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Analysis of Navy aircraft engine and engine component warranties

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ANALYSIS OF NAVY AIRCRAFT ENGINE AND
ENGINE COMPONENT WARRANTIES

by

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and
Suzanne Christine Hickey
December 1993

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Since the enactment of Title 10, Section 2403 of the United States Code in 1985, written warranty clauses have been mandated for the procurement of all major weapon systems. This thesis discusses the aircraft engine warranty program established by the Naval Air Systems Command in response to that warranty legislation. Warranty procedures and issues are examined during procurement, contract negotiations, and in the daily operations of the fleet. The aircraft engine warranty program of a major commercial airline (United Airlines) is presented to allow the reader to form a basis from which to make program comparisons. Those areas in which a commercial warranty may be applicable to a military environment are described and analyzed. Conclusions are drawn concerning the effectiveness of the Navy's warranty program and recommendations are suggested for improvements and/or follow-on studies.

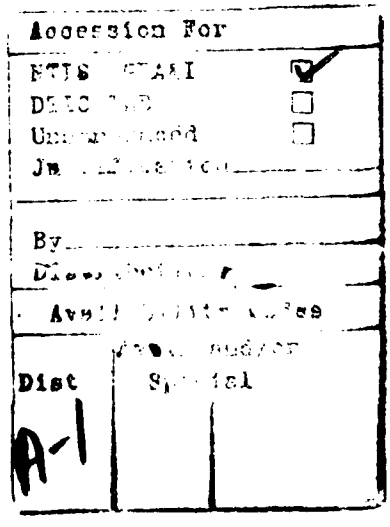

TABLE OF CONTENTS

I. INTRODUCTION

A. AREA OF RESEARCH

This thesis focuses on the application of aircraft engine and engine component warranties in the United States Navy and commercial aviation. Research was conducted to examine warranty issues throughout the life cycle of aircraft engines. Special emphasis was given to the procurement cycle, contracting process, daily maintenance operations (at all levels), and the warranty decision-making process at the policy-setting level.

B. DISCUSSION

Section 2403 to Title 10 United States Code, Weapon Systems Warranty Act, effective 1985, stipulated mandatory written guarantees for any major weapon system procurement. Since the passage of this legislation, the Navy has delegated the formal responsibility for developing and implementing a warranty program to each of its hardware systems commands. Our research will deal specifically with the aircraft engine warranty program instituted at the Naval Air Systems Command (NAVAIRSYSCOM, referred to in this text as NAVAIR).

NAVAIR laid the foundation for their warranty program in an instruction issued in 1985 delineating responsibilities within their organization. A supplemental notice was issued

in 1989 giving more specific guidance to the fleet user. In conjunction with spelling out their policy for warranties, NAVAIR also updated OPNAV instruction 4790.2E, the Navy's aviation maintenance "Bible". A more detailed discussion on these policy initiatives will be addressed in Chapter II.

The intent of this research was to investigate and evaluate the current Navy warranty program for aircraft engines and engine components and to identify areas of deficiency in the program. This thesis grew out of NAVAIR's Propulsion and Power Division's (AIR-536) concern that, although there was an established warranty program, it was not being followed and valid claims against contractors were not being submitted by the fleet.

C. OBJECTIVES

The main objectives of this thesis are as follows:

1. Evaluate the Navy's current aircraft engine warranty program in terms of overall manageability and effectiveness.
2. Evaluate a commercial airline engine warranty program and determine what aspects can be applied to the military.
3. If possible, determine the cost benefit of the Navy's warranty program and areas of deficiency in the program.
4. Identify areas for further research and analysis by Naval Postgraduate School students.

D. RESEARCH QUESTIONS

The primary research question is as follows:

Does the Navy have a program in place for aircraft engines/components that makes effective use of the 1985 warranty legislation?

Subsidiary research questions are as follows:

1. What is the 1985 warranty legislation and what does it require?
2. Are claims being filed by the Navy against warranted items?
3. Is the Navy's program cost-effective or are improvements required?
4. Are there more effective programs currently being used by the civilian sector (i.e. United Airlines)?
5. Can a commercial program be adapted by the Navy for their use?

E. SCOPE

This thesis was initially focused on answering three questions posed by AIR-536. The basic content of these questions dealt with whether or not there was an effective Navy program in the fleet to track and monitor claims, was there a more generic warranty program that would be less cumbersome to track and monitor, and finally, whether there is a cost benefit to having a warranty in the first place. At this point, NAVAIR has no idea if aircraft engines should be warranted. No study has been done on this topic to justify either side of the argument. After conducting several visits to Aviation Intermediate Maintenance Departments (AIMDs) and

a Navy Depot, we determined that the Navy had a program, though it was not totally effective. During our visit to NAVAIR, interviews were conducted with various functional components within the NAVAIR organization. It was suggested that our study focus on the feasibility of incorporating commercial warranty applications into military procurement contracts. As a result, the focus of the thesis was amended to concentrate on the study of the Navy's program and maintenance operations as compared to that of a major commercial airline.

F. RESEARCH METHODOLOGY

Research for this thesis was conducted using on-site visits, phone interviews, warranty literature review, and discussions with faculty in the acquisition and contracting curriculum at the Naval Postgraduate School (NPS).

The on-site portion of the data gathering phase was comprised of interviews with naval aviation maintenance personnel at Naval Air Stations, North Island and Miramar, CA, both at the organizational and intermediate maintenance levels and at Naval Aviation Depot, Alameda, CA, for the depot level of maintenance repair. A fact-finding trip was taken to the Naval Air Systems Command Headquarters in Washington, D.C., where extensive interviews were conducted with policy and program managers who are involved with warranty issues. On the commercial side, a visit of the United Airlines'

Maintenance Operating Center (MOC) provided detailed aspects of their engine and engine component warranty programs.

Due to fiscal and time constraints, phone interviews were conducted with numerous warranty experts to flesh out our understanding of the total warranty picture. These interviews included, but were not limited to, engine contractor warranty representatives, Administrative Contracting Officers (ACO's), and commercial airline contracting officials.

An in-depth search of all pertinent warranty literature was attempted. All thesis material on record at the Naval Postgraduate School library was reviewed. We also obtained many germane articles from the Defense Logistics Studies Information Exchange (DLSIE) for perusal. Periodicals such as Aviation Week and Space Technology also shed light on warranty concerns.

The warranty issue is replete with questions and dilemmas of a contractual nature. Additionally, many features of a warranty deal with complex acquisition strategies. These are areas outside our realm of expertise. Therefore, we relied heavily upon the assistance of our thesis advisors and other NPS faculty to guide us through the maze of regulations and requirements in these fields as they related to our thesis.

G. ORGANIZATION OF THE STUDY

Chapter II defines the theory behind a warranty and acquaints the reader to the 1985 warranty legislation. It

introduces the main focus of warranty coverage and presents the most critical definitions associated with warranties. This chapter also presents the Navy philosophy on warranty programs and details current warranty policy and guidance.

Chapter III examines the Navy engine warranty program during the various phases of the acquisition process. The operational maintenance environment is examined with respect to key warranty roles and reporting procedures. Chapter IV addresses the commercial airline engine warranty program and is presented in the same format as Chapter III to facilitate a comparison of features of the two programs in Chapter V. In Chapter V, we will also investigate possible applications of the commercial program to a military setting, highlighting potential roadblocks and limitations. In Chapter VI, we will summarize the thesis, present our conclusions and make recommendations for changing current Navy policy concerning warranty issues. We will also offer suggestions for possible areas of further study.

II. BACKGROUND

The term warranty is defined in the Federal Acquisition Regulation (FAR), Subpart 46.701, as a "promise or affirmation given by a contractor to the Government regarding the nature, usefulness, or condition of the supplies or performance of services furnished under the contract." [Ref. 1:p. 2] In recent years warranties have received increased visibility and importance with the passage of the Defense Procurement Reform Act (DPRA) of 1984. As a consequence of this reform act, Title 10, Section 2403, of United States Codes was enacted in January 1985. Title 10 specifically mandates that written warranty clauses and/or guarantees be included in all major weapon system procurements after 1 January 1985. These should address design and manufacturing requirements, defects in materials and workmanship, and essential performance requirements (EPRs). Exceptions or waivers to this policy are to be granted only on a case by case basis and require extensive justification and documentation. A more detailed discussion of these requirements will follow later in this chapter.

A. WARRANTIES DEFINED

Prior to the enactment of Title 10, the Government had not been obligated or required by Congress to incorporate written warranties or guarantees into weapon system procurement contracts. Warranties at that time were used only in special procurement actions and generally not applied to defense programs across the board. The previous major warranty legislation passed by Congress prior to 1984 was in 1964 under Section I-324 of the Armed Service Procurement Regulation (ASPR). ASPR outlined the tenets for warranty use and stressed that they were to be used as an exception to policy rather than as the rule and should be based on cost-effectiveness analysis. Warranties and guarantees were viewed as incentive programs for contractors to meet Government program objectives.

There were three basic types of warranties/guarantees used by the Government in procurement contracts in order to evaluate weapon systems. These were/are the Reliability Improvement Warranty (RIW), Mean Time Between Failure (MTBF) Guarantees, and Logistics Support Cost Commitment (LSCC) warranties. It should be noted here that there is a difference between the terms "warranty" and "guarantee" in that a warranty implies a repair/replace responsibility while a guarantee infers an incentive/penalty system.

Under the RIW, the equipment is covered for a multi-year period (typically three or more years) with the contractor

responsible for performing depot level repair when required. A target reliability level (failure rate) is established and agreed upon by both the Government and the contractor. The contractor must pay for repairs if the system falls below the target level and can be rewarded monetarily if the system exceeds the target level.

Similarly, under MTBF the Government is warranted for X hours of operation before a system failure occurs. If the failure occurs prior to X hours, the contractor will repair or replace at his expense and take all necessary actions needed to meet the MTBF requirement. The contractor may also provide spares to the Government to compensate for the lower MTBF rate. When the MTBF rate is higher than the targeted rate, the contractor may receive monetary benefits.

In the LSCC warranty there is an agreed-upon written logistics cost objective that is monitored during the course of normal maintenance operations. The contractor receives monetary benefits if the stated LSCC is exceeded and is penalized if the LSCC falls below the LSCC objective.

