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Refining the U.S. Navy Flight Clearance (Airworthiness Certification) Process: Maximizing Acquisition Reform Benefits for Commercial Derivative Aircraft Acquisitions

A Thesis Presented for the Master of Science Degree
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Dedication

This paper is dedicated to my wife Jodi for her persistence and patience with me to complete this task, without her support this paper would not have been written.

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I also must thank Mr. Robert J. Skalamera, of the Naval Air Systems Command. His tireless efforts to publish a coherent policy instruction for the Navy are noteworthy. This thesis builds on his vision of certification of commercial aircraft for military use, and in fact provides practical application and validation of that instruction with the lessons learned presented here.

Abstract

The purpose of this thesis is to propose several specific process improvements to the U.S. Navy Flight Clearance process. It also makes recommendations for investment in test and evaluation infrastructure to better support commercial derivative aircraft acquisition for military use. Recent changes to Department of Defense acquisition regulations have increased alternatives available to the services to meet military operational requirements. In order to reduce cost and cycle times, the military services are turning more and more to acquiring commercially developed and certified aircraft to meet military requirements.

This new direction in acquisition has led to the discovery of several lessons learned on programs that were fielded between 1997 and 2000. This thesis attempts to identify the lessons learned in each of these programs and propose specific changes to Navy policy instructions and processes that lead to a Navy airworthiness certification. In addition, a small investment in test and evaluation infrastructure bolstering experience and understanding of the Federal Aviation Administration airworthiness certification processes will result in additional warfighter resources being freed up by less procurement cost and faster cycle times.

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1. Introduction

The purpose of this paper is to propose a refinement to the Naval Air System Command (NAVAIR) Flight Clearance process, the Navy process for performing airworthiness certification on aircraft. An additional goal of this paper is to also define and outline changes to the Navy's test and evaluation infrastructure to better support commercial derivative aircraft acquisitions. This thesis is an attempt to clearly define a specific process and criteria for program managers and leadership to consider when purchasing, modifying, or operating an existing Federal Aviation Administration (FAA) certified aircraft to meet Navy requirements. Although the title clearly states that this is about refinement of the Flight Clearance process – many of the recommendations and actions fall on higher headquarters within the Naval Air Systems Command and the FAA to lead their respective organizations in changing paradigms. The main references for this thesis are a series of policy instructions from the Department of Defense (DoD) and the Naval Air Systems Command (NAVAIR). Specifically these policies are the recently cancelled DoD 5000 series directive/instructions, NAVAIR Instruction (NAVAIRINST) 1334.01B - Flight Clearance Policy For Manned Air Vehicles, and NAVAIRINST 1300.15 – Engineering Technical Review of Commercial Derivative Aircraft Programs. The main reference used is my practical experience fielding several commercial derivative aircraft acquisitions as an Aircraft Programs and Engineering Class Desk Officer at Commander, Naval Air Forces, U.S. Pacific Fleet (COMNAVAIRPAC).

Although the Deputy Under-Secretary of Defense for Acquisition and Logistics recently canceled the DoD 5000 series of acquisition policy in 2002, the concepts contained in the old directives are still valid under a series of interim guidance statements from the Secretary of Defense. As with any acquisition program, the certification strategy starts with a well thought out acquisition plan at the program office, which is a response to a set of known operational requirements. During my tour at COMNAVAIRPAC, I was involved with several efforts to acquire, modify and maintain FAA certified aircraft to meet Navy requirements. Some of these were traditional programs where a full analysis of alternatives was completed. Some were the result of excess aircraft from other sources becoming available and placed into service by the Navy for a different mission than envisioned by the original FAA certification. This experience with several types of aircraft, varying degrees of complexity, changes in the original operational usage of the aircraft and mission environment for original FAA certification led me to capture the lessons learned with these programs. The intent of this thesis is to outline a better acquisition and airworthiness certification planning process, and establishment of test and evaluation infrastructure. These process and infrastructure improvements will assist program managers in developing an optimum acquisition strategy that capitalizes on all the cost/schedule benefits of a commercial derivative acquisition. An additional goal is also to better quantify and integrate the FAA and the Navy's certification processes to support the goal of less cost and shorter product development cycle times. The four major efforts which I will draw lessons from are:

(1) Conversion of the Fairchild C-26D Metroliner to a radar and telemetry equipped range support aircraft.

(2) Lease of B-737-200 airframes to meet E-6B TACAMO In-Flight Training requirements.

(3) Acquisition of UC-35B/D Cessna Citation Ultra.

(4) In service engineering support of C-20G Gulfstream IV Logistics Support aircraft.

Each of these programs had unique lessons learned and considerations which can be reviewed and have been used to generate some general guidelines to achieve the stated goals. In order to fully realize the power Acquisition Reform has given program managers and Naval Aviation implementation of these guidelines will require some paradigms to shift within the Naval Air Systems Command. This shift must occur with full support of the NAVAIRSYSCOM Chain of Command.

2. Background

In the last 10 years there has been a significant effort to lower acquisition cost and the time it takes to field a new system. This effort is based on a concept known as "Acquisition Reform" within the DoD. This was initiated by a major overhaul to the now cancelled Department of Defense 5000 series directive/instructions – those guiding the acquisition of systems for the DoD. The thrust and impetus of this thesis is based upon DoDinst 5002 which clearly states the preferred options for meeting a mission need and still holds true in the interim guidance following the cancellation of the instruction:

"Generally, use or modification of systems or equipment that the DoD Components already own is more cost and schedule-effective than acquiring new materiel. If existing U.S. military systems or other on-hand materiel cannot be economically used or modified to meet the operational requirement, an acquisition program may be justified. The acquisition decision-makers shall follow the following hierarchy of alternatives:

(1) **<u>the procurement(including modification) of commercially available domestic or international technologies, systems or equipment,</u>** or the additional production (including modification) of previously-developed U.S. military systems or equipment, or Allied systems or equipment

(2) a cooperative development program with one or more Allied

nations

(3) new joint Component or Government Agency development program;

(4) a new Component-unique development program."[1]

The significance of placing commercially available solutions above all except modification of existing equipment has had profound effect on the acquisition process. It has offered opportunity for quickly meeting service requirements at a lower cost than having a military developed solution. In many programs this concept has been capitalized on – in others process failures have led to cost and schedule overruns. A common thread in the programs that did not meet the stated goals of a commercial acquisition can be attributed to poor assumptions, lack of planning, and lack of communication between various NAVAIRSYSCOM competencies. Despite the lofty goals of Acquisition Reform, the lack of a defined process to provide for Navy use of FAA certified aircraft places programs at risk.

The key element of combining the FAA and the Navy airworthiness processes is for the fleet operators, NAVAIR program offices, airworthiness engineers, test and evaluation (T&E) community, and all other stakeholders including the FAA to clearly define and agree upon Navy unique differences prior to the start of the program. Navy unique differences include the aircraft operating environments, missions, and physical configuration. These differences are between the proposed Navy mission usage and the missions/flight environments that the aircraft was originally certified for under the FAA process.

These agreements will determine program risk and drive the airworthiness certification strategy used to develop a T&E plan. This test and certification plan should specifically set out the optimum certification processes and airworthiness standards to be utilized. In some cases elements of the original FAA Type certification process will remain valid and there is no value added to a Navy effort to revalidate those elements. In other cases, the Navy's process may present the least cost/schedule risk to the program and some elements will have to be fully analyzed and tested within Navy processes. Programs that failed to clearly define the certification strategy and define Navy differences early in program development have experienced cost and schedule penalties to the program, and the benefits of Acquisition Reform were not fully realized.

In the author's opinion, these failures were a direct result of the failure to define a coherent <u>**process based methodology**</u> using the freedom given the services in the DoD 5000 instructions to use commercial standards and processes. For many years the vast majority of programs managed by the Naval Air System Command were developed under military standards, specifications and processes. To realize the power given in Acquisition Reform a major shift in paradigms of how aircraft are developed and fielded is required. Only in March 2002 has an effort to define a process for dealing with commercial derivative aircraft resulted in a NAVAIR Policy Instruction, with NAVAIRINST 13100.15 being issued. However, organizational inertia still has to be overcome, and investment made in adequate FAA airworthiness test and evaluation infrastructure to fully capitalize on the flexibility of these policy shifts. Until the policy guidance from the top of the chain of command is fully implemented and accepted within all NAVAIR competencies (program office, engineering, and T&E), programs will continue to be subjected to undue risk with each competency community having the power to drive major design changes based solely on standards and processes and policies inherent within Naval Air Systems Command.

