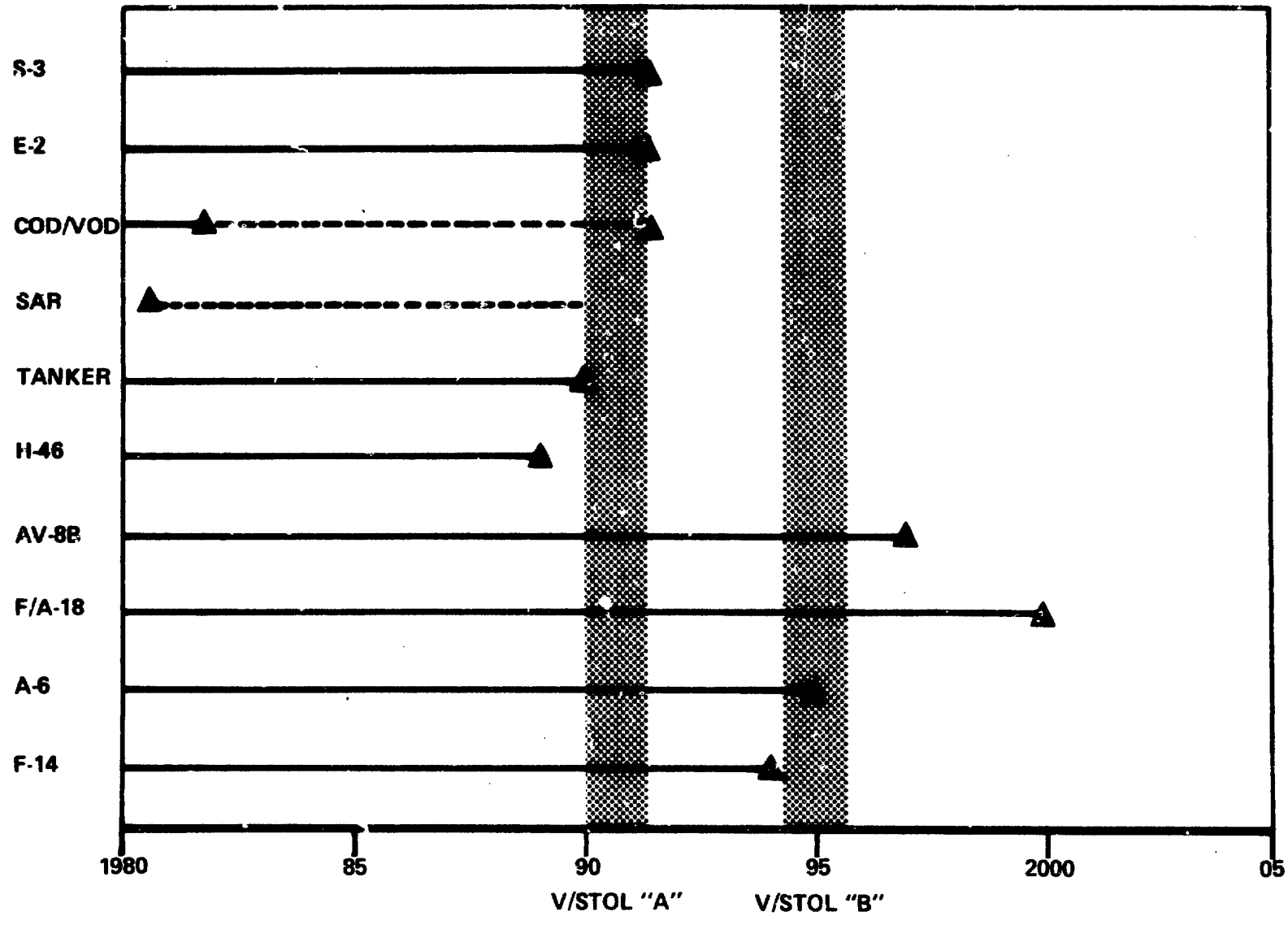
--Provide alternative courses of action that would allow time to establish plans for follow-on CTOL aircraft early in the 1990s to reduce the overall risks of the transition.

--Transit to pure VSTOL carriers when the VSTOL capability has been achieved.

TABLE 1

NAVAL AVIATION PLAN

APPROXIMATE IOCs FOR REPLACEMENT AIRCRAFT



--Direct aircraft research and development efforts primarily to VSTOL during the transition phase.

--Replace current CTOL models, at the end of their normal service life, with VSTOL.

--Transit from CTOL carrier aircraft to VSTOL carrier aircraft for all sea-based, manned, tactical air missions in the U.S. Navy.

--Maintain the capability of the carrier/naval aviation force at a level not below its current status.

VSTOL AND FORCE COMPOSITION

The phasing in of VSTOL aircraft into the Navy inventory envisions replacing each current sea-based conventional aircraft at the end of its service life. Both VSTOL and CTOL aircraft can be expected to be operating off large deck carriers during the transition period and beyond. It is probable that pure VSTOL ships will be operating at the same time or shortly thereafter. The combined air and ship inventory may result in a sea-based aircraft Navy much larger than the present one. The temptation to propagate that configuration would be great. The large deck carrier advocates could present a strong case for retaining CTOL aircraft.

In contrast, a critical point could be reached whereby VSTOL is not ready and CTOL decisions are needed. Thus, a slip in the VSTOL program, past that point will mean that an advanced CTOL could easily be required to become the sea-based aircraft program.

FUNDING AND PROGRAM DELAYS

As Navy's estimates show, the VSTOL program will be expensive. Cost estimates available now, covering the first 5 years of the 14-year VSTOL program of development, show a $1 billion figure. Shipbuilding and modification program cost estimates had not been completed at the time of the report.

Thus far congressional action indicates less than full support for VSTOL due partly to congressional needs for better and more complete information about Navy's plans.

Congressional funding action cut Navy's fiscal year 1978 budget request for VSTOL in half.

In August 1977, the Secretary of Defense made a tentative cut in the fiscal year 1979 and 1980 VSTOL budget. According to Navy officials, this action would have delayed the prototype development and the projected operational date for the aircraft by about 2 years. We were advised that Navy's position is that funding cuts during this concept formulation period would not allow it the opportunity to decide whether technology will be able to support VSTOL development. The Navy stated that, according to DOD acquisition policies, a decision of this type is more appropriately made when a program reaches a major decision point. 1/ The next major decision for VSTOL is currently scheduled for late 1980. We were told that the Secretary agreed with Navy's reasoning and the funding was restored. However, large funding cuts have been made in Navy's fiscal year 1981, 1982, and 1983 development estimates. These cuts will affect the planned prototype development phase for VSTOL.