B. DEFENSE PROCUREMENT REFORM ACT (DPRA) OF 1984

During the years following the passage of ASPR, allegations were levied against defense industry contractors involving price gouging and the production and delivery of substandard equipment to the fleet. As a result, Congress passed the Defense Procurement Reform Act in 1984 to end any

further attempts by defense contractors to short-change the Government on defense contracts by requiring written warranties and guarantees in procurement contracts.

The specific wording of the 1984 legislation defines a weapon system as the following: "...items that can be used directly by the Armed Forces to carry out combat missions and cost more than $100,000 per unit or for which the total procurement cost is more than $10,000,000." [Ref. 1:p. 6] In the Department of Defense (DoD) Federal Acquisition Regulation (DFAR), Subsection 246.770-1, the definition of a weapon system is enhanced and a fairly inclusive list of items considered to be weapon systems is provided. Included in this list are aircraft and propulsion systems.

Title 10 USC 2403 also "stipulates that the prime contractor provides the warranty and that in cases where there are subcontractors, the prime contractor may impose warranty requirements on those subcontractors, but still assumes responsibility in the event of a warranty breach." [Ref. 1:p. 6] The law also mandates that three specific types of guarantees be addressed in the contract. These guarantees, as mentioned before, are design and manufacturing requirements, defects in materials and workmanship, and essential performance requirements.

> Design and manufacturing requirements are the structural and engineering plans and manufacturing particulars, including precise measurements, tolerances, materials, and

furnished products tests. This type of warranty provides assurance that the product is designed and built as specified. It covers such features as size, weight, interfaces, power requirements, processes, tests, and material composition. Periodic audits can be conducted during a production run to ensure continuity of adherence to design and manufacturing requirements. [Ref. 1:p. 7]

In a warranty against defects in materials and workmanship as stated in 10 USC 2403, the item provided under the contract, at the time it is delivered to the United States, will be free from all defects in materials and workmanship. DFARS, Subpart 246.7, uses the term "weapon system" instead of "item" and specifically defines acceptance criteria. [Ref. 1:p. 7]

Essential Performance Requirements (EPRs) represent a radical departure from the former procurement practices in that they extend the contractor's liability to operational performance, including reliability and maintainability. The "old way" requirement was to pass a reliability acceptance test. This has given way to the "new way" warranty - measure field reliability and/or maintainability over a period of time and compare to the guaranteed value(s) to determine conformance. The contractor is responsible for corrective action (to include redesign if required) in the event of failure to meet a warranted EPR... EPRs should represent system level characteristics rather than those of sub-systems and components. The system specifications must be analyzed to determine which elements are candidates for warranty coverage because of their importance to the overall performance of the system and because of the risk they present to production and subsequent operation.... Guarantee of EPRs applies only to weapon systems in mature, full-scale production - that is, weapon systems manufactured after the first one-tenth of the total production or after the initial production quantity, whichever is less. [Ref. 1:p. 7]

Waivers for any warranty requirement can only be granted by DoD based on the interest of national defense and cost effectiveness analysis. DoD must notify both the House and Senate Armed Forces and Appropriations Committees when a wavier on a warranty requirement has been granted. Very few,

if any, waivers have been granted by DoD since the legislation was signed and passed into law. [Ref. 1:p. 9]

When Congress passed the Defense Procurement Reform Act in 1984 it did not make provisions for enforcement or implementation of warranties. Congress mandated the use of warranties/guarantees in order to hold defense contractors more accountable for their products and to ensure that the Government received equitable monetary restitution from the contractor for valid warranty claims. Each service was given the mission to develop and implement warranty programs, but were given no monetary incentive to enforce their programs, since all monetary payments made by contractors against valid Government claims were made payable to the United States Treasury and not the Department of Defense or the individual services. A more detailed discussion on monetary and material reimbursement for warranty claims will follow in Chapter V.

Another aspect of this legislation is that, while all Government procurement contracts now have warranty and guarantee clauses, the question remains as to whether or not these clauses are enforceable. Chapter III will address the problems facing the Navy associated with trying to enforce warranty and guarantee contract clauses based on the initial type of contract let by the Government to design and develop the technical data packages for weapon systems.

C. THE NAVY'S PHILOSOPHY ON WARRANTIES

The Navy's basic philosophy on warranties and guarantees is that they should be at no additional cost to the Government since the contractor should be responsible for delivering a highly reliable and quality weapon system in the first place [Ref. 2]. Keeping this philosophy in mind, the Navy went about developing and implementing a warranty program as a result of the Defense Procurement Reform Act of 1984. Instead of centralizing warranty administration in the service, the Navy assigned to each one of its hardware systems commands the responsibility for developing, executing, and enforcing a warranty program tailored to its specific needs.

The initial guidelines for warranty policy established by NAVAIR were published 9 December 1985 in NAVAIRINST 13070.7, "Policy Guidance For Warranty Application on Naval Air Systems Command Weapon System Procurements." (See Appendix A). This instruction delineates the responsibility for warranty policy and administration in the Naval Air Systems Command Headquarters, Naval Air Systems Field Activities and Inventory Control Points, and the Naval Aviation Logistics Center.

At NAVAIR, the Assistant Commander for Systems and Engineering (AIR-05) is assigned the management and administrative control over the entire NAVAIR warranty program. The Assistant Commander for Logistics/Fleet Support (AIR-04) is given the responsibility for establishing a data feedback system for warranty programs in the aviation

community and for performing logistical support analysis on the impact of warranties on the weapon system maintenance plans.

Official Navy policy on warranties was published by the Secretary of the Navy in SECNAVINST 4330.17, "Navy Policy on Use of Warranties" dated 18 September 1987 (Appendix B). The initial NAVAIR instruction was then updated and amended by NAVAIRNOTE 4855 "Warranty Guidance" dated 17 May 1989, and still serves as the latest update (Appendix C).

The NAVAIR warranty administration program approach is detailed in the most recent version of the Navy's maintenance "Bible," OPNAVINST 4790.2E, the "Naval Aviation Maintenance Program." The data tracking system for warranty claims at the organizational and intermediate ("O" and "I", respectively) maintenance levels has been established using the Maintenance Action Form (MAF) in conjunction with the 3-M Data System. (OPNAVINST 4790.2 was updated 1 January 1988 to provide guidance to the fleet on the use of the MAF and 3-M System for warranty reporting through Naval Aviation Maintenance Support Office (NAMSO).) Subsequent to publishing the warranty program, OPNAV INSTRUCTION 4790 has been updated periodically with changes through the unclassified message traffic channel along with updated warranty instructions for specific engines and engine components.

Since the use of warranty clauses became mandatory for procurement contracts, very few if any claims have been

submitted by the aviation community to NAVAIR with regard to warranties on aircraft engines and components. A more detailed discussion of the warranty reporting system related to fleet maintenance operations will follow in Chapter III.

D. GAO ASSESSMENTS OF WARRANTY PROGRAMS

On a larger scale, GAO has conducted assessments of warranty administration since the enactment of the DPRA in 1984. Their first study was conducted in 1987 and their findings were published in GAO report (GAO/NSIAD-87-122, July 21, 1987). The 1987 report recommended that DoD ensure that procurement activities:

1. Perform cost-effective analysis of proposed warranties;
2. Specify warranted performance requirements;
3. Define the contractors redesign responsibilities;
4. Appropriately identify warranted systems as warranted items. [Ref. 3:p. 4]

A second study on warranty administration was conducted by GAO in 1989. The results of this study are reported in GAO/NSIAD-89-57, September 27, 1989. The study found that:

1. Fully effective administration systems had not been established;
2. The Office of the Secretary of Defense (OSD) did not actively oversee warranty administration;

3. Adequate cost-effective analyses are not being prepared;

4. Post-warranty evaluations are not being prepared. [Ref. 3:p. 4]

E. THE SPECTOR REPORT

In April 1992, the Office of the Deputy Director for Defense Systems Procurement Strategies conducted a review (known in DoD as "the Spector Report," named for Eleanor Spector, the Director, Defense Procurement) of six DoD weapon systems programs under the purview of the Director for Defense Procurement to assess warranty program benefits. The systems under review were the Army's Abrams Tank and the AGT 1500 Engine, the Navy's Standard Missile II and Phalanx CIWS, and the Air Force's AN/APG-68 FC Radar and the F-15. The findings, annotated in that report, are as follows:

1. Contractor expenses for warranty repairs were less than the negotiated price for warranty in 4 of 5 cases.

2. A significant number of warranty claims were determined to be non-valid.

3. On contracts with the threshold form of warranty, the thresholds were never reached.

4. No systemic warranty claims have been submitted under the contracts with systemic warranty coverage.

5. Warranty provisions were negotiated that did not consider the data capabilities of the existing supply maintenance systems.

6. The program with the clearest warranty administration system experienced a minimal level of warranty activity.

7. Fundamental problems exist with the Air Force's warranty tracking system.

8. Post-award reviews of warranty cost-effectiveness are not performed by the services. [Ref. 3:p. 2]

The report concluded that the services lacked essential elements in warranty administration and, therefore, the benefits derived from having warranties cannot be fully realized. For the aforementioned reasons, the report recommends repeal of the warranty statute, Title 10 USC 2403. As of this date (December 1993), the statute has not been repealed by Congress. Since the law remains in effect, the issue of warranty programs and their questionable benefit is a high-interest topic within the DoD community.

F. JOINT AERONAUTICAL COMMANDERS GROUP (JACG)

In the early 1990's, the services established an Aviation Business Process Board (ABPB) under the auspices of the Joint Aeronautical Commanders Group (JACG). As a part of this board, an Engine Warranty Sub-board (EWS) was formed in November of 1992 to evaluate current warranty practices and benefits in terms of return-on-investment versus warranty costs. [Ref. 4] The Engine Warranty Sub-board was charged specifically with the responsibility to:

1. Identify opportunities in the area of engine warranties to enhance interservice/Defense Logistics Agency (DLA) commonality;

2. Understand differences in business practices and processes that are barriers to commonality;

3. Develop common business policies and approaches for review by the ABPB;

4. Recommend implementation actions to the ABPB. [Ref. 4]

The EWS was supposed to propose their findings and recommendations to the Joint Aeronautical Commanders Group no later July 1993 but, as of September 1993, those recommendations have not been submitted. [Ref. 4] The board has made progress in defining warranty terms and language to which all board members and their respective services agree. Those terms are due to be published and distributed in the January 1994 timeframe.

G. SUMMARY

This chapter has provided the foundation and background information necessary to examine and evaluate the Navy's performance in carrying out the basic intent of Title 10 USC 2403. That examination and evaluation will follow in the next four chapters.