Currently this is a **personality dependent** process led by the program office Integrated Product Team (IPT) Leader or the NAVAIR Flight Clearance Officer due to positional authority. However, many times leadership will also typically fall on the shoulders of the test pilot/project officer. The project officer has significant functional authority within an IPT flowing from Test Pilot School training. **The test pilot's unique ability to cut across many competencies with their blend of operational experience/perspective, engineering knowledge, and communication skills can be an invaluable tool for a program in the early stages.** The end goal is to ensure that the planning process for airworthiness certification of commercial derivative aircraft within the Navy and Marine Corps becomes **process oriented versus the current personality** orientation.

The NAVAIR engineering community governs design and performance standards for aircraft programs through NAVAIR Instruction 13034.1B, Flight Clearance Policy For Manned Air Vehicles:

"This instruction applies to all manned air vehicle, systems development, systems integration, and in-service programs managed by the NAVAIR, Deputy Commander for Acquisition and Operations (AIR-1.0); the aviation Program Executive Offices (PEO) for Air Anti-Submarine Warfare, Assault and Special Mission Programs (PEO(A)); the PEO for Tactical Aircraft Programs (PEO(T)); and the PEO for Strike Weapons and Unmanned Aviation (PEO(W)). It also applies to all Assistant Secretary of the Navy for Research, Development and Acquisition (ASN(RDA)) designated manned aviation acquisition programs being developed or acquired for U.S. Navy (USN) and/or U.S. Marine Corps (USMC) use."[2]

In essence the Flight Clearance process for commercial derivative aircraft is an independent engineering review of FAA and original equipment manufacturer (OEM) airworthiness data to ensure it meets basic Navy airworthiness requirements. The requirement for a Navy Flight Clearance flows from OPNAVINST 3710, the governing document for the Naval Aviation Training, Operating and Standardization (NATOPS) Program. The NAVAIR Flight Clearance instruction states:

"NAVAIR, PEO(T), PEO(A) and PEO(W) are responsible for the acquisition, integration, support, and development of naval aviation systems. As weapon systems develop and mature they usually undergo configuration changes and/or expansions of the operational flight envelope. At each step, from first flight through retirement of the platform, airworthiness must be assured and certified by a NAVAIR Flight Clearance. A Flight Clearance provides temporary flight authorization for an aviation system operating in a nonstandard configuration/nonstandard envelope, pending promulgation of a Technical Directive (TD) or change to a NATOPS flight manual or TACMAN."[3]

It further goes on to say:

"Following OPNAVINST 3710, chapter VII, no USN or USMC aircraft shall be flown in a nonstandard configuration without a naval Flight Clearance."[4]

The NAVAIR Flight Clearance process is depicted in appendix (a), figure (A-1).

At the top of this process is NAVAIR Code 4.0P, the Flight Clearance Officer. He is responsible for executing this policy and reports to Naval Aviation's "Chief Engineer", NAVAIR Director of Research and Engineering, Air 4.0. Using engineering capabilities resident in NAVAIR 4.0 the various engineering disciplines must agree to the issuance of the Flight Clearance prior to operating the aircraft. In accordance with the instruction:

"To minimize duplicative effort, the Flight Clearance process shall utilize OEM and FAA data to the maximum extent possible in establishing airworthiness and equipment limitations for commercially derived naval aircraft."[5]

This is where the conflicting standards and engineering paradigms come into play. Although the above statement clearly states that OEM and FAA data may be used, it does not specifically address FAA design standards versus the Navy's own experienced based standards developed by and resident within the NAVAIR engineering community. Due to the unique operating environment of operating aircraft from sea based platforms, NAVAIR engineering has developed a comprehensive set of experienced based standards and practices that apply to disciplines such as crash loads, structure, flying qualities, and other engineering disciplines. Although the vast majority of NAVAIR developed aircraft must safely operate in a totally Navy unique environment, there is a segment of naval aircraft that operate in the land-based environment where less stringent FAA standards may be more applicable. Because of these conflicting mission environments and standards, the Flight Clearance process can result in major cost and schedule implications if the process is not carefully controlled, and standards to be designed into the aircraft clearly defined early in a program effort. Once these "ground rules" are agreed upon and defined – they must remain in force through development and issuance of a Flight Clearance. Obviously in the course of testing a system as unknown undesirable characteristics are discovered –design changes may be required and all stakeholders must come to consensus agreement on new standards and processes, applied just as they agreed to up front in the program's development.

3. Program Lessons Learned Summary

A. UC-35 Program

The UC-35 Program was a U.S. Marine Corps program to replace aging CT-39D executive transport aircraft. This program was a relatively straightforward commercial acquisition. The only Navy unique changes to the aircraft were additional military unique communications equipment added to support an airborne battle management requirement. Minimal "Navy unique" environment/operating deltas were considered in the development and fielding. Test and evaluation efforts were limited to electromagnetic compatibility, specifically Tempest (security)/EMI/EMC of the communications systems added to the aircraft. NAVAIR engineering and the Flight Clearance process accepted the basic Citation FAA Type certification.

This program was fortunate as the timing of the UC-35 program was one of the first Navy acquisition programs covered under the then new DoD 5000 Acquisition Reform guidelines. Engineering review by the Flight Clearance process and NAVAIR engineering was very limited for commercial derivative acquistions. The unintentional positive lesson learned by the UC-35 was:

(1) When a well established commercially certified aircraft is used by the military for the purpose it was FAA Type certified for (i.e. high speed executive transport for the UC-35), the Flight Clearance and T&E process can be limited in scope.

B. RC-26 Program

In 1998, the U.S. Navy acquired several excess C-26D Metroliner aircraft from the U.S. Air Force. The initial intent of these aircraft was to place them in service as transport aircraft in Japan and the Mediterranean to provide logistics support in those areas of responsibility, a very similar mission to the original FAA Type Certification. As the aircraft were about to be fielded, a combination of events led to a decision by COMNAVAIRPAC to fund and request that NAVAIR convert 3 of these C-26D airframes to replace RC-12F range support aircraft at Pacific Missile Test Range, Barking Sands HI (PMRF). Surface surveillance radar and other telemetry and test instrumentation equipment installed in the RC-12F to support PMRF's missile test mission was to be migrated into the RC-26. PMRF managed existing RC-12F radar and range support equipment contracts and took responsibility for the contracting effort for the RC-26 conversion program.

During the initial program planning, the NAVAIR was in the process of coming to grips with the Acquisition Reform concepts, and attempted to define a commercial derivative acquisition policy in the form of a draft NAVAIR Policy Instruction. In accordance with the proposed NAVAIRINST 13100.15 which was to govern commercial derivative acquisition, this type of effort could be handled under existing FAA Supplemental Type Certificate (STC) processes with minimal interface with NAVAIR engineering. Based in this initial guidance from the program office, PMRF contracted for an effort to develop, install and modify the C-26 with the RC-12 systems using the

FAA's STC process. ***No meeting between the operators of the aircraft use and NAVAIR took place to analyze Navy unique mission differences prior to contracting. No flight test community representation, and no Flight Clearance policy leadership were represented prior to and during development of the contract statement of work and the solicitation process.***

Due to Navy unique external configuration differences, significant mission and operational environment differences this effort most likely should have been undertaken within the NAVAIR process. An acceptance of the basic C-26 airframe type certificate by NAVAIR and testing the RC-26 differences and issuing a Flight Clearance versus use of the FAA STC process would have been a more effective approach.

Specific lessons learned causing cost and schedule delays were:

(1) Failure to contract for a Navy Flight Clearance and clearly define Navy unique requirements in the statement of work.

(2) No Operational Requirements Document (ORD) to guide development of technical and mission requirements. The Navy accepted aircraft from the Air Force and "found" a mission for the excess aircraft.

(3) Late participation by Navy Flight Clearance experts, and requirements changes to satisfy Navy Flight Clearance process after the contract was signed and design matured.

(4) Discovery of unacceptable flying qualities, due to radome design, which resulted in moving the test program from the contractors facility to the Navy Flight Test Center.

(5) Lack of early, consistent, and dedicated flight test personnel to design and execute a test program to meet Navy and FAA certification requirements.

(6) Differences in Navy and FAA flight test techniques and processes.

(7) Navy/FAA unfamiliarity and lack of recognition for each other's processes.