The broader issue is the current state of financial affairs for naval aircraft programs. The Navy has been saying for some time that its problem is insufficient funds being made available to procure sufficient numbers of aircraft for the fleet. In addition, too many types of aircraft are being operated with low-production runs and resultant high unit cost. With current and projected fiscal constraints, it could be difficult for Navy to fund the VSTOL program and continue to procure enough new fighter and attack aircraft to maintain force levels.

A Navy fallback position, in the event VSTOL technology does not mature, is the potential for applying VSTOL technology to improve the state of the art for CTOL aircraft. Having a credible fallback plan is to the Navy's credit. However, consideration should be given to how much the expenditure for VSTOL will be until the concept arrives at the total commitment point.

1/A review at the Secretary of Defense level for major system acquisitions.

CHAPTER 3

VSTOL OPERATIONAL CONCEPT IMPLICATIONS

The Navy has studied, and is continuing to study, how VSTOL aircraft will be used in its operational concept for sea-based aircraft missions. Operational concepts are being formulated by Navy as part of a comprehensive study effort to generate accurate and timely information needed to evaluate the capabilities and cost effectiveness of current and future ship, aircraft, and weapon system combinations.

The primary benefit VSTOL will provide to sea-based aircraft will be the dispersion on smaller aircraft carriers air-capable ships, and fleet surface combatants. The Navy claims dispersion enhances operational flexibility and reduces total force vulnerability partly by diverting the enemy away from the high-priority, large carrier targets. In exploring new operational concepts for VSTOL, consideration should be given to the effect of achieving varying levels of dispersion and how these levels will affect the plan to change to a VSTOL sea-based air fleet.

STUDIES AND ANALYSES OF OPERATIONAL CONCEPTS AND REQUIREMENTS

Anticipated modes of operation for VSTOL aircraft has inspired the Navy to consider new and innovative ways to use sea-based aircraft. With VSTOL, the Navy recognizes that future naval operational strategies may need to be redefined which, in turn, could lead to a total force mix restructuring.

Over the past 15 years, naval studies have looked at VSTOL aircraft in various roles. However, in 1975 the first indepth review of VSTOL was undertaken to relate vertical lift aircraft applications to Navy's warfare concepts. At that time, the CNO directed a study to formulate the future requirements for Navy VSTOL aircraft and identify appropriate VSTOL missions and platforms. A study report had not been published by the time we had completed our review. A draft report, entitled "Navy VSTOL Warfare Concepts Study," dated April 1977, recommended that the (1) Navy move toward a VSTOL aircraft posture by the early 1990s and (2) Navy make an extensive analysis of force mix and size, future air-capable ships' performance, and sea-based aircraft and support ships of all types.

CONCEPT OF DISPERSED SEA-BASED AIR POWER

The primary benefit VSTOL will provide to sea-based aircraft in Navy operations will be the dispersion on smaller, more affordable aircraft carriers, air-capable ships, and fleet surface combatants. The Navy claims dispersion of aircraft on a larger number of surface ship platforms enhances flexibility and reduces force vulnerability. The nature of the vulnerability reduction would be in diverting the enemy away from the high-priority, large carrier targets and in complicating his targeting problem.

Dispersion is important to the VSTOL concept, and how effectively it can be achieved may be of prime importance. Operational concepts envisioned for VSTOL, as they apply to dispersion, convey the following implications:

--Whether VSTOL should be developed at all if the Navy cannot achieve designs for effective basing on the small surface combatants.

--Whether the additional capability provided by basing VSTOL on small surface combatants is worth the VSTOL development expenditure, assuming advanced CTOLs can replace current CTOLs on large carriers.

The converse of the above implications is whether the somewhat more limited dispersion of sea-based aircraft on smaller more austere aircraft carriers (the pure VSTOL carrier) alone justifies the development of VSTOL.

Although the cost effectiveness of VSTOL is unknown at this time, one theory is that VSTOL should be more costly than CTOLs; however, the smaller VSTOL carrier platform may more than offset the aircraft cost increase. Another theory is that the operational concepts using VSTOL begin to become more cost effective as they are based on ships other than carriers; i.e., on all air-capable ships taken as a whole.

CONGRESSIONAL INFORMATION NEEDS

The House Committee on Armed Services, during the fiscal year 1978 budget review, deleted about 90 percent of Navy's request for VSTOL program research and development funds. The Senate voted the full amount and about half that amount was restored by joint Senate and House of Representatives conference action. The House Committee's stated reason for the deletion was that the Navy had not submitted a plan that described sound rationale and system objectives.

Since those hearings the Navy had developed a master study plan to provide

> "* * * a framework for a systematic and complete investigation of alternatives and issues necessary to support decisions concerning the future of sea based air. It incorporates a wide range of studies programed to generate accurate and timely information required to evaluate the capabilities and cost effectiveness of current and future platform, aircraft and weapons system combinations."

The Navy, at the direction of Congress, is performing a cost and effectiveness study, to be completed by February 1978, which is being programed into the master plan.

Although costly, we believe the study effort outlined in the master plan is necesary. If the Navy is allowed the time and resources to complete the study effort in the best professional way, in our opinion the Navy will be able to provide higher authority review levels with the rationale and data needed to evaluate the VSTOL program.

CONCLUSIONS

Dispersion is of prime importance to the VSTOL program. How effectively dispersion can be achieved may determine the degree to which VSTOL is ultimately implemented. In exploring new operational concepts for VSTOL, consideration should be given to the effect of achieving various levels of dispersion and how these levels will affect the plan to change to a VSTOL sea-based air fleet.

RECOMMENDATION

We recommend that the Secretary of Defense give priority attention to whether the operational concepts being proposed for VSTOL are realistic and cost effective. Of particular importance is whether VSTOL can be effectively dispersed.

CHAPTER 4

TECHNOLOGY FOR VSTOL

In developing VSTOL, the Navy is faced with the complex issues of developing a new type of aircraft as well as advancing the state-of-the-art for the aircraft's primary features (airframes, propulsion, and avionics). Advances must also be made in VSTOL's reliability, availability, and maintainability.

The Navy is using a vast array of technical resources to meet the challenge of VSTOL technology requirements. The Navy cannot say, at this time, what the chance of success will be.