It is important to understand that since the Weapon Systems Warranty Act was signed into law in 1985, the Navy has made a conscious attempt to implement a warranty program. The portion of the program we will concentrate on is the engine

warranty program developed by NAVAIR. NAVAIR components have disseminated instructions to the fleet on how to implement the program they have developed. They have also been active participants in the Joint Aeronautical Commanders Board whose objective it is to standardize the warranty structure within the aviation community of the services.

Finally, studies have been conducted by both DoD and GAO to determine the services' performance on implementing warranty programs. Those studies were critical of the services' warranty administration.

III. NAVY AIRCRAFT ENGINE WARRANTY PROGRAM

The Navy aircraft engine warranty program will be discussed in great detail in this chapter. In order to gain an understanding of how warranties interact in the design, development, and delivery of a weapon system, the first three sections of the chapter examine warranties during the procurement, contracting, and operational phases. The final section of the chapter looks at the structure of the Naval Aviation System Command Headquarters and the role it plays in developing, implementing, and administering warranties.

A. WARRANTY PROCEDURES IN THE PROCUREMENT PHASES

Warranties play an intricate part of a weapon system's life cycle from program initiation to retirement. A weapon system's life cycle is divided among five sequential phases known in the acquisition community as Concept Exploration and Definition, Demonstration and Validation, Engineering and Manufacturing Development, Production and Deployment, and Operation and Support. Warranty issues are prevalent during each of these phases. (See Figure 1--Warranty and the System Life Cycle--[Ref. 5:p. II-9]).

The weapon system's program manager is responsible for warranty planning, coordination, and execution throughout each

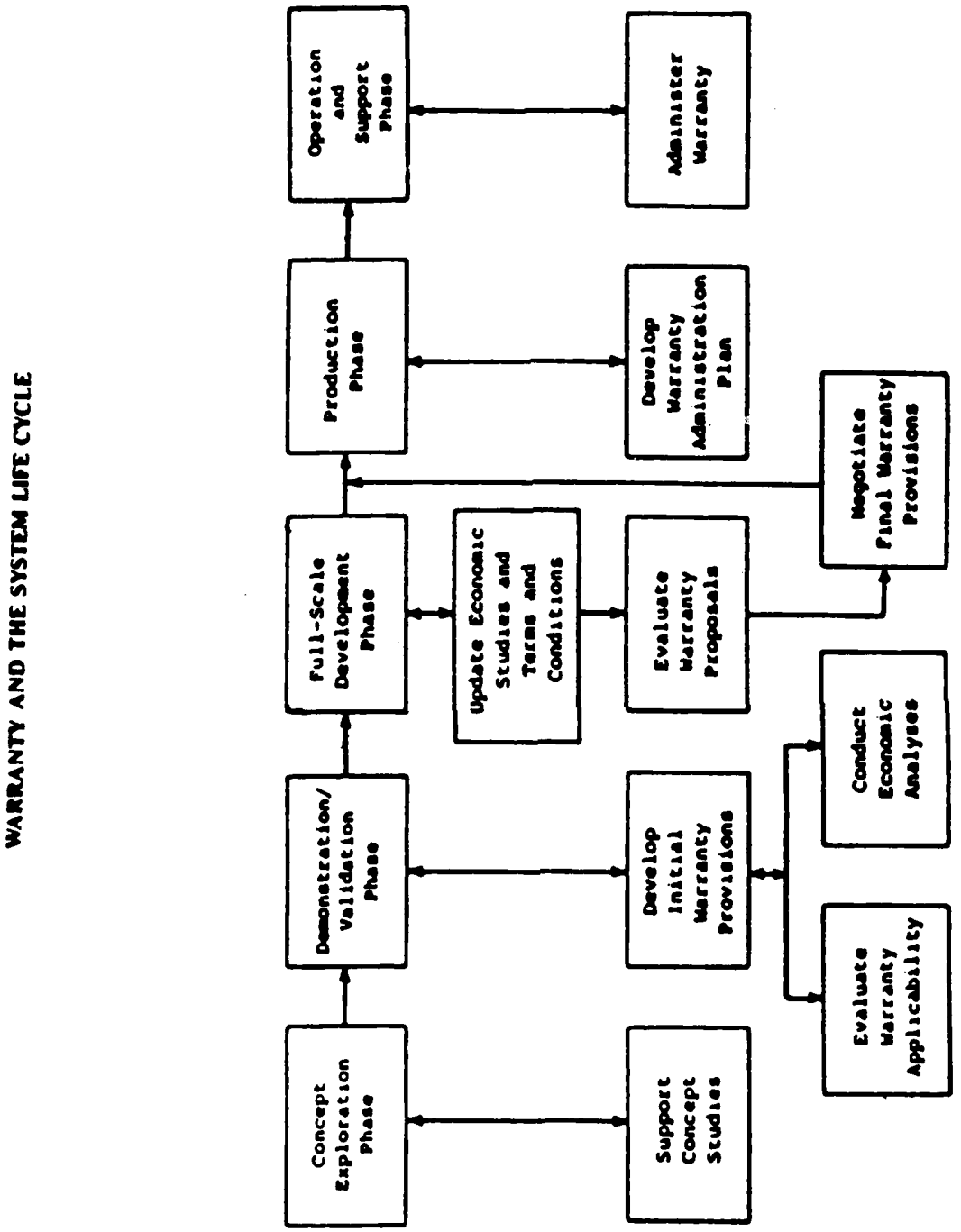

Figure 1. Warranty and the System Life Cycle.

phase of the life cycle. The program managers for naval aircraft weapon systems are headquartered at the Naval Air Systems Command in Washington, DC. There they are assisted by a staff of engineers, contracting specialists, legal counselors, and policy officials who collaborate on the development, application, and enforcement of warranty policy as it pertains to a specific weapon system. A more detailed discussion of NAVAIR's structure is presented in the final section of this chapter.

1. The Life Cycle Phases

In the Concept Exploration and Definition phase, the initial focus is the development of functional and performance characteristics that will meet the operational requirements detailed in the mission need statement (MNS). Consideration is also given in this phase to identify system reliability objectives and essential performance requirements. In the Demonstration and Validation phase the initial warranty provisions are drafted as system requirements. In this phase, the Request For Proposal (RFP) for the actual production contract is constructed incorporating the initial warranty provisions.

During the Engineering and Manufacturing Development Phase, major decisions on warranty requirements are determined after assessment of the reliability, maintenance, support parameters, and operating capabilities become available.

Warranty decisions are made throughout this phase with respect to the various acquisition actions that occur involving the allocated baseline, system prototype tests, Integrated Logistics Support (ILS), quality assurance plan, Life Cycle Cost (LCC) update, Test Evaluation Maintenance Plan (TEMP), and acquisition plans. Tables I and II provide an expanded view of these decisions. [Ref. 1:pp. 5-7,5-9]

In the Production and Deployment Phase, provisions for warranty clause implementation are finalized. During the last phase, Operation and Support, the clauses are implemented and administered.

2. NAVAIR Warranty Cost Analysis

During procurement, the NAVAIR Cost Analysis Division (AIR-524), is responsible for performing cost-effectiveness analysis on proposed weapon system warranties to determine their economic feasibility. Currently, there are three program models that AIR-524 developed and uses to analyze warranty cost-effectiveness. These models are known as the PC Warranty Model (WARPC), the VAX Warranty Model (Warranty Manager), and off-line analysis.

a. PC Warranty Model (WARPC)

The WARPC model is written with *Symphony* software and is applicable to generic aviation equipment, avionics and aircraft engines. The model can be operated on a personal computer by using *LOTUS 123* applications. The engineers from

CONCEPT EXPLORATION & DEFINITION PHASE

ACQUISITION ACTIVITY	WARRANTY INTERFACES
Requirements Analysis	Identify key parameters as candidates for EPRs coverage.
Functional Analysis	Relate key performance parameters to applicable hardware/software elements.
Trade Studies	Analyze various warranty strategies and interfaces as trade studies are conducted in requirements, configuration, and supportability.
Technology/Risk Assessment	Identify potential warranty approaches to address identified risks.
Logistics Supportability	Consider impact of various warranty support strategies on overall logistics support structure.
LCC Assessment	Identify LCC factors to consider for warranty cost-benefit analysis.
Acquisition Strategy/Plans	Identify/update major warranty alternatives.

DEMONSTRATION & VALIDATION PHASE

ACQUISITION ACTIVITY	WARRANTY INTERFACES
Engineering Development Models	Evaluate technology and performance to identify key risk factors.
Preplanned Product Improvement (P^3I)	Couple warranty alternatives with any P^3I alternatives under consideration.
Functional Baseline	Refine EPRs to be consistent with the functional baseline.
LCC Update	Establish/refine requirements of LCC analysis if LCC is part of warranty acquisition strategy.
Test and Evaluation Master Plan (TEMP)	Define any test requirement necessary to implement warranty.
Preliminary Manufacturing	Address design and manufacture warranty requirements.
Industrial Base Issue	Address any potential impacts of warranty industrial base.
Logistics Support Analysis	Update earlier analyses and define warranty alternatives that are consistent with planned ILS system.
Acquisition Plans	Update warranty acquisition plans.

Table I. Warranty Interfaces During Procurement Phases I/II.

Table II. Warranty Interfaces During Procurement Phase III.