C. B737-200 Lease to Support E-6 In Flight Training

The effort to lease B-737 series aircraft arose from the failure of a series of aging aircraft inspections on the B707-320 series airframes, Navy designation TC-18F. These aircraft were operated to train newly designated pilots to fly the E-6B TACAMO aircraft. When it was determined that the TC-18F's were beyond economical repair, the Commander Naval Air Forces determined that the B-737-200 was an acceptable substitute training aircraft for prospective E-6 pilots. When go-ahead for this effort was given, a key step was to hold a meeting between the Navy's Flight Clearance office and the fleet program sponsors. The sole purpose of this meeting was to define the scope of the Flight Clearance effort and to clearly define the Navy unique aspects of this program. The contracting effort took careful steps to ensure that the Navy Flight Clearance was considered and contracted for. The statement of objectives and technical requirements documents are found in appendix (c) and (d) with the applicable sections highlighted. The major factors affecting the Flight Clearance are reviewed in those documents. During the source selection process a factor in the selection was the potential of the aircraft and maintenance plan presented to meet Navy Flight Clearance requirements. Participation in the development of the statement of objectives and technical requirements generation and in source selection by NAVAIR engineering personnel resulted in minimal issues to resolve in the Flight Clearance process. Overall the B737 lease program was done quickly and efficiently though early consensus agreements between all stakeholders and early participation of the engineering community in the contracting process.

D. C-20G In Service Support

The C-20G is an FAA certified Gulfstream G IV series aircraft used for long range, high speed logistics support. It is mainly used for executive transport and some palletized cargo. The lessons learned from this program do not address initial Navy airworthiness certification, but mainly supporting modifications and configuration changes which require Flight Clearance. The major issue with the C-20G program centers on crash load requirements for internal structure (i.e. seats). In late 2001 the U.S. Marine Corps opted to change the configuration of their interior to an FAA certified alternate interior. This alternate interior configuration was not the interior that the Navy accepted with the C-20G. In accordance with the Flight Clearance instruction this configuration change required a Flight Clearance:

"Fleet operations following modification or envelope expansion, pending promulgation of an approved NAVAIR issued Technical Directive (TD) or change to the NATOPS or Tactical Manual"

Upon review, the engineering community objected to the 9G forward crash load FAA requirement, wanting a more stringent standard. Ultimately the Flight Clearance Officer overruled and the clearance was granted, an example of the lack of consistent standards being applied in the Flight Clearance process. The aircraft was certified with a 9G interior originally and the Flight Clearance process attempted to elevate a technical requirement above and beyond the original FAA certification. This is an example of the failure to promulgate policy for what is an acceptable standard for an FAA certified Navy aircraft with no Navy unique differences. This situation could be avoided by clear policy from NAVAIR accepting FAA engineering standards and existing FAA STCs for alternate interior configurations for commercial aircraft acquisition/modification programs with no Navy unique aspects.

4. Recommendations for Flight Clearance Process Improvement

A. Levels of Navy Unique Factors

Each Program is unique and should be approached as such. These recommendations are not to be taken as a "cookie cutter" approach for every program, but as a framework to approach a commercial derivative program. The level of Navy unique factors will drive all engineering issues. The first step in any program considering a commercial derivative option is for the program manager and the ultimate user of the aircraft to define the differences in proposed operational use, missions and environments between the aircraft's initial FAA certification and the Navy's usage. There are clearly several break points that can be identified and by which some basic principles can be applied. These are:

1) Minimal configuration differences.
2) Environmental/Mission differences.
3) Major configuration differences.

Each of these break points are presented and defined as stand alone sections. ***The key element to any successful commercial derivative program is for program management, NAVAIR engineers and the operational user to meet in order to and clearly understand, identify and define the scope of the effort by examining the Navy unique differences***. This meeting should occur as early as possible in a program, result in acquisition strategy planning, and should also be used as a forum to maintain ongoing liaison during the design and contracting process.

B. Minimal Differences

The easiest aircraft program to manage is one where there are minimal differences between the original certification and the proposed Navy usage. Minimal differences are defined as no changes to the outer mold line of the aircraft. For example, differences limited to avionics (i.e. radios and other communication equipment) and interior within the FAA certified Center of Gravity envelope. The only potential source of conflict in these cases will most likely come from differences between FAA standards and accepted Navy engineering standards. Generally as long as the basic aircraft FAA type certificate is accepted as part of the initial acquisition and throughout the aircraft's life cycle, there will be minimal issues. However if at some point during the life cycle of the aircraft it becomes necessary to change configuration – a Flight Clearance will be required while the aircraft is flown in a non-standard configuration. Should the aircraft operators manual, maintenance manuals or NATOPS manual already contain updated configuration data (documenting an existing FAA certified option), or if there is an existing FAA STC for the configuration, a Flight Clearance should not be required. Modifications to the aircraft interior structure will result in standards issue such as the crash loads issue the one that occurred in the C-20G program. Rarely are there any testing issues for these types of minimal difference programs. Obviously if a non-FAA certified subsystem is added, there should be appropriate testing conducted. The program office personnel must meet with the Flight Clearance experts to determine testing requirements. The best example of this would be adding a government furnished radio and secure communications system. This will require the proper electro-magnetic interference/compatibility and security testing of the secure communications systems as was the case in the UC-35 program. Another example may include adding hush-kits to engines for Navy aircraft where FAA certification already exists for the type aircraft and hush kits.

C. <u>Mission Environment Differences</u>

The next breakpoint occurs where there are environmental differences due to mission usage; the best example is the 737 as an in-flight trainer. No configuration differences were required but the mission and mission environment is different from the original FAA certification. The aircraft is flown much less in the "at altitude" navigation environment, rather it spends a much higher percentage of the time at lower altitude in the landing pattern, flying instrument approaches and experiencing a greater cycling of the landing gear and flaps systems. Additionally, the landings per flight hour ratio is much higher, requiring differences in maintenance planning. From an airworthiness standpoint these differences should be considered. An over-riding issue is maintenance planning to ensure that planning factors in depot level maintenance are taken into consideration so that no components limited by landings or aircraft/engine cycles expire before the next depot maintenance action. Typically timing of "C" and "D" checks are a result of the aircraft reaching either a flight time limit or a landing cycle limit for inspections and component changes. The basic manufacturer's maintenance plan is written to account for a baseline utilization rate for the aircraft, in the case of the 737 a

1:1 ratio of landings to flight hours. This plan must be analyzed and the driving factors for depot maintenance actions identified and accounted for in a tailored maintenance plan. Otherwise, the risk of operating with an expired component or overflying an inspection is great. Another consideration is the reliability differences that will be manifested in higher failure rates of components due to mission environmental differences. For the 737, greater time flying with the landing gear and flaps extended, as well as higher rates of cycling gear and flaps. A good reliability centered maintenance (RCM) analysis program is essential during operation of the aircraft to identify and analyze potential and actual failures within systems affected by the mission environmental differences. A sound RCM program will ensure heavily stressed components (due to mission operating environment differences) are identified and can be upgraded or placed on a forced removal cycle to prevent a hazard.

The RC-26 program also contained examples of these mission environmental differences. These were the lower altitude use of the aircraft and a much different fatigue life spectrum due to the Navy mission of range support. The RC-26 routinely flies at 500-1000 ft subjecting the airframe to higher and more frequent gust loads than the original FAA C-26 certification. The aircraft is also maneuvered much more aggressively than a commercial airliner. The basic FAA maneuvering limits still apply, but the range support mission requires much higher rate of G-loading occurrences in excess of 1.5-2.0g versus that of an airliner. In order to quantify the navy unique mission impact on the RC-26 fatigue life, accelerometers and flight data recorders were installed and the data downloaded at a regular interval and sent to the NAVAIR structures engineering group to refine fatigue life for the RC-26.

In a program were there are strictly mission environmental differences, flight test is generally not required. In programs where the mission is different (i.e. range support vs. transport or pilot training vs. transport) there may be some mission testing required to ensure the aircraft meets Navy mission requirements. In the case of the 737 lease program testing focused solely on the mission requirement, mainly a qualitative evaluation of cockpit interfaces and flying qualities examining the suitability of the 737-200 to be an adequate surrogate in-flight trainer for the E-6.