TECHNOLOGY NEEDS

After much study, the Navy reported, in spring 1976, that, the naval technical aviation community believed it was possible to develop and produce VSTOL aircraft which could fulfill the future mission requirements laid out for sea-based, manned tactical aircraft. Two factors led to this conclusion

--development of advanced technology jet aircraft engines with their very high thrust-to-weight ratios and

--the science of subminiaturization which would enable airborne weapon systems to be reduced in size and weight.

The Navy advised us that general advances in the state-of-the-art for these areas, vice specific advances, were the basis for the above statements.

The Navy is continuing to assess whether technology will be able to support VSTOL development. One such effort for the VSTOL A program was the information request to industry in February 1977. Ten airframe manufacturers submitted responses, and eight types of propulsion concepts were identified. The results of the Navy's analysis will be reflected in design requirements to be established in the forthcoming request for design concepts. The Assistant Secretary of the Navy (Research, Engineering, and System) conducted another assessment effort. The report on this effort had not been released by the Navy at the time we had completed our review.

The design studies, themselves, will add to the Navy's assessment and definition of VSTOL technology needs. These studies will also be used to define operational VSTOL weapon systems, establish realistic performance and cost goals, identify major areas of risk, and formulate detailed total development plans.

The Navy's VSTOL program manager described the technology risk areas as shown below:

Technology	Need
Propulsion	High efficiency, high thrust-to-weight
Airframe	Weight reduction
Avionics	Extreme weight reduction, small light airborne early warning radar
Flight characteristics	Subsystem integration, transition corridor to and from the vertical, unrestricted ship operations

Brief technical discussions of two of these areas--propulsion and avionics is included in appendix II.

TECHNOLOGY RISK ASSESSMENT

The Navy is deciding what the technological risk of VSTOL should be. Navy technology experts said that traditional approaches to risk assessment have to be modified because the type of assessment which is now being done for VSTOL had not been made this early for other program developments.

High risk is built into the critical path of the initial phases of the program in order to advance the technology. Significant amounts of time and money are needed to reduce these areas to low risk by the time the full-scale development decision is to be made in 1985.

LARGE INCREASES IN RELIABILITY, MAINTAINABILITY, AND AVAILABILITY ARE NEEDED

The key to the usefulness of VSTOL is dispersion, which can only be achieved through a substantial increase over CTOL

experience in reliability, maintainability, and availability. The Navy's tentative goals for the reliability and maintainability characteristics of VSTOL represent a 5 to 6 fold increase over current experience. The availability goal is 1-1/2 times greater than the current fleet experience. The Navy is assessing the potential for achieving these goals.

Reliability is defined as the probability that equipment will perform its intended function for a specified interval, under stated conditions, and it is measured in terms of mean flight hours between failures (MFHBF). Maintainability is a characteristic of design and installation which is expressed as the probability that equipment will be retained or restored to a specified condition within a given period of time, when maintenance is performed in accordance with prescribed procedures and resources. It is measured in terms of mean time between maintenance (MTBM) actions. A maintenance goal of 1 hour MTBM is being sought by the Navy for VSTOL. This is a significant improvement over current experience with CTOL aircraft. Operational availability is the probability that a system or equipment, when used under stated conditions in an actual operational environment, shall operate satisfactorily when needed.

Naval analysis of industry's response to an informal request for information (see p. 20) indicated that a reliability of 2.84 hours as the mean flight hours between failures (MFHBF) was currently feasible on a system level. Analysis was not done below the system level since some or all the parts comprising the system evaluated may not be in the VSTOL. The Navy is looking for a 6.5 hour MFHBF which represents a 500 percent increase over the Navy's current experience.

The Navy is experiencing a 60-percent rate of availability for sea-based aircraft, which is acceptable on the large carriers with their extensive support operations. This experienced rate is not adequate for the anticipated VSTOL operations off smaller ships with limited space for spare parts, storage, and repair operations. The Navy's goal for VSTOL availability, however, is 90 percent.

POTENTIAL FOR ACHIEVING GREATER RELIABILITY AND MAINTAINABILITY

Navy technology officials stated that greater reliability and maintainability has not been required for prior aircraft programs because of funding constraints. One of the tenets

of the VSTOL program is that reliability and maintainability improvements have to be cost effective. The Navy is devising a plan on how reliability has to be allocated among aircraft components to be able to achieve the goal.

As in all areas of the VSTOL program, tradeoffs have to be made with regard to reliability and maintainability. However, since VSTOL funds are not unlimited cost/benefit studies must be performed to determine the amount of money to be spent for the required reliability. Tradeoffs between manpower, spare parts, and the reliability and maintainability of the system are being made in order to find the optimum level of availability affordable to the Navy.

CONCLUSIONS

We believe that because VSTOL is such a substantial departure from the Navy's current operational philosophy, it is going to require new operational concepts that will put a greater premium on reliability, maintainability, and availability. At the same time, significant advances in technology are needed to reduce the high risk areas to low risk by the time the full-scale development decision is made in 1985.

RECOMMENDATION

We recommend that the Secretary of Defense determine whether the advances in technology necessary to develop VSTOL are reasonable and can be achieved prior to the scheduled full-scale development decision.

CHAPTER 5

APPLICATION OF NEW PROCUREMENT POLICIES FOR IMPROVED FRONT-END MANAGEMENT OF SYSTEMS ACQUISITIONS

The Federal procurement process has recently undergone significant change to front-end management policies affecting major systems acquisition. The change--in the form of increased emphasis in the initial steps in the acquisition phase of major programs--is embodied in the Office of Management and Budget (OMB) Circular A-109, entitled "Major System Acquisitions," and in implementing DOD directives. This section of the report discusses the Navy's application of the OMB and DOD front-end management policies to the VSTOL program.

The Navy is committed to following the precepts of the circular. The VSTOL mission need document, although previously approved, is now being revised in accordance with direction from the Secretary of Defense. Navy program officials and some OMB policymakers, however, differ on whether some of the completed and planned VSTOL program actions comply with the new policies. The Office of the Secretary of Defense (OSD) has expressed its intention to monitor compliance of the VSTOL program with the revised policies. However, monitoring procedures have not yet been finalized. What remains to be seen is whether the Navy interprets these policies the way the OMB intended. The fiscal year 1979 budget review by OMB, we understand, will be addressing this potential issue.