ENGINEERING & MANUFACTURING DEVELOPMENT PHASE

ACQUISITION ACTIVITY	WARRANTY INTERFACES
Allocated Baseline	Define quantitative warranty requirements at appropriate subsystem levels.
System Prototypes Tests	Evaluate and use data to perform warranty analyses (e.g., LCC and R&M).
ILS	Address warranty implementation and administration.
Quality Assurance Plan	Identify approaches to implement warranty controls on design and manufacture and defects in materials and workmanship.
LCC Update	Update LCC model for warranty cost-benefit analysis and refine data base.
TEMP Update	Identify/update warranty test requirements.
Acquisition Plans	Interface with development and potential production contractors. Draft warranty RFP clauses for industry review. Evaluate comments.

the Propulsion and Power Division (AIR-536), use this model to analyze the impact of 36 key life cycle indicators on the cost of warranting the engine. The model assists the engineers in this endeavor by deriving a baseline MTBF for the engine. If the actual/proposed MTBF of the engine is less than the baseline MTBF then it would be cost-effective to warranty the engine. If, however, the actual/proposed MTBF for the engine is greater than the baseline MTBF then it would not be cost-effective to warranty the engine. The model also provides a graphic display of manufactured unit cost per engine estimates for warranted and unwarranted engines. Due to its generic design, WARPC does have limitations which prevent it from fully analyzing life cycle costs. In addition, not all important cost factors have been included. For example, costs for depot level maintenance are excluded as are transportation costs outside the continental U.S. However, of the three applications, WARPC is the least manpower intensive to analyze and the easiest to understand and is, therefore, the most widely used of the three models according to AIR-52431B. [Ref. 6]

b. Warranty Manager Model

The VAX Warranty Model, known as the Warranty Manager Model is primarily reserved for large, high-valued acquisitions with uniquely tailored warranties. This program does allow for more manipulation by the user to develop and

analyze alternative maintenance support concepts. However, it requires considerably more effort, data input, and training on the part of the user. Like WARPC, Warranty Manager has a generic framework for aircraft, avionics, and engine warranty cost analysis. The program compares the costs of two alternatives addressing Government and differential costs only (i.e., no contractor should-cost capability). Warranty Model Manager has the capability of analyzing a complete engine warranty program or analyzing the program lot-by-lot. It can analyze four standard alternatives; Title 10 performance warranties, Reliability Improvement Warranties (RIW), Contractor Repair Agreements (CRA), and no warranty. Unlike WARPC, this program requires extensive analysis and coordination between the Propulsion and Power Division (AIR-536) and the Cost Analysis Division (AIR-524) in order for an accurate cost/benefit analysis assessment to be made. [Ref. 6]

c. Off-line Analysis

Off-line analysis is a last resort option, performed only in special cases where a weapon system has a unique warranty program that requires additional alternatives to be examined that are not found in WARPC and the Warranty Manager programs. It necessitates an independent analysis and modeling of all warranty cost characteristics on the part of the analyst. As such, it requires significant amounts of time and other analytical resources. [Ref. 6]

During the interview sessions conducted with key personnel from the Propulsion and Power Division (AIR-536), several criticisms were made about the warranty cost-effectiveness analysis models. In particular, both warranty models take into consideration only the MTBF for the overall engine and not the sub-components of the engine. An aircraft engine consists of several modules that form what is known as the cold, hot and accessory sections. The components comprising these sections vary with the engine manufacturer and type of aircraft design. The cold section is a series of stator vanes and rotor discs that compresses the ingested air and directs it into the hot section. The hot section consists of the combustion chamber, some of the initial stator vanes, and power turbines. The compressed air is separated at the entrance of the hot section into cooling air (75%) and combustion air (25%) which is fed into the combustion chamber, mixed with fuel, and ignited. The resultant high pressure, high velocity, high temperature gas is directed through a series of stator vanes and rotor discs, called the power turbines, where the energy it contains is extracted. This energy is directed towards running the compressor (cold) section of the engine, driving the accessory section, and providing either thrust or torque for the required work. The accessory section of the engine extracts power by a mechanical link from the power turbine to run the ancillary engine functions; fuel control, fuel pump, oil pump, stator vane

control, etc. The fuel control unit is an example of an engine accessory and it is, for the most part, a warranted item. [Ref. 7]

Appropriate consideration should be given to the warranty expenditures for components in each of the sections as part of the cost effectiveness analysis process.

The Propulsion and Power Division (AIR-536) would like for the Cost Analysis Division (AIR-524) to develop a cost-benefit analysis model that would take these components into account and provide for a better estimate on the benefits of warranties. At this time, however, AIR-524 has no plan to develop any additional warranty cost-benefit analysis models, as they do not regard this to be a high priority issue.

3. Life Management Approach to Warranties

In recent years there has been a movement towards using commercial (private sector) warranties and management practices in defense procurement contracts. An example of a commercial application of a warranty that is gaining acceptance with various experts in the Navy is the "life management approach".

> The life management approach adapts commercial industry practices to establish an analytical assessment that is set on the known life of an engine or its components and is adjusted based on data from the fleet. [Ref. 8]

When using this approach it must be understood that life management and warranties are tied together throughout the engine's service life if the warranty is to be considered effective. This is because the duration of the warranty is directly related to the actual expected service life of an engine. Since the actual expected service life of an engine is nearly impossible to determine without placing it in an operational environment and collecting real- time data on its performance, certain assumptions must be made about its service life expectancy before, during, and after it has been fielded to the fleet.

The design and performance requirements provided to the contractor by the Government mandate the desired service life of the engine. For the purpose of illustrating the life management approach, assume that the service life (service life is defined as the amount of time before failures should occur(i.e., operating hours)) of the engine is estimated to be 4,000 hours. Without any field data available, it is hard for the Government and/or contractor to be statistically confidant that 4,000 hours is a realistic estimate for the engine service life.

To mediate this problem, during the development approval stage of Phase III (Engineering and Manufacturing Development), the Government and contractor meet to establish an agreed upon minimum low cycle life capability. This low cycle life capability establishes an estimated operating

interval somewhat less than the desired service life of the engine where there is greater statistical confidence that the engine will meet initial operational expectations.

In our example, let's assume the agreed upon figure is a service life of 2,000 hours. As more operational data from the field is gathered over the next five to ten years, the interval will gradually be refined (i.e., increased/decreased as the case may be) as statistical confidence in the engine changes. Thus, our 2,000 hour estimate may be increased or decreased by some amount to reflect the real-life data being collected by the Government and contractor engineers. The warranty coverage will either increase or decrease as the service life stabilizes. It also will also be applied retroactively to all engines previously fielded. [Ref. 9]

By integrating life management into the acquisition strategy the most tangible result will be an integrated logistic support system that provides adequate support in terms of repair part resourcing for weapon systems and accurate data on maintenance reliability of the system. What this implies is that the Navy will have a better measure with which to gage repair stockage and usage as well as the funding required to budget for any given year for repair and/or replacement.

In separate interviews conducted with representatives from NAVAIR Codes 411, 214, 516, 524, and 536, all indications are that the Navy plans to fully utilize the life management

approach extensively in future weapon system procurements. They hope that by doing so the Navy will be getting more for their money and can more accurately forecast the availability and maintenance required of engines and their components.

B. CONTRACTING ISSUES

1. Contracting Method

Contracting is done throughout the procurement process by using one of two methods, sealed bidding or competitive negotiation. In sealed bidding, the contract award is normally made to the bidder having the lowest responsible and responsive bid. In competitive negotiations, the Government awards the contract based on the vendor's particular experience with what is being procured, his technical and management capability, the availability of reliable cost information, and the contract type which the vendor is willing to accept in case of award. [Ref. 10:p.4-2] In order to use competitive negotiations one of the following four listed conditions must exist:

1. Time does not permit the solicitation, submission, and evaluation of sealed bids.
2. Award cannot be made on the basis of price or other price related factors.
3. It is necessary to conduct discussions with the responding vendors.
4. No more than one proposal will be submitted. [Ref. 10:p. 4-3]

Due to the complex nature of weapon systems procurement, competitive negotiations are the preferred contracting method.

One of the main advantages of using competitive negotiations in contracting, is the diverse range of the type of contracts that can be awarded. This range of contracts is divided into two groups of contracts offerings; fixed-price and cost-reimbursement. The basic difference between these two contracts is the amount of risk shared between by the contractor and the Government. In general, fixed-price contracts place the greatest percent of cost risk on the contractor while the Government assumes little or no cost risk. The reverse is true for cost-reimbursement contracts where the Government assumes most of the cost risk involved while the contractor's cost risk is minimized. In the majority of procurement actions where competitive negotiations were used, cost-reimbursement contracts were awarded because it was not practical to use a fixed-price contract due to some (often substantial) uncertainty in the design, the specifications, or in the cost of performance. [Ref. 10:p. 4-13] With that notion in mind, the five basic types of cost-reimbursement contracts will be addressed. (For a further breakdown of contract types, refer to Figures 2 and 3 [Ref. 10:pp. 4-19, 20]).

The five basic cost reimbursement contracts used are cost-no-fee contracts, cost-sharing contracts, cost-plus-

CONTRACT TYPES

CONTRACT TYPE	AWARDED BY	CONTRACTOR COST RISK	MANAGEMENT BURDEN	*NOTEWORTHY* CONDITONS FOR USE	BEST SUITED FOR
Firm Fixed Price (Price remains unchanged, regardless of actual cost experience)	Sealed Bidding or Competitive Proposals	Highest	Low	There must be clear specifications and ability to set realistic price for entire contract period.	Situations where there is prior cost experience, particularly for standard or modified commercial items.
Fixed-Price With Economic Price Adjustment (Specific cost elements are subject to upward, or downward, adjustment)	Sealed Bidding or Competitive Proposals	Moderate	Moderate	Labor and market contigencies must be specified. Care must be taken to eliminate any contingency allowance from contract price base to extent that adjustment is provided.	Situations where serious doubt exists as to stability of specific economic conditions during contract performance.
Fixed-Price Incentive (Contains formula under which profit (or loss) varies based upon actual cost experience and/or performance)	Competitive Proposals	Moderate	Moderate to High	Incentive provisions must have meaningful effect on manner in which contractor manages work. Cost incentives may be combined with incentives related to performance levels and delivery time.	Situations where nature of supplies or services is such that contractor will be motivated to control costs, improve performance, or expedite delivery.
Fixed-Price With Redeterminations (Price adjustments are negotiated either (a) during contract period, or (b) retroactively)	Competitive Proposals	Moderate to Low	High	Contractor's accounting system must be adequate to support price adjustment negotiations.	Situations where it is possible to negotiate fair and reasonable prices for initial period, but not for entire contract term. Rarely used.
Cost Plus-Fixed Fee (Contractor is reimbursed for all "allowable" costs and receives fee that remains unchanged)	Competitive Proposals	Lowest—fee is not subject to change	High	Contractor's accounting system must be adequate to support allowability of costs (this applies to all cost *reimbursement* contracts).	Situations where performance uncertainties are so great that the cost of performance cannot be estimated accurately enough to permit use of any other contract type.

Figure 2. Contract Types.