D. Major Configuration Differences

Major configuration differences are defined as those that affect aircraft flying qualities and aircraft performance. Any change to the outer mold line of the aircraft, envelope expansion, or operation near the edges of the FAA approved center of gravity envelope should be considered a major configuration difference. These types of programs will require involved effort by the test community to identify potential problem areas and develop a test program to ensure airworthiness. This may be done either under FAA processes or Navy processes or a combination of both. It will be incumbent on the program office with assistance from the Navy Flight Clearance experts to determine the methodology to be used. The Navy and FAA's flight test processes provide the same end goal – an airworthiness certification, they use much different processes to get to the goal. A combined flight test program can be accomplished, but extensive planning and coordination between FAA, DER, and Navy test pilots will be required to develop a test program that meets all Navy and FAA testing requirements. Differences in flight test technique, Navy unique mission, environments, and design standards will all be complicating factors in testing and airworthiness certification. The only time a combined effort should be used is if there is a compelling reason to maintain an FAA certification on the aircraft. ***A much better methodology is to accept the basic FAA airworthiness certificate, and examine the differences within the Navy airworthiness processes***.

E. Standards

The experiences listed in the previous sections have led me to propose several process improvements to the Flight Clearance process. The governing instruction NAVAIRINST 13034.1B, dated 20 Oct 2000, finally attempted to deal with the growing commercial derivative acquisitions, however it fell somewhat short in laying out clear standards by which program offices should follow. Although the current instruction refers to minimizing duplication of effort by using FAA and OEM data to the maximum extent practicable – it never specifically states that FAA standards are acceptable for a shore based FAA certified aircraft. It is clear that for Acquisition Reform goals to be realized, the military needs to accept commercial standards where they can be applied. Clearly an FAA certified aircraft that is operated with minimal "navy unique" differences can have FAA standards readily applied to the design process. A key element required accomplish this step of using FAA standards is a clear, and consensus understanding of these unique factors as discussed in a previous section. For the Flight Clearance process, program managers would be better served by adding the following statement in NAVAIRINST 13034.1B: ***"The applicable FAA standards are a minimum acceptable set of design and airworthiness standards for commercial derivative aircraft acquisition and modification programs. As a part of the design and test process, these FAA standards should be tailored by taking Navy unique mission, configuration and environmental differences into consideration."***

Obviously each program is somewhat different and there are varying degrees of "navy unique" aspects of each program – therefore, there must be a balance of cost, schedule, performance and risk. The Integrated Product Team (IPT) leader and the project test pilot (if assigned) are the natural fit to lead this effort within the engineering community. I would propose that the IPT leader/Project Officer/engineers must analyze each program and develop a tailored set of performance standards to meet mission and Flight Clearance requirements based upon the Navy unique differences defined with the operator. Based upon risk and cost constraints. the program manager must have the ability to tailor and choose between Navy and FAA standards. The engineering community naturally desires to minimize risk, although they currently exercise final control via the Flight Clearance process, and are not held accountable for cost and schedule. When the technical requirements are clearly stated by engineering, cost and schedule can be properly planned for and resourced. The ***engineering perspective is absolutely required early in the program and as the program's strategy is defined***. In no way is this thesis advocating removing or discounting NAVAIR engineering from the process, but rather advocating the cognizant engineers be included early in a program so that the program manager can be advised of the risks from engineering. Also to require NAVAIR engineering participation in the design and contracting process, as to make a “standards” decisions based on risk and cost. Again a clear policy statement accepting FAA standards as the minimum acceptable would go a long way in clearing debate. If the mission or a navy unique environment/utilization dictate a more stringent standard, it should be applied. That judgment should be left up to the program manager.

F. Process Changes

The existing Navy Flight Clearance process as depicted in figure (A-1) is a good framework to start from when looking at commercial derivative aircraft programs. However, some additional steps can be placed in the process to clear up standards issues. Mainly there should be an analysis of differences block added, and a design standards analysis block added. Figure (A-2) depicts the proposed new Flight Clearance process diagram. ***The key element in this new process is to connect the NAVAIR engineering community with the fleet user and/or test pilot to accurately define the Navy missions and potential differences between Navy missions and mission of the aircraft as originally certified by the FAA. Ultimately the fleet user should have final say in the suitability of the commercial aircraft to perform Navy missions.*** If the technical risks cannot be minimized, achieving lower procurement costs by a commercial derivative program, or if the fleet user does not deem a commercial alternative suitable, then a more traditional acquisition approach should be pursued.

G. Flight Test Issues

Most flight test issues are centered on differences between the detailed FAR certification requirements of the original aircraft certification and the lack of training on FAA flight test methodology that Navy's test pilots receive. A Navy test pilot is not formally trained in any FAA test processes, methodology, or standards. When a test pilot becomes involved in a commercial derivative program he is armed with a basic test methodology gained from Test Pilot School that applies to basic concepts, but has very little training on FAA flight test. It is essential that these test pilots involved with an existing FAA certified aircraft gain an understanding of the standards and processes that the airframe was certified under.

It is this author's opinion that test pilots involved with commercial derivative aircraft must receive training in FAA standards, policies and processes prior to becoming involved in the test planning. The active duty test pilots assigned to the Navy's test centers will ultimately rotate to other jobs and their valuable FAA experience will not be retained unless a more permanent expertise is established. There are several civilian test pilots and support contractor test pilots assigned to Test Teams within NAVAIR. These test pilots are perfect candidates for establishing an FAA test/certification knowledge base within NAVAIR. Designating a few civilian/contractor test pilots and engineers for training in FAA and commercial practices could accomplish a core team within NAVAIR. Establishment of a civil certification “schoolhouse” at the U.S. Naval Test Pilot School would also return investment by bringing in revenue in a short course type format, as well as assisting in retaining FAA expertise within NAVAIR. It would be of significant value added for the Navy to have these “commercial experts” receive FAA Designated Engineering Representative (DER) qualifications as part of their training in FAA practices. A small cadre of expertise in this area would easily allow the Navy to retain FAA certification of these aircraft if it so desired. This cadre could easily train additional in house active duty test pilots and function as a commercial derivative airworthiness certification office within the test squadrons and the Flight Clearance process.

A baseline knowledge of how the aircraft handles is also required if testing is to be conducted to determine if any degradations to flying qualities have occurred due to modification. In the case of the RC-26D, the baseline aircraft was already on the edge of acceptable flying qualities. Without baseline knowledge, it would have been difficult to determine if the modification had caused the problems or if the basic aircraft had flying qualities problems. Any flying qualities test program must include a baseline handling qualities evaluation prior to evaluating the modified aircraft.

5. Conclusions

It is clear that the cost and cycle time goals of Acquisition Reform can be realized by using commercial derivative acquisitions to meet Navy mission requirements, but refinements to existing policy must be made. All of the programs discussed in this thesis were executed in a gray zone while leadership wrestled with policy questions. The commercial derivative policy instruction, NAVAIRINST 13100.15 was not officially issued until well after these examples were fielded. The new instruction states the new policies, but does not detail the specifics regarding the Flight Clearance and test process for these aircraft acquisitions, nor does it officially state the applicable FAA Type design standards are the minimum acceptable standards if there are no navy unique missions, modifications or environments.

To support the goals of Acquisition Reform the Navy's Flight Clearance policy instruction, NAVAIRINST 13034.1B should be changed to state:

"The applicable FAA standards are a minimum acceptable set of design and airworthiness standards for commercial derivative aircraft acquisition and modification programs. As a part of the design and test process, these FAA standards should be tailored by taking Navy unique mission, configuration and environmental differences into consideration."

The instruction should also be amended to include the following statement:

"The Program Manger is expected to tailor and tighten standards where appropriate based on a cost/schedule/risk balance to meet Navy unique missions, environments and modifications. The program manager is responsible for ensuring that all cognizant NAVAIR engineering disciplines are included in initial commercial derivative acquisition planning as well as during contract statement of work development."

It is absolutely critical that the proper NAVAIR engineering disciplines are involved very early in the design process, and can influence technical requirements prior to any contracting action being taken. The Navy Flight Clearance process within NAVAIRINST 13034.1B should be modified as shown in figure A-2, to identify Navy unique factors and identify where commercial standards can be accepted in a commercial derivative acquisition/modification programs. The Flight Clearance process must require Navy unique airworthiness requirements to be identified early on, and included in design and contracting processes.

In order to better support the test and evaluation of the growing commercial derivative acquisitions seen in the Navy; the Naval Air Warfare Center, Aircraft Division should establish a "Commercial Derivative Flight Test Center of Excellence". The logical command for this center is within VX-20, the cognizant developmental test squadron for most commercial derivative aircraft programs. This center of excellence should include DER test pilots and flight test engineers who are a mix of active duty test pilots, but formed around a knowledge base of civil service and contractor test pilots who have been trained in FAA standards, certification requirements, and flight test methodology. This center of excellence should be made available to all program offices that anticipate a commercial derivative acquisition, and members of the Commercial Test Teams included at the beginning of any anticipated program. The center should encompass all aspects of airworthiness and include the appropriate engineering disciplines within NAVAIR engineering.