POLICY CHANGES IN MAJOR SYSTEM ACQUISITIONS

The Commission on Government Procurement issued a report in December 1972 which recommended a new plan for acquiring major systems. In response to these recommendations, the Office of Federal Procurement Policy (OFPP) was established and on April 5, 1976, OMB Circular A-109, was issued. This publication prescribed policy for all executive branch agencies in the acquisition of major systems. This policy attempts to diminish the controversy on whether new systems are needed and to effect reforms that would reduce cost overruns.

The new policy, in consonance with the Commission's recommendations, requires

--top-level management to determine agency mission needs and goals;

--an integrated systematic approach for establishing mission needs, budgeting, contracting, and managing programs;

--early direction of research and development efforts to satisfy mission needs and goals;

--improved opportunities for innovative and competitive private sector contributions to national needs;

--early communication with the Congress in the acquisition process by relating major system acquisitions to agency mission needs and goals; and

--avoidance of premature commitments to full-scale development and production.

The circular specifies certain key decisions and outlines the sequence of events to be followed in the major system acquisition process. It provides agencies with flexibility in determining how they will meet the requirements of the circular and staff key decisions. OFPP has been examining how well major acquisitions are adhering to the principles of the circular.

OSD implemented the OMB circular on January 8, 1977, and reissued two directives describing the policy for the management of major system acquisitions. The directives were effective immediately and required the services to issue implementing regulations within 120 days.

Policy changes for compliance with the circular addressed the front-end or planning phases of major systems acquisitions. Under this policy, the acquisition process begins when mission needs are first considered and reconciled with competing priorities for resources within DOD. The process provides an effective coupling of the technology base with the initial phase of the program and insures that alternative design concepts are identified as solutions to meet an established mission need. The policy changed the emphasis from a solution-oriented viewpoint to a mission-oriented viewpoint.

A Secretary of the Navy memorandum dated February 8, 1977, accompanied the Navy's distribution of the reissued DOD directives on major system acquisitions. This memorandum provided advanced direction for compliance within the Navy before its instruction was reissued. During our October 1977 review, the revised instruction had not been issued.

MISSION NEED STATEMENT IS BEING REVISED

A key element in the early stages of the major system acquisition process is to determine mission needs. An analysis identifying a deficiency in existing agency capabilities or an opportunity to establish new capabilities in response to a technologically feasible opportunity will be formally set forth in a mission need statement (MNS).

On January 20, 1977, the Secretary of Defense approved the Navy's mission need document for sea based air, as it applied to the Type A VSTOL development program. The MNS was justified on the basis that a technologically feasible opportunity was available which would improve present capability. The MNS specified a VSTOL aircraft as the means to satisfy the mission need and it stated that current technological advances in the critical areas of propulsion, airframe, and avionics now provide the Navy with an opportunity to develop VSTOL aircraft. According to the MNS, this technology is feasible because of development of lighter and smaller components and the attainability of higher-thrust levels and lower-fuel consumption in advanced engine designs.

On April 1, 1977, the current Secretary of Defense informed the Navy that the previously approved MNS was

> "* * * not specific enough about mission and threat to provide a sound basis for an acquisition program. Moreover, it unnecessarily restricts approaches to solution of the problem."

To remedy the situation, the Secretary requested the Navy to prepare and submit mission element need statements (MENS) for each of the missions envisioned for the Type A VSTOL. In addition, the Secretary requested, as a framework for these and other MENS, that the Navy submit a MNS for the

broad missions of sea control and sea power projection. Fiscal year 1978 VSTOL funding was also deferred pending receipt of the MNS and MENS. Both documents are due 30 working days before releasing the request for proposal for Type A VSTOL design studies.

The VSTOL MENS has been revised in accordance with the Secretary of Defense's requirements and approved by the Secretary of the Navy.

The Navy is not writing the requested MNS for sea control and sea power projection because it believes the Navy missions are adequately defined in Title 10, U.S.C.; DOD Directive 5100.1 and the Naval Warfare Plan, Volume 1, "Strategic Concept of the U.S. Navy." The Navy's position on this matter has been conveyed to the Secretary of Defense.

Specifying a VSTOL to satisfy the mission need appears to restrict the solution to a single system concept. An agency head can approve such a course of action as an exception within the process; however, the primary intent of A-109 is not to encourage such restrictions but to encourage consideration of alternative and competing concepts to find the most cost-effective solution to this problem. The Secretary of Defense, in approving the VSTOL MNS, exercised this exception.

NONCOMPLIANCE OF PROPOSED ACQUISITION PROGRAM ACTIONS

Two documents for the VSTOL program have been released to industry; the request for quotation/information and the preliminary acquisition strategy. The Navy is analyzing industry's responses to the information request and is preparing a request for proposal for design studies scheduled to be issued in mid-1978. This effort will be followed by a prototype design phase in which contracts for competitive development will be awarded.

In comparing aspects of the above program documents and Circular A-109 with Navy officials, we found differences in perception as to the extent to which VSTOL proposed program actions comply with the intent of the circular. For example:

--In the information request to industry, the Navy requested data on each of the aircraft's subsystems--airframe, propulsion, and avionics--instead of

requesting a proposal for the entire system design (as stated in A-109). This restricted industry innovation and the necessary tradeoffs that may be required among the various subsystems. Such restrictions, could result in optimizing each subsystem (referred to as system goldplating) instead of trading off individual subsystem performance reductions for a total system performance package. Further, after reviewing the Navy's acquisition strategy, it appears that the same approach could be used in requesting proposals for design studies.

--Both the information request to industry and the acquisition strategy document anticipate transfusing technology among contractors, again not providing the necessary motivation for contractors to initiate their best ideas for a complete system. According to the information request the Government would pick and choose subsystems or concepts to develop a design concept for subsequent use in the request for proposal for design studies. This, appears to be transfusion of technology and is not the intent of the circular. 1/

--The Navy's acquisition strategy contemplates re-competition which allows the introduction of new contractors during the prototype and full-scale development stages. The circular appears to require continuing contractural relationships through the complete acquisition process by eliminating the original competing contractors with less attractive system design concepts as development proceeds toward full scale development and initial production.

Subsequently, the Navy informed us that the acquisition strategy was only preliminary and not the final position. Further, the approach to be used in the request for proposal for design studies had not been decided, and alternative contractual means were still being considered. These include a proposal which could result in awards for each subsystem or awards for the entire aircraft design. We were subsequently informed that the Navy plans to solicit design study proposals for the entire aircraft system.

1/This is discussed in "A Discussion of the Application of OMB Circular No. A-109"; OFPP Pamphlet #1 Aug. 1976.