CONTRACT TYPE	AWARDED BY	CONTRACTOR COST RISK	MANAGEMENT BURDEN	NOTEWORTHY CONDITIONS FOR USE	BEST SUITED FOR
Cost Sharing (Contractor and Government share costs of performance—no fee is paid)	Competitive Proposals	Law, but contractor receives no fee	High	Contractor must agree to absorb portion of costs.	Situations where contractors are willing to absorb portions of costs because of potential benefits (new products, patents, prestige, etc.), usually in connection with research and development work of highly undefined nature.
Cost (Contractor is reimbursed for all "allowable" costs, but receives no fee)	Competitive Proposals	Law, but contractor receives no fee	High	Contractor's accounting system must be adequate for determining costs applicable to contract, and contractor will be subject to surveillance to assure use of efficient methods and effective cost controls.	Situations involving research, development, or facilities work by non-profit organizations and schools.
Cost Plus Incentive Fee (Contractor is reimbursed for all "allowable" costs, and receives fee that varies based upon actual cost experience and/or performance)	Competitive Proposals	Law, but contractor risks loss of fee	High	Cost and performance incentives must be not only desirable, but also administratively practical.	Situations where it is possible to motivate contractor through negotiation of target cost and fee adjustment formula.
Time & Materials and Labor Hour (Contractor is reimbursed (a) for time expended, at a fixed rate; and (b) for materials (not in Labor Hour), at cost plus handling charge)	Competitive Proposals	Law to Moderate	High	Adequate controls for close Government surveillance to prevent inefficiency and waste.	Situations where Government knows types of goods and/or services required, but cannot estimate extent or duration of the work (e.g. repair, maintenance, or emergency services)

Figure 3. Contract Types.

incentive-fee (CPIF) contracts, cost-plus-award-fee (CPAF) contracts, and cost-plus-fixed-fee (CPFF) contracts.

In a cost-no-fee contract the contractor is paid only for the costs incurred and receives no profit. In a cost-sharing contract, the Government and contractor share in the cost based on a predetermined ratio and profit is foregone. Under a CPIF contract, the contractor is reimbursed for all allowable and allocable costs and is allowed to receive a fee relative to the estimated costs and the incentives included in the contract. In a CPAF contract the contractor is paid for all allowable and allocable costs plus a fixed fee in addition to an award fee if earned. Under the final type of cost-reimbursement contract, the CPFF contract, an allowance is made for reimbursement of all allowable and allocable costs and a fixed fee regardless of contractor performance.

2. Contracting for Aircraft Engines

In the procurement of a new developmental aircraft and/or additional purchases of aircraft already in use in the fleet, contracting for the engine is handled separately from the airframe and associated hardware of the aircraft. The defense contractor responsible for designing and/or building the airframe is given the basic dimensions and location of the aircraft engine(s) in order to facilitate the design process and/or assembly process. All other requirements, specifications, and performance capabilities are the

responsibility of the defense contractor designing and/or building the engine.

An aircraft engine manufacturer can enter into a defense contract primarily in one of three methods. The first method is to receive the contract award for the initial development of the technical data package (blue-print) for the engine design along with the right to produce the initial production and additional follow-on production lots throughout the weapon system's life. The second method is for a contractor to be awarded a production contract for an engine based on the technical data package designed by another contractor. The third method is for a contractor to be awarded a production contract to ensure a second source for the engine.

The Government can also award a contract to an aircraft engine manufacturer for only the development of a technical data package for an engine without incurring an obligation to have that same contractor build the engine at a later date. In this instance, the contractor is only under contract to develop the technical drawings for the Government and will either retain limited or no rights at all to the drawings based on the contract specifications. The Government may require unlimited rights to the data developed or it may agree to limit its rights to such data. The Government may also agree, upon acceptance of all the data, to allow restrictive legends on portions of it thereby preventing it

from being used in competitive procurements. [Ref. 10:p. 9-7] DoD policy is to acquire only such technical data rights as are essential to meet Government needs. [Ref. 10:p. 9-8]

3. Government Concerns in Contracting

A key concern for the Government is the accepting delivery of the technical data package from the contractor. The Government must be aware that the data package it accepts might contain design errors or fail to meet the performance requirements due in part to either faulty Government specifications or faulty design on the part of the contractor. Both cases have an impact on the use and enforcement of future warranty clauses and claims. Carefully worded contracts penned by the Government will ensure its right to make future claims in either case.

A related Government concern is that technical data packages are typically experimental in nature and, thus, their contracts are generally written with cost-reimbursement clauses. This contracting phenomenon is commonly known as "technology-push," where the overriding factors surrounding the engine design concern performance (maximum thrust, operational ceilings, etc.) and possibly maintenance parameters due to limited shipboard storage space for spares and remoteness of normal operations. Unit price and total operation costs (including fuel usage) are rarely given top

consideration when performance of potentially every aircraft is in question.

Under such contractual agreements, the Government may have to pay the cost for redesign if it is found to be deficient at a later date regardless of who bears the fault (Government or contractor). In this case, warranty claims would be invalid or complicated at best to pursue and enforce.

The situation becomes even more muddled when two different contractors are involved. On one hand, there is the contractor who originated the technical data package and, on the other hand, there is the contractor who is actually manufacturing and producing the engine. Determining who is at fault for any failures can be a difficult, if not impossible, task.

4. The Administrative Contracting Officer (ACO)

All of these situations add up to a contracting officer's (CO) nightmare as well as a dilemma for the program manager (PM). The key player in this arena is the Administrative Contracting Officer (ACO), who serves as the Government's representative and on-site arbitrator in contracting disputes. Of all the personnel involved in the procurement cycle, the CO and ACO are the critical links in ensuring contractor compliance.

The ACOs are responsible for the firsthand monitoring of all warranty disputes as they pertain to the written law.

They provide valuable information to the program manager on all contractual matters. Under authority of the Contract Disputes Act of 1978 and the Federal Courts Improvement Act of 1982, the "...ACO has been given the broad authority to settle disagreements at an early stage in the disputes process...and allows him to decide all contractor claims...relating to the contract." [Ref. 10:p. 17-3] He also has the authority to make changes to the initial contract unless those changes are termed "cardinal changes". "Cardinal changes to the contract involve making the work as performed not essentially the same work as the parties bargained for when the contract was awarded." [Ref. 10:p. 10-6]

The ACO is also responsible for monitoring the Component Improvement Program (CIP) located at the contractor's manufacturing plant and any redesign or product improvement suggestion. (The CIP program will be discussed in greater detail in the next section of this chapter.)

When all is said and done in the contracting process, one of the last items up for negotiation is the warranty requirements of the contract. The terms of the warranty requirements are decided on a cost basis. If the dollar value of the contract is already substantially high, then warranty coverage is negotiated downward to minimize the overall cost of the contract. The basic warranty clauses, design and manufacturing requirements, defects in materials and workmanship, and essential performance requirements (mentioned

in Chapter II, Section B), are required by law and are not part of these negotiations. A sample Navy warranty is presented in Appendix D.

C. WARRANTY PROCEDURES IN DAILY OPERATIONS

In this section the various maintenance organizations responsible for servicing, repairing, and maintaining the aircraft engines will be examined along with the published guidance pertaining to engine warranties. In the Navy there are three levels of maintenance, organizational ("O" level), intermediate ("I" level), and depot ("D" level). The squadron to which the aircraft is assigned is responsible for performing the organizational level maintenance, the Aviation Intermediate Maintenance Department (AIMD) performs the intermediate level maintenance, and the Navy Depots (NADEP) perform the depot level maintenance.

At the organization level, minor adjustments and services are performed along with removal and installation of the aircraft engines. The intermediate level replaces and, in some cases, repairs the components of the aircraft engine and reassembles the engines. The depot level is responsible for performing major overhauls and component rebuilds. The two critical organizations in the warranty scheme are, therefore, the intermediate and depot level repair facilities.

1. Organizational ("O") Level Maintenance

The organizational level has a minor role in the warranty arena except for removing and installing engines and maintaining the engine log books. When an engine fails or is experiencing problems where corrective actions cannot be taken without removing the engine, the squadron notifies the AIMD, and then removes the engine and prepares it for turn in. At the same time the squadron submits a request through the supply channels for a "new" engine. In most cases, the squadron is issued the new engine along with an engine log book. The squadron then sends the unserviceable engine along with its log book to the appropriate AIMD using the container from the replacement engine just issued. The Aviation Supply Office (ASO) is notified that the action has been taken.

2. Intermediate ("I") Level Maintenance

When ASO receives word that the unserviceable engine is available for repair, they submit a work request to the AIMD by means of a Maintenance Action Form (MAF, Figure 4). [Ref. 11] The Power Plants Division of the AIMD examines the unserviceable engine. The first step is an initial inspection performed by a mechanic on the shop floor. In the majority of maintenance units, only the most experienced mechanics perform the initial and final inspections on equipment.

It is during the initial inspection that warranted items are identified and annotated on the MAF. Warranted