Bibliography

(1) Department of Defense Instruction 5000.1, Defense Acquisition, 15 March 1996.

Systems

(2) NAVIRINST 13034.1B, Flight Clearance Policy Instruction for Manned Air Vehicles, 24 Oct 2000.

(3) NAVIRINST 13034.1B, Flight Clearance Policy Instruction for Manned Air Vehicles, 24 Oct 2000.

(4) NAVIRINST 13034.1B, Flight Clearance Policy Instruction for Manned Air Vehicles, 24 Oct 2000.

Additional References

(1) NAVAIRINST 1300.15, Engineering Technical Review of Commercial Derivative Aircraft Programs, 30 March 2002.

(2) Policy Summary For Engineering Technical Review Of Commercial Derivative Aircraft Programs, 18 Jan 2002.

(3) Brief to Naval Air Systems Command Executive Leadership Council, Mr. Robert Skalamara, 26 March 2002.

Appendices

Appendix A - Full Page Figures

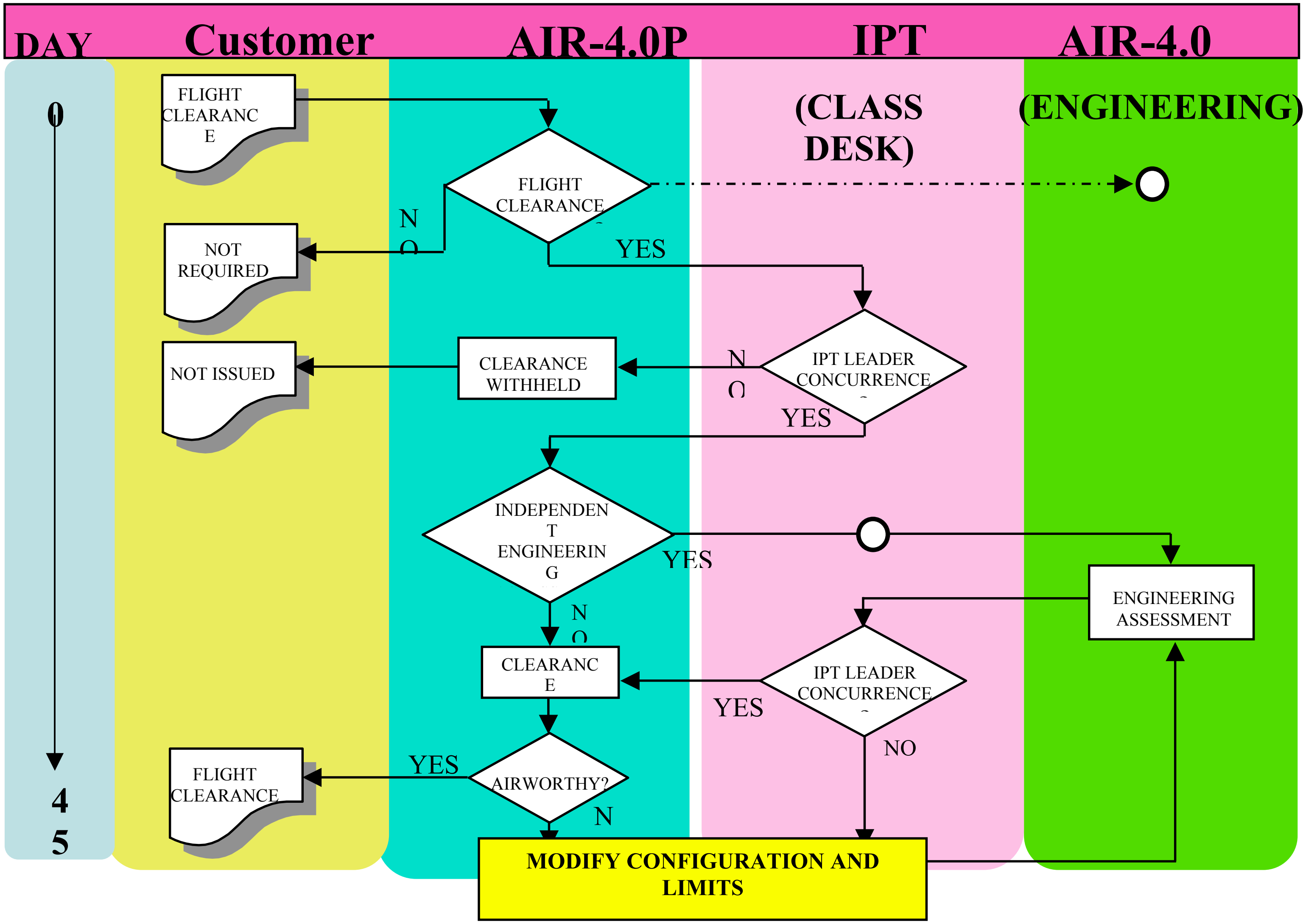

Figure A-1
NAVAIR Flight Clearance Process

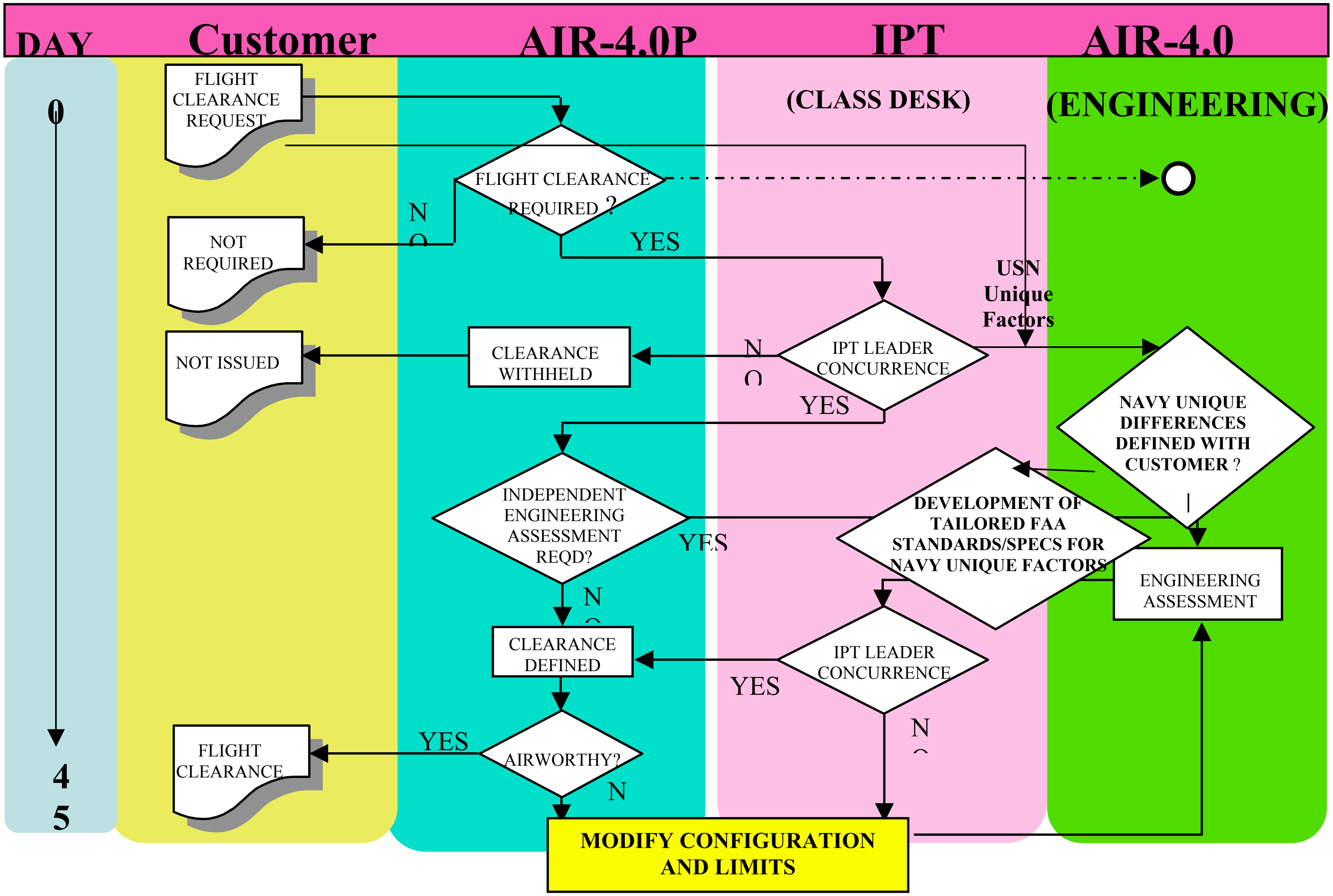

Figure A-2
Proposed NAVAIR Commercial Derivative Flight Clearance Process

Appendix B - Detailed Program Lessons Learned and Background

A. UC-35 Program

The UC-35 Program was a U.S. Marine Corps program to replace aging CT-39D executive transport aircraft. It leveraged an U.S. Army program to replace it's C-12 Super King Air series with commercial off the shelf Cessna Citation variants. The Marine Corps generated the requirements and funding for the aircraft and PMA-207 within Naval Air Systems Command Air 1.0 Executive Office executed the program. This program was a relatively straightforward commercial acquisition. The only service unique changes to the aircraft were additional military unique communications equipment added to support an airborne battle management requirement. Minimal "unique" environment/operating deltas were considered in the development and fielding. The only test and evaluation effort centered on electromagnetic compatibility, specifically Tempest(security)/EMI/EMC of the communications systems added to the aircraft. A well defined Operational Requirements Document aided the certification process by specifying that the aircraft be an FAA certified aircraft and the airframe retain it's FAA certification. NAVAIR engineering and the Flight Clearance process accepted the basic Citation FAA Type certification. The only additional limitations placed on the aircraft by NAVAIR were centered on roll over of arresting gear cables often found at Navy and Marine Corps airfields. The aircraft is limited to not rolling over the cables on take-off or landing roll at speeds greater than 20 knots.

This program was fortunate as the Flight Clearance process had a clearly defined scope. This was due mainly to the timing of the UC-35 program as it was one of the first Navy acquisition programs covered under the then new DoD 5000 Acquisition Reform guidelines. At the time the aircraft was being procured (1998/1999), the Flight Clearance process had yet to be expanded to include commercially developed airframes for Navy use, and engineering review by NAVAIR engineering was very limited. The unintentional positive lesson learned by the UC-35 was:

(1) When a well established commercially certified aircraft is used by the military for the puprose it was FAA Type certified for (i.e. high speed executive transport for the UC-35), the Flight Clearance and T&E process can be limited in scope.

In essence, the UC-35 program had the basic FAA airworthiness certificate accepted by the Navy, there were no outer mold line differences and minimal internal configuration issues dealing with the Communications Suite installed. The military unique communications suite differences were properly addressed via the cognizant Navy engineering and T&E process. This kept nearly all standards questions and controversy to a minimum, and this aircraft was fielded in a manner that realized the cost and cycle time goals envisioned by Acquisition Reform.

B. RC-26 Program

Unlike the UC-35 program, the RC-26 program was fraught with planning, and execution failures. These failures led to severe cost and schedule problems. In 1998, the U.S. Navy acquired several excess C-26D Metroliner aircraft from the U.S. Air Force. The initial intent of these aircraft was to place them in service as transport aircraft in Japan and the Mediterranean to provide logistics support in those areas of responsibility. As the aircraft were about to be fielded, a combination of events led to a decision by Commander, Naval Air Forces U.S. Pacific Fleet to fund and request conversion of three C-26D airframes to replace RC-12F range support aircraft at Pacific Missile Test Range, Barking Sands HI (PMRF). The RC-12s have surface surveillance radar and other telemetry and test instrumentation installed to support PMRF's missile test mission. The RC-12F airframes were not capable of supporting future near and far term Ballistic Missile Defense Testing. A congressionally mandated drawdown of the Navy's C-12 aircraft inventory made it attractive option for the Navy chain of command to deconfigure the radar and range support equipment from the RC-12 and move airframes back to CONUS. The RC-26 was a conversion program, and managed by the field site – PMRF whom already managed their radar and Range support equipment contracts. The simple intent was to migrate all RC-12 prime mission equipment (A high resolution radar, TM equipment, and missile termination relay equipment) to the RC-26. This

Figure B-1

RC-26D Aircraft

would require addition of a belly radome to the C-26 as well as additional UHF antennae. Figure B-1 presents the RD-26 aircraft.