With regard to technology transfusion, we were advised by the Navy that technology transfusion in the sense of the circular will not occur through the design study stage. The request for proposal for prototype development may require some transfusion expressed in terms of capability, but it will not dictate the technique necessary to achieve the desired characteristics.

In regard to continuing contractual relationships the Navy has not decided on whether to hold an open competition for the prototype phase.

A situation on differences of interpretation, as described above, is not unusual when attempting to apply a new policy and this particular new policy. Our prior reports disclosed similar differences in interpretations by DOD in how closely the Commission's recommended acquisition policy was being followed for selected major acquisitions. 1/ The Navy's evaluation of industry responses to the request for information was not available for our review and the request for proposal for design studies will not be available until 1978. Also, planned Navy actions are still uncertain. We are unable to comment on whether the Navy's plans will conform with the intent of the circular.

In order to more fully understand the intent and implication of A-109, we contacted OMB and received interpretations of the policy as it might be applied to various type major system acquisitions. OMB has advised us that during the fiscal year 1979 budget review cycle they plan to examine selected new major system acquisitions in sufficient depth, including VSTOL, to make the necessary determinations in respect to compliance with A-109. We were also advised that the assessment of compliance would be made available to the Navy.

1/GAO reports on three major acquisitions comparing the beginning steps in the acquisiton process with the acquisition plan recommended by the Commission on Government Procurement were issued on January 24, 1977. The systems reviewed include the Pershing II, (PSAD-77-51); the Shipboard Intermediate Range Combat System (PSAD-77-49); NAVSTAR (PSAD-77-50).

DOD OVERVIEW

In March 1977, the Chairman, Senate Committee on Appropriations, in order to fully consider the fiscal year 1978 budget request, asked DOD to provide specific information on how well the revised acquisition policies were being applied to their programs. VSTOL was one of the programs cited in the request to the Director of Defense Research and Engineering.

DOD's response, dated June 3, 1977, advised that the acquisition process for the VSTOL A program is structured to comply with the provisions of OMB Circular A-109. This intent to comply is stated in the Navy project charter for the VSTOL program. Also, VSTOL program officials have been briefed on (1) the new OMB policy (2) implementing DOD regulations, and (3) their applicability to the VSTOL development program. The response advised, further, that DOD will periodically review the VSTOL program to monitor compliance with the revised policies.

In October 1977, DOD policy implementation officials advised that due to a reorganization then underway, specific procedures for monitoring the circular's compliance had not been established. They said that DOD is still attempting to develop its roles in overseeing the revised major system acquisition process.

In January 1978, we were informed by OSD that on November 22, 1977 a review was held of 16 major programs to determine if they complied with A-109 or, lacking compliance what actions would be taken. This review was at the request of OFPP. The VSTOL program received considerable attention. Of primary concern to OFPP was that the MENS for Sea-Based Air which was submitted to the Secretary of Defense for approval on November 1 was really a statement of need for VSTOL. Other alternatives were not given sufficient emphasis and the actual mission need was not clearly stated. Further, OSD believed that VSTOL was a technology program which, if successful, could represent a candidate to satisfy the sea-based air mission. OSD concluded that VSTOL, on these grounds was compliant with A-109. The MENS is currently being reviewed by OSD officials.

CONCLUSIONS

Stated Navy and DOD policy is that the VSTOL program will comply with the provisions of OMB Circular A-109. As of the date of this report, the Navy was still planning the approach it would use in the acquisition process. OMB plans to review compliance of selected major system acquisitions during the FY79 Budget review cycle. OMB representatives advised that its position will be made available to the Navy during the fiscal year 1979 budget review cycle. The timing of OMB's review is critical because of the Navy's planned program action for March 1978; i.e., the release of the request for design study proposals.

RECOMMENDATION

We recommend that the Secretary of Defense resolve the question of compliance with regard to OMB Circular A-109 early in the VSTOL program.

APPENDIX I

CAPABILITIES FOR WARFARE TASKS

Fundamental tasks	Sea-based aircrafts performing mission CTOL	V/STOL
ANTIAIR WARFARE:		
Air superiority	F-14/F-4	B
Air defense	E-2C/F-14/F-4/AV-8a	
ANTISUBMARINE WARFARE:		
Distant operations	S-3	A
Close operations	H-3/LAMPS/S-3	A (S-3 replacement)
ANTISURFACE SHIP WARFARE:		
Distant operations	A-6/A-7/A-4	B and A
Close operations	LAMPS/A-6/A-7/A-4	B and A
STRIKE WARFARE:		
Nuclear	4/F-4/A-6/A-7/A-4	B
Conventional	F-14/F-4/A-6/A-7/A-4	B
AMPHIBIOUS WARFARE:		
Vertical Assault	H-53/H-46/H-1	A
Over the Beach	H-53/H-46/H-1	A
Close support	AH-1/A-6/A-7/A-4/F-4/AV-8	B
MINE WARFARE:		
Offensive	All Attack aircraft/S-3	A
Countermeasures	RH-53D	A/RH-53X
SPECIAL WARFARE		
Supporting Tasks		
INTELLIGENCE:		
Imagery	EA-3B	A and B
Reconnaissance	RA-5/RF-8	B
Surveillance	All	A
COMMAND, CONTROL AND COMMUNICATIONS	E-2C	A
ELECTRONIC WARFARE	EA-6B	A
LOGISTICS:		
Long haul resupply	C-2	A
Local resupply	C-1/C-2/H-46/H-53	A
Repair		A
STRIKE CONTROL	E-2C	A

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TECHNICAL DISCUSSION OF PROPULSION AND AVIONICS

Propulsion

In order for VSTOL to operate effectively, substantial efforts in the propulsion area have to be undertaken. The VSTOL engine has to be built from scratch for four reasons--size, efficiency over a wide range of thrusts, thrust-to-weight ratio, and reliability.

Naval technologists believe the desired technology goals for operation are not overly optimistic. As a minimum, they believe that within the current state-of-the-art in propulsion technology the thrust-to-weight ratios needed for VSTOL can be achieved.