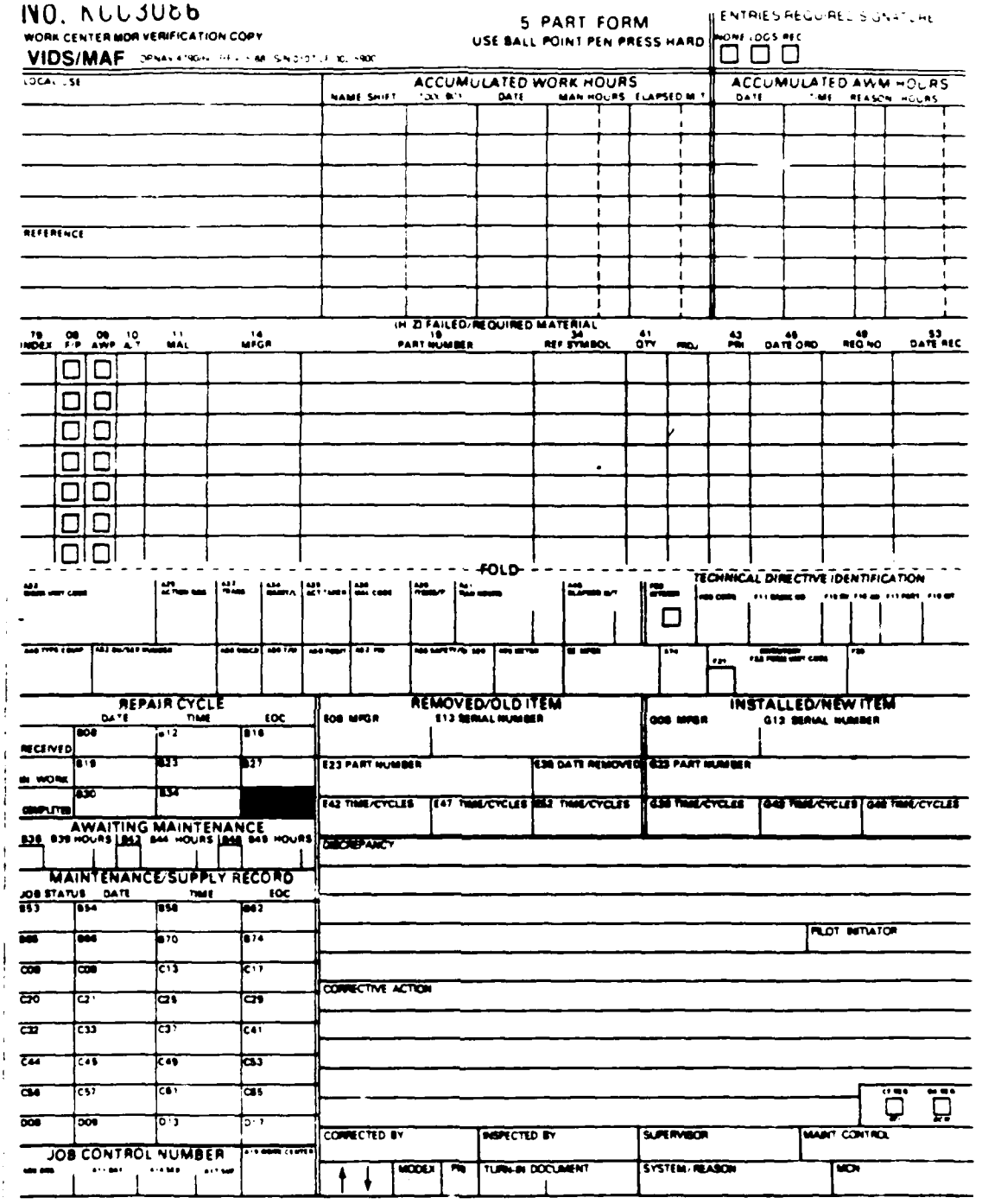

Figure 4. Maintenance Action Form (MAF).

items are identified by physically inspecting the engine and engine modules for warranty data plates and by checking the engine log book and engine container for warranty information and/or markings. As stipulated in the contract, the contractor is required to annotate warranty information in the engine log book either on the individual component sheets or in the miscellaneous history section of the log book and on the engine container.

OPNAVINST 4790.2D, dated 1 January 1988, provided the first instructions to aviation maintenance personnel on how to annotate warranty information on the MAF. The guidance requires the length of the warranty period to be annotated in blocks E47 and G43, prefixed by a "W" to indicate that the item is under warranty. Blocks E52 and G48 are to also contain the last four characters of the contract number which is listed in the engine log book and annotated on the engine data plate. [Ref. 12:ENCL(1)] Once this information has been annotated on the MAF, it is immediately entered into the 3-M Data System by the aviation administrationman (AZ).

Several problems have been noted during the course of our interviews. One is that not all log books and engine containers have been annotated with the appropriate warranty information even though required by MILSTD 129J, Appendix C, Para 20.23. [Ref. 13] Another is that in the case where containers were marked, the warranty information is often useless since containers are normally exchanged between

engines prior to turn in. Therefore, the only time the warranty information listed on the containers is valid is during the initial inspection of new engines immediately after the contractor delivers them to a stock point or the NADEP.

There is also a problem, particularly in carrier aviation maintenance, with annotating the warranty information on the component cards in the log book. Since carrier operations require the continuous availability of mission ready aircraft, the necessity to use controlled substitution or exchange engine parts between engines remains strong. The problem arises only when engine parts are exchanged and their corresponding entries in the log book are not. This same problem affects the shore-based maintenance facilities to a lesser degree.

3. Depot ("D") Level Maintenance

Those engines or engine components that require major rework or overhaul are sent to a Navy Depot (NADEP) along with the corresponding log book or log book entry sheets. These NADEPs are located on both coasts (Figure 5). Additionally, the Navy may send work to either Corpus Christie Army Depot (for T700 engine rework) or Tinker Air Force Base (for F110 engine rework).

At the depot the engines are disassembled into individual piece parts, sent to be tested for serviceability, and then repaired or replaced as necessary. Due to space and

Figure 5. Naval Aviation Depots.

personnel limitations and timing of the repair assemblies, engines often may not be reassembled with their original parts. Maintenance doctrine dictates using a system of first in and first out so as not to create a backlog of engines waiting for a specific serialized part. The result of using this system is that sometimes a part will lose its identity to a specific engine. This may cause problems when trying to determine if a particular part was still under warranty as its "hours since new" can no long be accurately determined.

All warranty repair work done at the NADEP will be entered into the Depot Management Data System (DMDS) which, in turn, will feed back through the 3-M Data System for reporting purposes. In the event that the failure is determined at the depot first, a Quality Deficiency Report (QDR) is required on the warranted item.

a. Technical Representatives (Tech Reps)

Another source of warranty information are the contractor technical representatives (tech reps) who are located at the AIMDs and NADEPs. They are often the individuals who identify warranted items and inform the maintenance personnel. The tech reps also provide technical assistance in repairing engine and engine components. They serve a useful purpose to both the Navy and the defense contractor. They are often the individuals who spot problem areas before they become critical issues. Tech reps keep

their company informed of all potential problems so that solutions can be found or reworks performed.

b. Cognizant Field Activity (CFA) Engineers

Another key component of the depot maintenance organization involved in warranty issues is the Cognizant Field Activity (CFA). The CFA is comprised of a group of Government field engineers located at the various NADEPs throughout the country. They are responsible for researching and answering all Engineering Investigation Message (EIM) traffic generated by the "O" and "I" level maintenance. An EIM is normally submitted by the fleet when they begin to experience unanticipated problems with a particular item (i.e., engines).

Once the CFA engineer has determined the source of the problem and if the engine is still under warranty, which is determined by checking the Hours Since New (HSN), he will work with the contractor to reach an agreement on a course of action. Upon reaching an agreement, the CFA engineer informs the contracting officer at NAVAIR of the agreement. If the contracting officer concurs with the agreement, he will send a contract message back to the CFA engineer, the contractor, and to any outside third party (authorized vendor) that might be involved, to authorize the repair. In instances where a third party is involved in performing the corrective action the actual monetary reimbursement may change hands between the

latter two parties without the Government being directly involved in the exchange.

The CFA engineer plays a critical role in administering and remedying warranties claims. He is, however, not included in the initial warranty planning and contracting discussions and decision making. A CFA engineer is only assigned after the engine has completed initial production and has been deployed out in the fleet for use. Prior to this the contracting officer for the engine is responsible for performing the functions a CFA engineer would handle.

c. Component Improvement Program (CIP)

The aircraft engine Component Improvement Program (CIP) plays a major role in supporting component redesign to resolve problems. There are typically five or six engines that are enrolled as part of the CIP. These engines are kept at the contractor's manufacturing plant in a "hot mock-up" configuration to simulate actual operating conditions. When field failures begin to occur at an alarming rate or before expected, the contractor can use one of the mock-up configurations to simulate the conditions that caused the failure. Engineers at the manufacturing plant can then take this information or just use the information provided to them by their representatives in the field and couple it with

previous failure data on the system as a basis for developing a component design improvement or a system quick fix.

4. Naval Aviation Warranty Program Report (NAWPR) System

The 3-M data generated from the MAF and DMDS data is sent monthly to the Naval Aviation Maintenance Support Office (NAMSO) in Mechanicsburg, Pennsylvania. From that data, the Naval Aviation Warranty Program Report (NAWPR) is supposed to be generated and forwarded monthly to every affected PCO/ACO responsible for administering the warranty and file claims. Recently it has slipped to being published quarterly.

> The report consists of four parts. The first part contains the initial maintenance action and will be used for warranty breach notification. The second part provides status for those equipments forwarded to a higher maintenance level for repair action. The third part provides data on I level organic repair actions and a summary of the removal/repair hours and parts/materials used. The fourth part provides data on depot level organic repair actions delineating repair hours and parts/materials used. The third and fourth parts are used for remedy negotiation. [Ref. 12:ENCL(1)]

The NAWPR also can serve as the notification and repair data submittal per the terms of the contract. [Ref. 12:ENCL(1)]

Unfortunately, much of the data needed to accurately reflect valid warranty entitlements is never entered into the system. If items are not properly marked, identifying them as warranted items, then they will never be entered into the system as such. There also is a problem with identifying the

contract on the MAF because only the last four digits of the contract number are annotated. According to NAVAIR Policy and Management Division (AIR-211), it is almost impossible to determine the correct contract given only the last four numbers of it from the MAF. If the contract number cannot be determined then a warranty claim cannot be filed.

D. WARRANTY FRAMEWORK AT NAVAL AIR SYSTEMS COMMAND

The Naval Air Systems Command Headquarters is responsible for developing, acquiring, and supporting weapon systems within the Naval aviation community.

> NAVAIR HQ is managed as a matrix organization, with functional groups for contracts, legal counsel, logistics, systems and engineering, corporate operations, and financial management. Each functional group is led by an assistant commander, including Assistant Commanders for Contracts (AIR-02), Fleet Support and Field Activity Management (AIR-04), Systems and Engineering (AIR-05), the Comptroller (AIR-08), Legal Counsel (AIR-00C), and Corporate Operations (AIR-07). [Ref. 14:p. 9]

Figure 6 is an organization chart of the NAVAIR organizational components related to warranties [Ref. 14:p. 9]

NAVAIR Headquarters is part of what is referred to as the "Naval Aviation Systems Team". The team includes four other components; three Naval Aviation Program Executive Officers (PEOs) and the Aviation Supply Office. As part of the team concept, NAVAIR Headquarters provides the three PEOs with