All contracting actions took place from PMRF vice through the Naval Air Systems Command program office. This was slightly out of normal procedures, but not unprecedented as PMRF had previously been permitted to manage the RC-12F program in this fashion when it was previously aligned as part the Naval Air Systems Command. As part of the 1990's Base Closure and Realignment (BRAC) process the command had been re-aligned to the fleet commanders, but it's primary mission remained test and evaluation. After the re-alignment the RC-26 program fell under NAVAIR PMA-207 cognizance. During the initial program planning, the NAVAIR was in the process of coming to grips with the Acquisition Reform concepts, and attempted to define a commercial derivative acquisition policy in the form of a draft NAVAIR Policy Instruction. In accordance with the proposed NAVAIRINST 13100.15 which was to govern commercial derivative acquisition, this type of effort could be handled under existing FAA Supplemental Type Certificate (STC) processes with minimal interface with NAVAIR engineering. Based in this initial guidance from the program office, PMRF contracted for an effort to develop, install and modify the RC-26 with the RC-12 systems using the FAA's STC process. No flight test community representation, and no Flight Clearance policy leadership were represented during program development or in the contract statement of work and the solicitation process.

In retrospect, this was the fatal mistake that caused the majority of problems experienced by the program. This was mostly due to the proposed commercial derivative reform effort at NAVAIR which was presented to the customer as the proper process to be followed. However, the new process was not staffed within the cognizant NAVAIR leadership and accepted within all the cognizant NAVAIR competencies. As the RC-26 program evolved, every new stakeholder (test and evaluation, structures engineering, etc) brought into the process had to undergo an education process, had input into the design, and resulted in changes to the airworthiness certification process after the contract for an FAA STC had been awarded. These valuable inputs from the NAVAIR competencies ultimately led to the fielding of the aircraft, but late design, airworthiness standard changes, and certification process changes led to many cost and schedule delays and customer dissatisfaction. Ultimately the draft process was followed to some degree, and resulted in an effort to combine the Navy's Flight Clearance process with the FAA's STC process. This resulted in a joint USN, contractor flight test program of 40 flight hours where many lessons were learned in how to execute such a program.

The first airworthiness issues began surfacing during critical design reviews where the cognizant NAVAIR structures engineers were finally included in the design process. Failure to achieve up-front agreement at the start of the program between all stakeholders relating to the differences in how the Navy would operate the aircraft (i.e. more time at low altitudes, maneuvering specra, and mission requirements) versus the original Metroliner FAA type certificate resulted in several major design changes very late in the process. In fact well after the design and certification contracts had been signed, and work already begun for the first test article. A breakaway feature for the belly mounted radome to mitigate the risk of a birdstrike resulting in the radome becoming deformed and interfering with flight control cables running adjacent to the radome was the most costly in terms of cost. Additional changes to install accelerometers and data recorders to monitor the airframe fatigue life based on the different Navy operating environment were also required. These changes were all indicative of the lack of upfront agreements previously mentioned. Other issues began to surface when the FAA test pilots and the Navy's attempted to reconcile their flight test plans. During the reconciliation it was clear that the FAA/contractor DER test pilots and the Navy test pilots were trained in very different standards and certification processes and were not familiar with each respective organization's processes. Test point entry and technique, which test pilot actually flies test points and the scope of the test program were debated and had to be resolved after the contract was signed. Complicating this FAA vs Navy test pilot issue was the fact that no less than 3 Navy project test pilots were assigned to the program in less than 1 year. The constantly changing Navy personnel assigned hampered test planning, coordination and efficiency due to the unique aspects of the RC-26 program, and the certification methodology. This led to many inconsistent expectations between the FAA, DER and Navy test pilots and resulted in delays.

Once the test planning and design issues were solved after a 1 year delay, flight test was begun at the Contractors facility. Testing progressed smoothly with the Navy test pilot and the contractor DER test pilot jointly flying the test points. Computational fluid dynamics modeling indicated that there would be minimal flying qualities changes due to the outer mold line change. The underwing mounted radome was mounted aft of the aircraft center of gravity, and it was anticipated that the C-26 very weak lateral-directional stability should be enhanced slightly. During approach to stall testing, the aircraft suffered from an uncommanded roll and yaw 10 knots above stall speed. Testing was ceased, and analysis recommended that vortex generators be installed on the side of the radome to rectify the undesirable characteristic. Initial efforts at the contractor facility failed to correct the deficiency, and a decision was made to move the test effort from the west coast contractor facility to the Navy's test center at Patuxent River. A series of baseline handling qualities evaluation flights were conducted with the radome off. These revealed that the basic aircraft lateral directional stability was on the ragged edge of the FAA certification standards, and in fact **would not have passed Navy flying qualities testing**. Once the basic characteristics were known, a flow visualization effort was undertaken by tufting the radome and filming the flow from a T-34C chase aircraft. This revealed asymmetric vortex shedding from the right side of the radome. Using the visual data, NAVAIR and contractor Aerodynamics engineers developed the optimum size vortex generator and placement on the radome to address the asymmetric shedding. Once corrected, the testing progressed uneventfully and the FAA test pilot validated the contractor and Navy data on one flight.