The six basic propulsion concepts for VSTOL are the tilt wing, the tilt engine, the thrust augmented wing, lift plus lift/cruise, lift/cruise fan, and rotor. The tilt wing concept uses the propellers to produce lift in the vertical mode and as the aircraft gains forward speed, to induce additional lift on the wings. Finally the wing and engines tilt horizontally for flight in the conventional mode. The tilt engine concept has fixed wings, the engines and fans being pivoted, so that take-off thrust is direct downward and conventional flight has the engines in their normal horizontal position. In the thrust augmented wing, high energy engine exhaust gases or fan exit air are used to entrap large quantities of ambient air which is drawn through and mixed in the augmenter to produce thrust/lift in the vertical mode. In conventional flight the exhaust gases are directed at and the augmenters closed. The lift plus lift/cruise concept was one engine solely for the purpose of providing lift for take-off and landing, while the other two engines are used for both lift, through vectoring or deflectors, and cruising thrust. The lift/cruise fan concept combines ducted fans buried in the wings and fuselage for direct lift with conventional jet engines to achieve horizontal flight. The exhaust from the jet engines drives the fans, thus eliminating a second propulsion system. The rotor concept is basically a helicopter type technology.

The propulsion power required for a high disc loading fan propelled VSTOL A aircraft is nearly twice that of its CTOL counterpart. The VSTOL A will be powered by two or more engines and require a system of shafts, gear boxes, and governing controls to rapidly transfer power between the

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thrust producing devices to produce control forces or to compensate for an engine failure. A relatively sophisticated digital flight control system will be required to operate and properly phase the thrust vectoring devices, fan thrust controls, and the conventional aerodynamic control surface. This is the case because it is the smallest and lightest system which will handle the multiplicity of control input signals, sensor information and phasing of control outputs required. The VSTOL A aircraft of the high disk loading type may require installed shaft power as high as 40,000 shp. For a two engine configuration 20,000 shp engines would be required, and 10,000 shp engines are needed for a four engine configuration. Although the largest developmental turboshaft engine built is the XT 701 which produces less than 8,000 shp, the engine size is considered within the state of art since high bypass ration fan engines with internal shaft horsepowers of 25,000 shp are flying today. Projected technology can produce the necessary engine gas flow path required to create the necessary IP/weight ratio for the basic shaft engine. Reliability questions, and unknown qualities of airflow distortion tolerance, however, will require much concentrated effort to resolve.

Airborne early warning radar

One of the equipment technology advancements necessary to the success of Type A VSTOL is the reduction of weight in the airborne early warning avionics suite. This could be accomplished by eliminating or extremely reduction the size and weight of the heavy antenna (rotodome) on top of the aircraft which performs the airborne early warning mission. It is too burdensome for an aircraft to achieve the required vertical mode of flight.

One type of airborne early warning radar being investigated in exploratory development by the Naval Air Development Center (NADC) is a phased array, using solid state components. Other research is being done at the naval research labs. NADC technology experts believe the new radar is of medium risk because there has been hardware sice 1976.

The radar being developed probably will not provide continuous and complete circular coverage. However, the sensors can be channeled in one direction so that the range of the radar can be extended in that direction. Also, by directing all radar power in one direction, an option not currently

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available, electronic counter-countermeasures will be enhanced. One advancement in the new airborne early warning radar will be increased reliability.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

April 5, 1976 CIRCULAR NO. A-109

TO THE HEADS OF EXECUTIVE DEPARTMENTS AND ESTABLISHMENTS

SUBJECT: Major System Acquisitions

1. Purpose. This Circular establishes policies, to be followed by executive branch agencies in the acquisition of major systems.

2. Background. The acquisition of major systems by the Federal Government constitutes one of the most crucial and expensive activities performed to meet national needs. Its impact is critical on technology, on the Nation's economic and fiscal policies, and on the accomplishment of Government agency missions in such fields as defense, space, energy and transportation. For a number of years, there has been deep concern over the effectiveness of the management of major system acquisitions. The report of the Commission on Government Procurement recommended basic changes to improve the process of acquiring major systems. This Circular is based on executive branch consideration of the Commission's recommendations.

3. Responsibility. Each agency head has the responsibility to ensure that the provisions of this Circular are followed. This Circular provides administrative direction to heads of agencies and does not establish and shall not be construed to create any substantive or procedural basis for any person to challenge any agency action or inaction on the basis that such action was not in accordance with this Circular.

4. Coverage. This Circular covers and applies to:

a. Management of the acquisition of major systems, including: • Analysis of agency missions • Determination of mission needs • Setting of program objectives • Determination of system requirements • System program planning • Budgeting • Funding • Research • Engineering • Development • Testing and evaluation • Contracting • Production • Program and management control • Introduction

of the system into use or otherwise successful achievement of program objectives.

b. All programs for the acquisition of major systems even though:

(1) The system is one-of-a-kind.

(2) The agency's involvement in the system is limited to the development of demonstration hardware for optional use by the private sector rather than for the agency's own use.

5. Definitions. As used in this Circular:

a. Executive agency (hereinafter referred to as agency) means an executive department, and an independent establishment within the meaning of sections 101 and 104(1), respectively, of Title 5, United States Code.

b. Agency component means a major organizational subdivision of an agency. For example: The Army, Navy, Air Force, and Defense Supply Agency are agency components of the Department of Defense. The Federal Aviation Administration, Urban Mass Transportation Administration, and the Federal Highway Administration are agency components of the Department of Transportation.

c. Agency missions means those responsibilities for meeting national needs assigned to a specific agency.

d. Mission need means a required capability within an agency's overall purpose, including cost and schedule considerations.

e. Program objectives means the capability, cost and schedule goals being sought by the system acquisition program in response to a mission need.

f. Program means an organized set of activities directed toward a common purpose, objective, or goal undertaken or proposed by an agency in order to carry out responsibilities assigned to it.

g. System design concept means an idea expressed in terms of general performance, capabilities, and characteristics of hardware and software oriented either to

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operate or to be operated as an integrated whole in meeting a mission need.

h. Major system means that combination of elements that will function together to produce the capabilities required to fulfill a mission need. The elements may include, for example, hardware, equipment, software, construction, or other improvements or real property. Major system acquisition programs are those programs that (1) are directed at and critical to fulfilling an agency mission, (2) entail the allocation of relatively large resources, and (3) warrant special management attention. Additional criteria and relative dollar thresholds for the determination of agency programs to be considered major systems under the purview of this Circular, may be established at the discretion of the agency head.

i. System acquisition process means the sequence of acquisition activities starting from the agency's reconciliation of its mission needs, with its capabilities, priorities and resources, and extending through the introduction of a system into operational use or the otherwise successful achievement of program objectives.

j. Life cycle cost means the sum total of the direct, indirect, recurring, nonrecurring, and other related costs incurred, or estimated to be incurred, in the design, development, production, operation, maintenance and support of a major system over its anticipated useful life span.