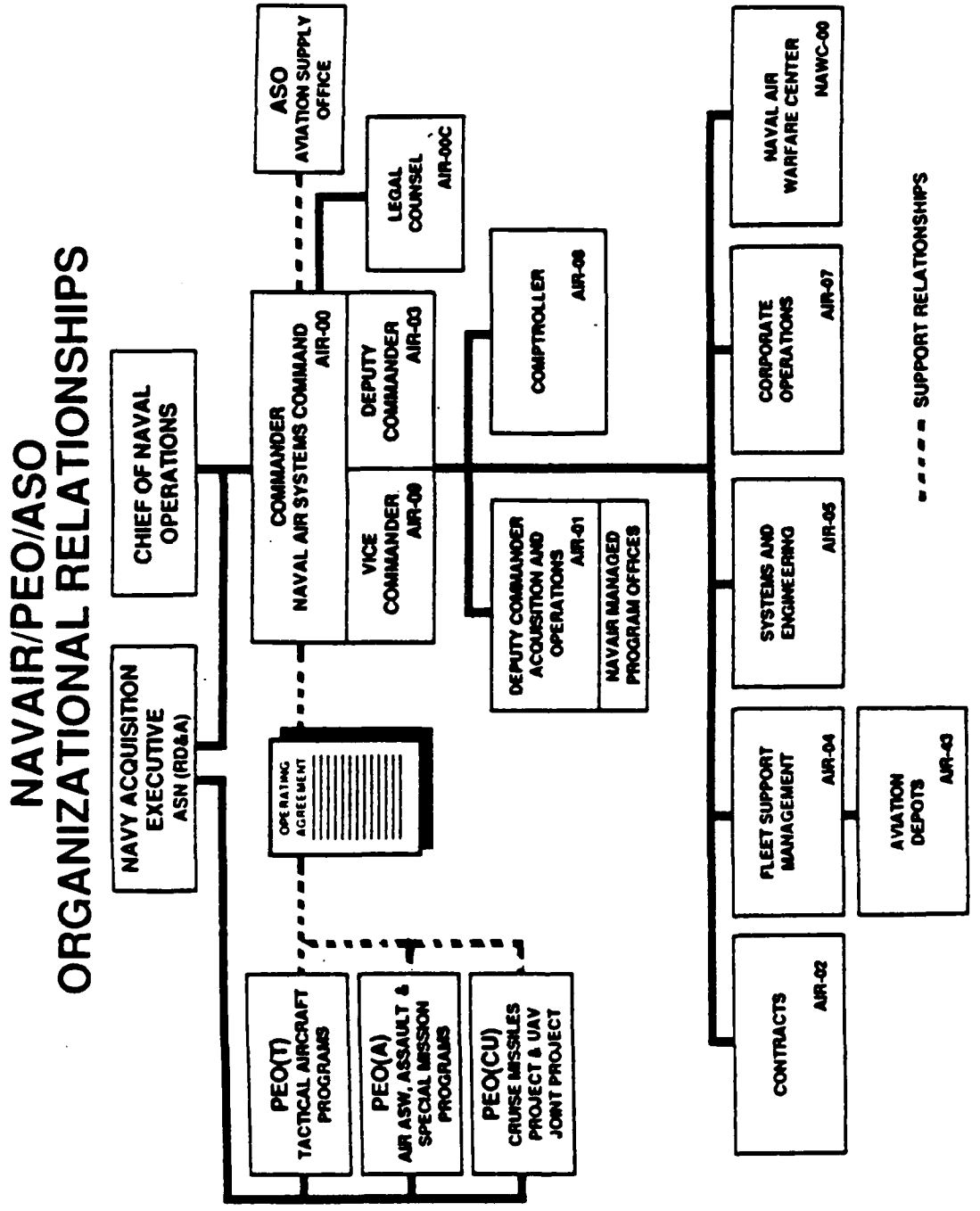

Figure 6. NAVAIR Warranty Organization.

"technical, logistics, contracting legal, and fiduciary expertise" for their programs. [Ref. 14:p. 8]

The NAVAIR office with overall responsibility for warranty policy is Product Integrity and Production Engineering Division (AIR-516). Various other offices within NAVAIR are responsible for warranty administration in one form or another. In particular, Logistics Support Division (AIR-411), was responsible for initiating the warranty program for AIR-516 by developing and publishing the tenets of the program. AIR-411 also reviews all engine contracts prior to approval in order to ensure that all essential warranty clauses have been included.

The Propulsion and Power Division (AIR-536) is responsible for developing the performance specifications and the initial design details for aircraft engines. They also are involved in developing the warranty requirements for the contracting officers to negotiate. As part of the life cycle management of a particular engine, AIR-536 also routinely tracks maintenance data on the various aircraft weapon systems.

In an attempt to improve the timeliness and reliability of the data, NAVAIR has developed a new monitoring program called the Engine Reliability Analysis Program (RAP), to assist in this effort. When the program is in place it will directly link the NADEPs with NAVAIR and AIR-536, in particular, to provide the latter with real time information on aircraft propulsion systems. The goal of the program is to "...assess

reliability, maintainability, and logistic performance and direct program resources to improve operation and readiness." [Ref. 15]

The Assistant Commander for Contracts (AIR-02), is responsible for originating, negotiating, and awarding the contracts with assistance from legal and the propulsion and power divisions. The Tactical Aircraft Contracts Division (AIR-214), keeps abreast of all active warranty issues/claims dealing with tactical aircraft and associated engines. This is also the office responsible for drafting letters to contractors when warranty issues pursuant to assigned aircraft and engines arise.

As previously mentioned, Policy and Management Divisicn (AIR-211), is responsible for publishing an annual report detailing the type and amount of warranty claims received and pursued during a fiscal year. The report is published based on information received from other offices within NAVAIR.

NAVAIR does not manage or monitor warranties per say. Most of the actual administration of warranties has been delegated to the ACOs located at the various weapon systems plants throughout the country. After conducting exhaustive interviews within the various offices of NAVAIR, the researchers found that no formal reporting requirement exists mandating warranty tracking within the Naval aviation community. As a result, there is no data available at NAVAIR on the number of warranty claims filed or the amount of

monetary restitution the Navy has received from previous warranty claims.

IV. COMMERCIAL AIRLINE WARRANTY PROGRAM

This chapter focuses on the engine warranty program currently in use at United Airlines. United Airlines was selected for study based on the fact they have an established engine warranty program in place that has achieved tangible monetary results. They also operate a consolidated maintenance facility at the San Francisco International Airport, which is in close proximity to the Naval Postgraduate School.

United Airlines operates a Reliability Centered Maintenance Program (RCM) that has captured the interest of NAVAIR, particularly the interest of the Assistant Commander for Logistics and Fleet Support (AIR-04). Although this thesis does not address and is not particularly concerned with RCM, AIR-04's interest in United Airlines was one of the motivations for our selection of that airline for study.

This chapter will also provide a brief summary of background information on United, a detailed view into the procurement and contracting practices used by United, and an indepth look at engine maintenance operations at United's Consolidated Maintenance Operations Center (MOC) in San Francisco, California.

A. BACKGROUND

United Airlines is a major U. S. airline flying commercial passenger traffic in the domestic United States and in the international and transoceanic markets of Europe and the Far East. United has approximately 525 planes in their active inventory which range from short-haul domestic jets to ultra-long range widebodies. United's inventory includes ten different Boeing models, two MacDonnell Douglas models, and one model of the Airbus. There are five basic engines that United Airlines uses on these aircraft; the CF6, -2000, -4000, JT, and CFM. General Electric (CF6 and CFM) and Pratt&Whitney (-2000, -4000, JT9D and the JT8DS) are the major manufacturers of these engines. All told, there are over 1,500 engines in the fleet, including spares.

United Airlines has one major consolidated maintenance facility where engine, avionics, and structural (airframe) maintenance work are performed; it is located at the San Francisco International Airport. A second maintenance facility in Indianapolis, Indiana, is scheduled to become operational in March 1994. The Indianapolis facility will handle the airframe maintenance for the Boeing 737 initially, and is scheduled to add engine maintenance for the 737 approximately 18 months later. [Ref. 16]

United Airlines established their engine warranty program two years ago with the hope of financial and material compensation for valid warranty claims. They reassigned two

individuals from within the company to develop, coordinate, and monitor the program. Three individuals from other administrative sections in the airline are temporarily assigned to assist the warranty coordinators process and track aircraft engine warranty claims. The need for this program arose out of the cost saving measures the airline began implementing to reduce overall costs to stay competitive without sacrificing customer safety.

United Airlines' engine warranty program achieved approximately $14 million in direct cash reimbursements with another $8 to $10 million in parts, labor, and services last year alone. [Ref. 16] They hope to achieve similar results this year as well. As a consequence, warranty reimbursement has become a major budget issue at the airline. In fact, the engine division plans their annual operating budget based on being reimbursed a certain amount of dollars per year in valid engine warranty claims.

B. WARRANTY PROCEDURES IN THE PROCUREMENT PHASES

In commercial aviation the relationship between the manufacturer and the airline is based on supply and demand. The aircraft and engine manufacturers query the system for product demand and improvement. Manufacturers design and develop airframes and engines to supply a specific demand, a practice referred to as "demand-pull."

Businesslike decisions are made regarding timing of entry into the marketplace, specifications, and performance. Often, the desirability of a decision is defined by economic considerations where trade-offs exist between desired MTBF, engine unit price, and even total engine operation costs, to include fuel consumption. The airline then purchases airframes and engines based on the reputation of the manufacturer, giving considerable emphasis to performance and cost characteristics associated with the item being procured. The industry buys the equipment "off the shelf" so to speak and, therefore, assumes none of the risks or responsibilities that the Government does during this phase.

When United Airlines negotiates a contract for an aircraft, they enter into simultaneous negotiations for the airframe and the engine. United sends out what is referred to as a "Term Sheet" to the various engine manufacturers. The term sheet lists the terms and conditions United wants the engine to meet. This is similar to the Government's use of a Request For Bid (RFB). United establishes a deadline by which the engine manufacturers must respond to be considered for selection. Based on the responses received from the engine manufacturers, United selects the manufacturer ideally suited for its business needs. United will enter into an "Engine Agreement" with the manufacturer and negotiate the actual terms of the contract. During this phase, price ceilings and extended warranty coverage are discussed. [Ref.17]

C. CONTRACTING ISSUES

United Airlines receives a warranty on engine installation from the prime contractor of the aircraft as part of an overall packaged deal. The prime contractor of the aircraft will also convey, through the engine manufacturer, a "boiler plate warranty" which covers the initial operating hours of the engine. United Airlines will be responsible for negotiating with the engine manufacturer for a "service life policy" to extend the warranty coverage beyond this initial period. Any further extension of warranty coverage beyond the service life is done on a pro-rated basis. [Ref. 17] The guidelines that govern warranty negotiations in private industry are delineated in the United States Uniform Code of Contracting (UCC).