Ultimately the decision to move the testing to the Navy facility benefited the program greatly. All NAVAIR stakeholders and resources were brought to bear and resolved a significant deficiency. In retrospect, due to the external configuration differences, this effort most likely should have been undertaken within the NAVAIR process, with NAVAIR accepting the basic airframe Type certificate and testing the RC-26 differences and issuing a Flight Clearance vice using the FAA STC process. Other Major lessons learned causing cost and schedule delays were:

(1) Failure to contract for a Navy Flight Clearance and clearly define Navy unique requirements in the contract statement of work.

(2) No operational requirements document to guide development of technical requirements.

(3) Late participation by Navy Flight Clearance experts, and requirements changes to satisfy Navy Flight Clearance process after the contract was signed and design matured.

(4) Discovery of unacceptable flying qualities due to radome design that resulted in moving the test program from the contractors facility to the Navy Flight Test Center.

(5) Lack of early, consistent, and dedicated flight test personnel to design and execute a test program to meet Navy and FAA certification requirements.

(6) Differences in Navy and FAA Flight Test Techniques and Processes

(7) Navy/FAA unfamiliarity and lack of recognition for each agency’s processes.

C. B737-200 Lease to Support E-6 In Flight Training

The effort to lease B-737 series aircraft arose from the failure of a series of internal inspections on the B707-320 series airframes, Navy designation TC-18F. These aircraft were operated at the squadron used to train newly designated pilots to fly the E-6B TACAMO aircraft. These FAA certified 707 airframes were required to fly 3000 flight hours and 6000 landings per year to support these initial and refresher training requirements. They were grounded in November 1999 when a series of aging aircraft inspections were performed on the wing structure of the airframes. It was determined that the TC-18F's were beyond economical repair. A search for available 707-320 airframes was futile as all the candidate airframes were in a poor material condition and unable to meet the airworthiness requirements set by the Navy. A fleet effort revealed that the B-737 series could be used as an intermediate training step between the T-1 Jayhawk and the E-6B. When go-ahead for this effort was given, a key step was to hold a meeting between the Navy's Flight Clearance office and the fleet program sponsors. The sole purpose of this meeting was to define the scope of the Flight Clearance effort and to clearly define the Navy unique aspects of this program. These were the Navy landings per hour ratio of 3:1 vice 1:1 for airline use, and airframe material condition. The contracting effort took careful steps to ensure that the Navy Flight Clearance was considered and contracted for. The statement of objectives and technical requirements documents are found in appendix (c) and (d) with the applicable sections highlighted.

The major factors affecting the Flight Clearance were reviewed in those documents. During the source selection process, a factor in the selection was the potential of the aircraft and maintenance plan presented to meet Navy Flight Clearance requirements. The landings/flight hour ratio was responsible for numerous adjustments to the basic 737 series maintenance plan. Several key members of the Flight Clearance process representing E-6 systems engineering, structures, engines, and hydraulic systems were part of the source selection team. These team members ensured that all airworthiness considerations were accounted for in maintenance planning as a result of the change in mission operating environment. Their participation in the development of the statement of objectives and requirements as well as in the source selection resulted in minimal issues to resolve in the Flight Clearance process. Overall the B737 lease program was done quickly, program start in November 2000, aircraft fielded in May 2000, and efficiently though early consensus agreements between all stakeholders and early participation of the engineering community in the contracting process.

D. C-20G In Service Support

The C-20G is an FAA certified Gulfstream G IV series aircraft used to for long range, high speed logistics support. It is mainly used for executive transport and some palletized cargo. The lessons learned here do not address initial Navy certification, but mainly supporting modifications and configuration changes which require Flight Clearance. The major issue with the C-20G program centers on crash load requirements for internal structure (i.e. seats). In late 2001 the U.S. Marine Corps opted to change the configuration of their interior to an upgraded fully reclining seat and a workstation for their primary customer, a 3 star Marine General. The alternate interior was an option for the Gulfstream IV series covered under by an FAA STC, however it was not the interior accepted by the Navy with the C-20G. In accordance with the Flight Clearance instruction this configuration change required a Flight Clearance:

"Fleet operations following modification or envelope expansion, pending promulgation of an approved NAVAIR issued Technical Directive (TD) or change to the NATOPS or Tactical Manual"

Although an FAA certified option, this alternate interior needed to be submitted to the Flight Clearance process for review. Upon review the engineering community objected to the 9G forward crash load FAA requirement, wanting a more stringent standard. Ultimately the Flight Clearance Officer overruled and the clearance was granted. However this is an example of the lack of consistent standards being applied in the Flight Clearance process. The aircraft was certified with a 9G interior originally, why should the customer pay extra for a retrofit that met a higher standard later standard in the aircraft's life cycle? The Flight Clearance process attempted to elevate technical requirements above and beyond the original FAA certification for this FAA approved modification. This example highlights the failure to promulgate policy for what is an acceptable standard for an FAA certified Navy aircraft with no Navy unique differences. Although the Flight Clearance Officer made the decision to approve the FAA standards, it puts the Flight Clearance Officer in a difficult position of over-ruling his subordinates.

This situation could be avoided by clearly accepting FAA engineering standards and existing FAA STCs for alternate interior configurations for commercial aircraft acquisition/modification programs with no navy unique differences.

Appendix C E-6 In-Flight Trainer Lease Statement of Objectives

E-6 In-Flight Trainer Lease Statement of Objectives

Program Objectives: Fleet Air Reconnaissance Squadron SEVEN (VQ-7) is the U.S. Navy's Fleet Replacement Squadron (FRS) for the E-6 TACAMO aircraft. VQ-7 's mission is to train naval aviators for fleet squadrons. The purpose of this solicitation is to provide VQ-7 with Boeing 737 lease aircraft to specifically accomplish flight training of naval aviators.

1. Aircraft and Training. Provide one or more Boeing 737 lease aircraft to meet the annual need for 2000 flight hours /6000 landing cycles of operation in support of VQ-7's mission. The basic period of the lease (FY01) will be prorated to 835 flight hours /2500 landing cycles. Operations are home-based at Tinker AFB, OK. Aircraft may fly anywhere in the continental USA in pursuit of training objectives. Aircraft availability is specified in Technical Requirements Document (TRD) paragraphs 3.2 and 3.3. The Navy will operate aircraft in accordance with the FAA-approved airplane flight manual for the aircraft type.

2. Aircraft Lease. Provide all logistics and maintenance needed to sustain the aircraft except as specifically identified in TRD Sections V and VI. Aircraft must possess and maintain a current FAA airworthiness certificate in accordance with Federal Aviation Regulations. The Navy provides flight crews and fuel.

2.1. Lease Period. The basic period of the lease shall be from 1 May 2001 to 30 September 2001 with three one-year options through 30 September 2004.

2.2. Configuration. All aircraft provided must be of the same type, series, engines and have the same cockpit configuration.

3. Maintenance and Logistics. Provide all required aircraft organizational and field level maintenance, to include aircraft preflight and post flight service in accordance with the TRD Section V. Provide a supply support system that ensures parts availability and required transportation in support operational requirements anywhere in the continental USA.

3.1. All leased aircraft must possess and maintain an FAA airworthiness certificate throughout the period of the lease.

3.2. Navy Flight Clearance. Lease aircraft must acquire Navy Flight Clearance for operation by naval aviators before 1 May 2001. See TRD paragraphs 2.5, 3.11 and 5.2.

4. Management. Provide management needed to execute the program. Provide maintenance and logistics plans and management in accordance with the TRD Section IV and V.