6. General policy. The policies of this Circular are designed to assure the effectiveness and efficiency of the process of acquiring major systems. They are based on the general policy that Federal agencies, when acquiring major systems, will:

a. Express needs and program objectives in mission terms and not equipment terms to encourage innovation and competition in creating, exploring, and developing alternative system design concepts.

b. Place emphasis on the initial activities of the system acquisition process to allow competitive exploration of alternative system design concepts in response to mission needs.

(No. A-109)

c. Communicate with Congress early in the system acquisition process by relating major system acquisition programs to agency mission needs. This communication should follow the requirements of Office of Management and Budget (OMB) Circular No. A-10 concerning information related to budget estimates and related materials.

d. Establish clear lines of authority, responsibility, and accountability for management of major system acquisition programs. Utilize appropriate managerial levels in decisionmaking, and obtain agency head approval at key decision points in the evolution of each acquisition program.

e. Designate a focal point responsible for integrating and unifying the system acquisition management process and monitoring policy implementation.

f. Rely on private industry in accordance with the policy established by OMB Circular No. A-76.

7. Major system acquisition management objectives. Each agency acquiring major systems should:

a. Ensure that each major system: Fulfills a mission need. Operates effectively in its intended environment. Demonstrates a level of performance and reliability that justifies the allocation of the Nation's limited resources for its acquisition and ownership.

b. Depend on, whenever economically beneficial, competition between similar or differing system design concepts throughout the entire acquisition process.

c. Ensure appropriate trade-off among investment costs, ownership costs, schedules, and performance characteristics.

d. Provide strong checks and balances by ensuring adequate system test and evaluation. Conduct such tests and evaluation independent, where practicable, of developer and user.

e. Accomplish system acquisition planning, built on analysis of agency missions, which implies appropriate resource allocation resulting from clear articulation of agency mission needs.

(No. A-109)

f. Tailor an acquisition strategy for each program, as soon as the agency decides to solicit alternative system design concepts, that could lead to the acquisition of a new major system and refine the strategy as the program proceeds through the acquisition process. Encompass test and evaluation criteria and business management considerations in the strategy. The strategy could typically include: • Use of the contracting process as an important tool in the acquisition program • Scheduling of essential elements of the acquisition process • Demonstration, test, and evaluation criteria • Content of solicitations for proposals • Decisions on whom to solicit • Methods for obtaining and sustaining competition • Guidelines for the evaluation and acceptance or rejection of proposals • Goals for design-to-cost • Methods for projecting life cycle costs • Use of data rights • Use of warranties • Methods for analyzing and evaluating contractor and Government risks • Need for developing contractor incentives • Selection of the type of contract best suited for each stage in the acquisition process • Administration of contracts.

g. Maintain a capability to: • Predict, review, assess, negotiate and monitor costs for system development, engineering, design, demonstration, test, production, operation and support (i.e., life cycle costs) • Assess acquisition cost, schedule and performance experience against predictions, and provide such assessments for consideration by the agency head at key decision points • Make new assessments where significant costs, schedule or performance variances occur • Estimate life cycle costs during system design concept evaluation and selection, full-scale development, facility conversion, and production, to ensure appropriate trade-offs among investment costs, ownership costs, schedules, and performance • Use independent cost estimates, where feasible, for comparison purposes.

8. Management structure.

a. The head of each agency that acquires major systems will designate an acquisition executive to integrate and unify the management process for the agency's major system acquisitions and to monitor implementation of the policies and practices set forth in this Circular.

b. Each agency that acquires--or is responsible for activities leading to the acquisition of--major systems will

establish clear lines of authority, responsibility, and accountability for management of its major system acquisition programs.

c. Each agency should preclude management layering and placing nonessential reporting procedures and paperwork requirements on program managers and contractors

d. A program manager will be designated for each of the agency's major system acquisition programs. This designation should be made when a decision is made to fulfill a mission need by pursuing alternative system design concepts. It is essential that the program manager have an understanding of user needs and constraints, familiarity with development principles, and requisite management skills and experience. Ideally, management skills and experience would include: • Research and development • Operations • Engineering • Construction • Testing • Contracting • Prototyping and fabrication of complex systems • Production • Business • Budgeting • Finance. With satisfactory performance, the tenure of the program manager should be long enough to provide continuity and personal accountability.

e. Upon designation, the program manager should be given budget guidance and a written charter of his authority, responsibility, and accountability for accomplishing approved program objectives.

f. Agency technical management and Government laboratories should be considered for participation in agency mission analysis, evaluation of alternative system design concepts, and support of all development, test, and evaluation efforts.

g. Agencies are encouraged to work with each other to foster technology transfer, prevent unwarranted duplication of technological efforts, reduce system costs, promote standardization, and help create and maintain a competitive environment for an acquisition.

9. Key decisions. Technical and program decisions normally will be made at the level of the agency component or operating activity. However, the following four key decision points should be retained and made by the agency head:

a. Identification and definition of a specific mission need to be fulfilled, the relative priority assigned within the agency, and the general magnitude of resources that may be invested.

b. Selection of competitive system design concepts to be advanced to a test/demonstration phase or authorization to proceed with the development of a noncompetitive (single concept) system.

c. Commitment of a system to full-scale development and limited production.

d. Commitment of a system to full production.

10. Determination of mission needs.

a. Determination of mission need should be based on an analysis of an agency's mission reconciled with overall capabilities, priorities and resources. When analysis of an agency's mission shows that a need for a new major system exists, such a need should not be defined in equipment terms, but should be defined in terms of the mission, purpose, capability, agency components involved, schedule and cost objectives, and operating constraints. A mission need may result from a deficiency in existing agency capabilities or the decision to establish new capabilities in response to a technologically feasible opportunity. Mission needs are independent of any particular system or technological solution.

b. Where an agency has more than one component involved, the agency will assign the roles and responsibilities of each component at the time of the first key decision. The agency may permit two or more agency components to sponsor competitive system design concepts in order to foster innovation and competition.

c. Agencies should, as required to satisfy mission responsibilities, contribute to the technology base, effectively utilizing both the private sector and Government laboratories and in-house technical centers, by conducting, supporting, or sponsoring: • Research • System design concept studies • Proof of concept work • Exploratory subsystem development • Tests and evaluations. Applied technology efforts oriented to system developments should be performed in response to approved mission needs.