Appendix D - Excerpts from 737 Lease Technical Requirements Document

Excerpts from 737 Lease
Technical Requirements Document
(TRD)

SECTION I – GENERAL

1.1 Purpose.

This Technical Requirements Document (TRD) describes tasks to be accomplished in support of E-6 aircrew training conducted by Fleet Air Reconnaissance Squadron SEVEN (VQ-7) at Tinker AFB, Oklahoma. Requirements herein describe a lease needed to provide an interim capability to train naval aviators pending delivery of Boeing 737NG aircraft by a separate contract in FY04/05. As the Boeing 707 is no longer a production aircraft, and currently no known used 707 aircraft meet Navy requirements for Flight Clearance, Boeing 737 aircraft have been determined by government analysis to be the best choice to fulfill the role as E-6 In-Flight Trainer (IFT) aircraft.

1.2 System Description.

The E-6A/B Mercury aircraft is a Boeing 707-320 series aircraft modified to meet the TAKE CHARGE AND MOVE OUT (TACAMO) mission. E-6B aircraft are also configured to support the Airborne National Command Post (ABNCP) mission. E-6 aircraft were the last production 707 aircraft having CFM-56-2-2A high bypass fan jet engines with thrust reversers. All fleet aircraft have digital avionics and EFIS flight instrumentation. A forthcoming aircraft modification program titled "Multi-function Display System (MDS)" will retrofit the aircraft with the latest 737NG glass cockpit. Included in this modification are Traffic Collision Avoidance System (TCAS II) and Enhanced Ground Proximity Warning System (E-GWPS) equipment group upgrades. The MDS equipped E-6 aircraft will employ the same large color liquid crystal displays found in Boeing 737-700 commercial jetliner aircraft. IFT aircraft acquired under this lease serve as surrogate aircraft providing an E-6 aircrew flying training platform and a means to off-load proficiency flying from fleet aircraft.

1.3 Mission Description.

The E-6 Mercury aircraft is home based at Tinker AFB. VQ-7's mission is to qualify and provide refresher training for E-6 Mercury crews. For flight crews, training is accomplished in phases. The ground training phase is accomplished using the Contract Flight Crew Training System (CFCTS). CFCTS is a complete service including computer-based, classroom and simulator training. The ground training facility is located in Bldg. 830 on Tinker AFB. The flying phase is accomplished using IFT aircraft. At the current moment, VQ-7 lacks surrogate aircraft due to the grounding of their TC-18F aircraft following structural inspection. For economic reasons TC-18F aircraft are being retired in lieu of repair. Flying training at VQ-7 is also in a state of transition due to the addition of the ABNCP mission and impending MDS modification designed to meet

Global Air Traffic Management (GATM) requirements. In analyzing the need for a surrogate aircraft for the future, it has become apparent the best choice for interim service is a Boeing 737 having conventional or EFIS instrumentation and the best choice for the long term is a new Boeing 737NG aircraft. This document describes the need for a lease to fill the gap until new Boeing 737NG aircraft arrive. The offeror is herein referred to as "the contractor."

1.4 General Program Requirements

General Program Requirements are defined by the Statement of Objectives (SOO) for the program. Requirements of the SOO are incorporated by reference and have the same force and effect as if they were given herein in full text.

1.5 Original Equipment Manufacturer (OEM) Agreements

The contractor shall establish agreements with appropriate OEMs that permit the contractor to obtain approved data and technical support necessary to complete requirements herein.

SECTION II – DATA AND DOCUMENTATION

2.0 Aircraft Owner/Operator Data. The contractor is solely responsible to acquire aircraft manufacturer data needed in support of this lease.

2.1 Aircraft Operator Data. The contractor is responsible to ensure government access to Boeing's Flight Technical Services Internet web sites for the aircraft type (secure and normal sites). For the duration of the lease, the aircraft owner will ensure that Boeing's database lists VQ-7 as a 737 aircraft operator. VQ-7 requires one copy of the FAA approved airplane flight manual for each airplane leased.

2.2 Maintenance Records and Forms. The contractor is required to use forms for initiating and documenting aircraft use and discrepancies in accordance with FAA directives. Contractor format is acceptable.

2.4 Maintenance Planning. Aircraft maintenance shall be based upon the requirements in the Boeing Maintenance Planning Document (MPD) and its associated inspection cards. The contractor shall establish and execute a time-phased plan for accomplishment of all flight cycle and calendar driven inspections.

2.5 Aircraft Records. There is a requirement for delivery of aircraft records in support of obtaining a Navy Flight Clearance. A copy of the records for each aircraft proposed shall be provided to the government within 15 days of contract award for the sole purpose of obtaining a Navy Flight Clearance. Subsequent aircraft furnished in conjunction with this contract also require a Navy Flight Clearance. Records of subsequently furnished aircraft shall be provided to the Navy Flight Clearance Office 30 days prior to the first planned flight.

SECTION III – GENERAL REQUIREMENTS

3.9 Minimum Equipment List (MEL) and Dispatch Deviations Procedures (DDP). The contractor shall develop a MEL and a DDP acceptable to the government. As a minimum the MEL must be consistent with the FAA's Master Minimum Equipment List (MMEL) for the aircraft model.

3.10 FAA Requirements. All leased aircraft must possess and maintain a valid FAA airworthiness certificate throughout the period of the lease. The Navy will operate aircraft in accordance with the FAA approved Airplane Flight Manual (AFM) for the aircraft type. Passenger accommodations required include a minimum of five rows of double seating and single forward lavatory. Galley accommodations include small refrigerator, coffee and fresh water services. Passenger cabins shall have essential safety equipment for the number of seats installed, operable emergency lighting, and passenger oxygen. Storage space shall be provided for student training materials, airplane flight manuals, and other materials needed to support aircraft operation and student training.

3.11 Navy Flight Clearance. Leased aircraft must obtain Navy Flight Clearance prior to 1 May 2000. See "Acceptance For Navy Service and Release for Flight of Commercial Aircraft, NAVAIRINST 13030.1A and Flight Clearance Policy for Manned Air Vehicles, NAVAIRINST 13034.1B". The government will make every effort to process Flight Clearance requests.

SECTION IV – PROGRAM MANAGEMENT REQUIREMENTS

4.5 Personnel. The contractor shall hire, train and maintain a qualified staff to support all elements of this program. The contractor shall ensure sufficient quantities of trained and qualified personnel, including FAA-certified personnel, are available at contract start and throughout the period of performance to meet contract requirements.

4.10 Quality. The contractor shall develop, implement and maintain a quality plan and inspection system that complies with FAA requirements. In addition, the contractor shall support quality audits by government representatives.

SECTION V - AIRCRAFT MAINTENANCE REQUIREMENTS

5.***1 Basic Maintenance Requirement. The contractor shall perform all aircraft maintenance in accordance with FAA requirements***.

5.2 Maintenance Plan. ***The contractor shall provide a copy of his proposed aircraft maintenance program as developed from the Boeing Maintenance Planning Document (MPD) for the aircraft model. The contractor shall review and make a recommendation to the government on the contractor's proposed maintenance program. The maintenance program should reflect planned usage, e.g., three landing***

cycles per flight hour. The plan should address all calendar-driven inspections, high use items, hard-time items, engines, flight controls, landing gear, and hydraulic systems, etc. The maintenance plan shall include background and engineering justification for changes as required to support and facilitate obtaining a Navy Flight Clearance. Future changes to the maintenance plan shall be coordinated with and approved by the Navy.

5.3 Maintenance and Logistics. The contractor shall provide required aircraft organizational, field and depot level maintenance including aircraft preflight and post flight services. The contractor shall provide supply support as required to meet the availability requirements of the lease. The contractor shall ensure repair sources are FAA approved and parts are maintained to original part number specification or any subsequent upgrade. This requirement pertains to all subcontractors.

5.7 Government Oversight. The FAA does not have jurisdiction at military installations, and as a general rule does not perform oversight of maintenance or records of public use aircraft. The Navy reserves the right to proxy for the FAA.

Vita

CDR Doug Lucka was born in Dayton, Ohio on December 20 1965. He was raised in Tipp City, Ohio and attended Bethel Local Schools in Tipp City. He graduated from Bethel High School in 1984. From there he attended Miami University, Oxford Ohio where he graduated with a Bachelor of Science in Aeronautics in May 1988. Following college graduation he was commissioned an Ensign in the U.S. Navy where he was designated as a Naval Flight Officer in 1990. In 1996/97 he attended U.S. Naval Test Pilot School and graduated from the Airborne Systems Program in Class 111.

CDR Lucka is currently assigned as the Phased Maintenance Deputy Product Manager at Naval Air Depot North Island California where he oversees depot level phased maintenance production of S-3B, H-60, H-1, and H-53 aircraft. He is pursing his MS degree in Aviation Systems from the University of Tennessee Space Institute.