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11. Alternative systems.

a. Alternative system design concepts will be explored within the context of the agency's mission need and program objectives--with emphasis on generating innovation and conceptual competition from industry. Benefits to be derived should be optimized by competitive exploration of alternative system design concepts, and trade-offs of capability, schedule, and cost. Care should be exercised during the initial steps of the acquisition process not to conform mission needs or program objectives to any known systems or products that might foreclose consideration of alternatives.

b. Alternative system design concepts will be solicited from a broad base of qualified firms. In order to achieve the most preferred system solution, emphasis will be placed on innovation and competition. To this end, participation of smaller and newer businesses should be encouraged. Concepts will be primarily solicited from private industry; and when beneficial to the Government, foreign technology, and equipment may be considered.

c. Federal laboratories, federally funded research and development centers, educational institutions, and other not-for-profit organizations may also be considered as sources for competitive system design concepts. Ideas, concepts, or technology, developed by Government laboratories or at Government expense, may be made available to private industry through the procurement process or through other established procedures. Industry proposals may be made on the basis of these ideas, concepts, and technology or on the basis of feasible alternatives which the proposer considers superior.

d. Research and development efforts should emphasize early competitive exploration of alternatives, as relatively inexpensive insurance against premature or preordained choice of a system that may prove to be either more costly or less effective.

e. Requests for alternative system design concept proposals will explain the mission need, schedule, cost, capability objectives, and operating constraints. Each offeror will be free to propose his own technical approach, main design features, subsystems, and alternatives to schedule, cost, and capability goals. In the conceptual and

less than full-scale development stages, contractors should not be restricted by detailed Government specifications and standards.

f. Selections from competing system design concept proposals will be based on a review by a team of experts, preferably from inside and outside the responsible component development organization. Such a review will consider: (1) Proposed system functional and performance capabilities to meet mission needs and program objectives, including resources required and benefits to be derived by trade-offs, where feasible, among technical performance, acquisition costs, ownership costs, time to develop and procure; and (2) The relevant accomplishment record of competitors.

g. During the uncertain period of identifying and exploring alternative system design concepts, contracts covering relatively short time periods at planned dollar levels will be used. Timely technical reviews of alternative system design concepts will be made to effect the orderly elimination of those least attractive.

h. Contractors should be provided with operational test conditions, mission performance criteria, and life cycle cost factors that will be used by the agency in the evaluation and selection of the system(s) for full-scale development and production.

i. The participating contractors should be provided with relevant operational and support experience through the program manager, as necessary, in developing performance and other requirements for each alternative system design concept as tests and trade-offs are made.

j. Development of subsystems that are intended to be included in a major system acquisition program will be restricted to less than fully designed hardware (full-scale development) until the subsystem is identified as a part of a system candidate for full-scale development. Exceptions may be authorized by the agency head if the subsystems are long lead time items that fulfill a recognized generic need or if they have a high potential for common use among several existing or future systems.

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12. Demonstrations.

a. Advancement to a competitive test/demonstration phase may be approved when the agency's mission need and program objectives are reaffirmed and when alternative system design concepts are selected.

b. Major system acquisition programs will be structured and resources planned to demonstrate and evaluate competing alternative system design concepts that have been selected. Exceptions may be authorized by the agency head if demonstration is not feasible.

c. Development of a single system design concept that has not been competitively selected should be considered only if justified by factors such as urgency of need, or by the physical and financial impracticality of demonstrating alternatives. Proceeding with the development of a noncompetitive (single concept) system may be authorized by the agency head. Strong agency program management and technical direction should be used for systems that have been neither competitively selected nor demonstrated.

13. Full-scale development and production.

a. Full-scale development, including limited production, may be approved when the agency's mission need and program objectives are reaffirmed and competitive demonstration results verify that the chosen system design concept(s) is sound.

b. Full production may be approved when the agency's mission need and program objectives are reaffirmed and when system performance has been satisfactorily tested, independent of the agency development and user organizations, and evaluated in an environment that assures demonstration in expected operational conditions. Exceptions to independent testing may be authorized by the agency head under such circumstances as physical or financial impracticability or extreme urgency.

c. Selection of a system(s) and contractor(s) for full-scale development and production is to be made on the basis of (1) system performance measured against current mission need and program objectives, (2) an evaluation of estimated acquisition and ownership costs, and (3) such factors as

contractor(s) demonstrated management, financial, and technical capabilities to meet program objectives.

d. The program manager will monitor system tests and contractor progress in fulfilling system performance, cost, and schedule commitments. Significant actual or forecast variances will be brought to the attention of the appropriate management authority for corrective action.

14. Budgeting and financing. Beginning with FY 1979 all agencies will, as part of the budget process, present budgets in terms of agency missions in consonance with Section 201(i) of the Budget and Accounting Act, 1921, as added by Section 601 of the Congressional Budget Act of 1974, and in accordance with OMB Circular A-11. In so doing, the agencies are desired to separately identify research and development funding for: (1) The general technology base in support of the agency's overall missions, (2) The specific development efforts in support of alternative system design concepts to accomplish each mission need, and (3) Full-scale developments. Each agency should ensure that research and development is not undesirably duplicated across its missions.

15. Information to Congress.

a. Procedures for this purpose will be developed in conjunction with the Office of Management and Budget and the various committees of Congress having oversight responsibility for agency activities. Beginning with FY 1979 budget each agency will inform Congress in the normal budget process about agency missions, capabilities, deficiencies, and needs and objectives related to acquisition programs, in consonance with Section 601(i) of the Congressional Budget Act of 1974.

b. Disclosure of the basis for an agency decision to proceed with a single system design concept without competitive selection and demonstration will be made to the congressional authorization and appropriation committees.

16. Implementation. All agencies will work closely with the Office of Management and Budget in resolving all implementation problems.

17. Submissions to Office of Management and Budget. Agencies will submit the following to OMB:

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APPENDIX III

a. Policy directives, regulations, and guidelines as they are issued.

b. Within six months after the date of this Circular, a time-phased action plan for meeting the requirements of this Circular.

c. Periodically, the agency approved exceptions permitted under the provisions of this Circular.

This information will be used by the OMB, in identifying major system acquisition trends and in monitoring implementations of this policy.

18. Inquiries. All questions or inquiries should be submitted to the OMB, Administrator for Federal Procuremeht Policy. Telephone number, area code, 202-395-4677.

HUGH E. WITT
ADMINISTRATOR FOR
FEDERAL PROCUREMENT POLICY

Approved:

JAMES T. LYNN
DIRECTOR

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