1. Uniform Code of Contracting (UCC)

The UCC is a federal regulation written for private sector enterprises which delineates the use of four specific types of warranties. These are warranty of title, implied warranty of merchantability, implied warranty of fitness for a particular purpose, and expressed warranty. [Ref. 18:p. 631]

A warranty of title implies the contractor has title to the item and thereby is authorized to sell the item. The merchantability warranty covers material and workmanship clauses pertaining to freedom from defects. In warranty for fitness, the buyer is ensured that the equipment purchased

from the contractor will, in fact, meet his specific needs and use. Finally, an expressed warranty typically refers to the material's performance characteristics, physical composition, appearance, and so on. [Ref. 18:p. 632]

Federal regulations pertaining to warranties are broad and vague, allowing the buyer and seller to tailor the requirements to their needs without undue burden. As a consequence, industry can modify the warranties in these four categories as long as the modifications do not conflict with local and state regulations.

2. Negotiating for Warranties

United Airlines negotiates for warranty coverage and engine guarantees prior to the actual purchase of the engine(s). Every engine contract the airline negotiates is considered to be unique. This is due to the diversity of engines required to power the various aircraft in United's fleet and the fact that each of the engine manufacturers United negotiates with has their own internal and external processes and procedures for contracting.

United handles all procurement actions relating to aircraft engine purchases at a central location (corporate headquarters, Chicago). They collaborate, however, with the engine contracting office at the consolidated Maintenance Operating Center (MOC) in San Francisco to determine which engines to order, how many to order, and what warranties and

guarantees are desired. Once the contracting phase for the engine purchase has been completed, follow-on contracting involving logistical support for the engines is handled at the San Francisco Contracting Office.

The San Francisco MOC oversees leasing additional aircraft engines when needed from either the engine manufacturers or other airlines and is also responsible for negotiating maintenance support agreements with other approved outside vendors and/or the engine manufacturers.

The United warranty program executes three types of warranties; full engine warranties, piece part warranties, and resultant damage warranties. Additionally, United's warranty program includes performance reliability guarantees. [Ref. 17]

a. Full Engine Warranty

The full engine warranty provides basic coverage for the entire engine from the time it is received, installed, and becomes operational. When an engine fails it is sent to a maintenance facility for repair. After repair and reassembly, the engine warranty resumes where it left off. In cases where the integrity of the engine has been broken, full engine warranty coverage will cease and the warranty coverage will revert to a piece part warranty for the remainder of the engine's service life, covering instead the individual components. As discussed earlier, an example of breaking the

integrity of an engine would be removing a serialized component from an engine and repairing it but not returning it to the same engine. [Ref. 16]

b. Piece Part Warranty

A piece part warranty covers the individual parts that comprise the engine. United refers to these parts as primary parts. "These primary parts are the parts that the vendor is prepared to provide warranty coverage for. The coverage provided varies by type of part, and all coverage is not standard." [Ref. 16]

c. Resultant Damage Warranty

In addition to full engine warranties and piece part warranties, there are warranties that cover secondary damage. Secondary damage refers to the damage caused to other components by the failure of a primary part. United refers to this damage as "resultant damage." Resultant damage is covered as long as the primary part was under warranty at the time of mishap. An exception to this is when catastrophic damage occurs (i.e., an aircraft crashes). The resultant damage warranty would not apply in that case. [Ref. 16]

d. Performance Reliability Guarantees

Performance reliability guarantees mandate specific tolerances and include provisions for coverage in foreign object damage (FOD) incidents, remote sight removal (of engines), exhaust gas temperature (EGT), inflight shut-down,

delays/cancellations due to engine failure, and fuel consumption rates, to name a few. [Ref. 16]

D. WARRANTY PROCEDURES IN DAILY OPERATIONS

As mentioned earlier, United Airlines operates a consolidated maintenance facility, the MOC, at San Francisco International Airport. This facility performs maintenance on all aspects of the aircraft from minor component repair to major overhaul. The division of this facility that we are concerned with is the engine repair section. All repair work on aircraft engines is completed by this division. The engine can either come from an aircraft at the facility for scheduled phase maintenance or from an aircraft operating out of one of the many airports United Airlines serves.

When an engine arrives at the engine maintenance facility, it is logged into the automated maintenance system, COSMOS, and placed in a stall to wait for an initial inspection. A "stall inspector" will inspect the engine and annotate on a engine review sheet the initial work scope needed to be performed. The engine is then broken down into modular sections (i.e., hot section, cold section, and accessory section, etc.) and taken to the appropriate modular bay to be further disassembled into parts. The parts are then placed in carts and taken to the "subassembly inspectors" for serviceability identification. The subassembly inspectors separate the serviceable parts from the unserviceable parts,

routing the latter to the appropriate station for repair or scrap. The inspector annotates the findings and repair instructions on a form known as the Job Production Card (JPC).

The subassembly inspector receives an Engine Composition List (ECL) as part of the packet of paperwork for each job.

> The ECL is a computer generated list of tracked, serialized parts. The list identifies whether a part is under warranty and specifies Time Since New (TSN). The ECL is part of the Engine Parts Monitoring (EPM) System.
>
> The EPM ...is an engine parts tracking system...It tracks by time, hours, and cycles. The EPM hours and cycles are driven by the ANIS (Aircraft Monitoring In-Flight System)...ANIS is driven by the on-board computers of the aircraft which track, record, and relay all pertinent maintenance data. When a plane comes in for maintenance, the number of hours are downloaded into the ANIS...It knows how many hours that plane and its engines have operated and how many cycles, etc.... [Ref. 19:p. 2]

After reviewing the ECL, the subassembly inspector can tell how many hours there are on a particular part and whether the part is warranted. The inspector can identify warranted parts on the ECL because a separate column on the report is annotated "yes" or "no" for a warranted item.

Once the subassembly inspector has identified the unserviceable part as a warranted item, he fills out a Warranty Notice (Figure 7, [Ref. 19:ENCL (1)]) and assigns a lot number (LOT# WA_____) for tracking purposes. On the warranty notice he identifies what is wrong with the part and what he wants done with it. In cases where the part is

Attach to part & route:

Engine Type:_____

WARRANTY NOTICE

Engine S/N :_____
Engine TT: _____
Engine CSN _____
EON: _____

A

Cause of Removal:_____

QT'Y:_____

PART INFORMATION

LOT # WA_____

Part #:_____
PCN: _____
S/N: _____
Noun: _____

TSN:_____
CSN:_____

Was this part?
[] From a 1st run Engine
[] ECL Listed

Comments, precise description_(include dimensions):_____
_____
_____
_____
USE BACK IF MORE ->
DISPOSITION: SCRAP ( ) or REWORK ( ) SPACE REQ'D

Inspector Stamp:_____Area:_____ Date:_____

B

* OEM/VENDOR *
Concurrence with SFOPI findings: [] YES [] NO

If not in concurrence; REASON._____
_____
_____

Vendor signature:_____ Date:_____ Phone#:_____

C

* E42-01-WA--SEND THIS FORM TO OSV-WA-WARRANTY.

D

* SFOWA *

WA Claim #:_____

Final Disposition of Part: [] Scrap Value $_____
[] OSV Repair/Return
[] Repair in House # Hours_____

Vendor Settlement [] YES Amount $_____
[] NO

Figure 7. United Airlines Warranty Notice.

warranted but the subassembly inspector is not sure of its serviceability, the part is sent to the "home shop inspector" to make the call.

When a part has been identified as unserviceable, it can either be scrapped or sent to rework. The subassembly inspector annotates on the warranty notice the preferred method. Once annotated, the notice and part are sent to a holding area for review by a vendor's representative. [Ref. 19:p. 3] The vendor's representative has 24 hours to review the warranty notice and either agree or disagree with the inspector's findings and sign the warranty notice. If the vendor's representative agrees with the inspector's findings, the notice and part are routed per instructions on the JPC and warranty notice. If, on the other hand, the vendor's representative disagrees with the findings, copies of the notice and part will then be sent to a higher level within United and the vendor company for arbitration. At the end of arbitration the part is routed accordingly.

On parts to be reworked, the repair can be accomplished by one of three sources; United Airlines MOC, the Original Engine Manufacturer (OEM), or by a mutually approved Outside Vendor (OSV). Upon return from rework performed by United or an OSV, a claim is submitted to the OEM for parts, labor or both as appropriate. If the part is to be scrapped, a claim is filed upon receipt of the warranty notice. (See Appendix E for United's Warranty Claim Manual). Once the warranty claim is

submitted, United Airlines processes the claim for reimbursement for manhours and materials. The claim is then logged into an off-line computer program and tracked until complete payment from the OEM is received.

As mentioned earlier, the Engine Parts Monitoring system is used by the engineers at United Airlines to track parts usage. However, the Engine Warranty Coordinator for United Airlines estimates only 50% of all warranted parts are entered into the system. He would like to see that percentage increased. [Ref. 16] An item not entered into the EPM that would result in additional savings for United is turbine engine blades. Blades come in sets but each blade is individually serialized, requiring numerous computer entries in order to be input into EPM.

E. SUMMARY

United Airlines represents a fairly typical model with which to study the elements involved in warranty contracting and administration in the airline industry. The manner in which they procure and contract for aircraft engines is radically different from the way the Government procures engines. An analysis of the comparisons and applications between the Navy and a commercial airline will be made in Chapter V.

V. COMPARISONS AND APPLICATIONS

This chapter compares the Navy and United Airlines in the procurement, contracting, and operational aspects of aircraft engine warranties. It also examines the possibility of the Navy adopting commercial warranty procedures and presents the associated roadblocks.

A. PROCUREMENT COMPARISONS AND APPLICATIONS

The fundamental difference between Government (Navy) and commercial procurement of aircraft engines is the Government requires development and production of engines based on Government demanded performance criteria, while the commercial industry buys the final product off the shelf.

The Government and the contractor form a partnership from the inception of the weapon system. The Government provides the design and performance criteria and finances the manufacturer to produce aircraft engines which are primarily for the Government's use. The Federal Government mandated statutes requiring contractors to conform to specified standards in design and manufacturing requirements, materials and workmanship, and essential performance requirements.

In commercial industry, the engine manufacturer's money is spent on development and design of aircraft engines with the

intent of selling the engines to many users, thus, indirectly passing the research and development costs on to the customers. As a result, the airline industry is not responsible or held monetarily accountable for latent defects or reengineering costs that might arise at a later date.

Only if the Government was willing to buy off the shelf engines could it possibly adopt the commercial approach to the warranty policy or administration. Given the military requirements for engines, that does not seem likely. Thus, in this phase, the Government and commercial industry will continue to operate at opposite ends of the spectrum.

B. CONTRACTING COMPARISONS AND APPLICATIONS

The Government and the airline industry contract for engines separately from the airframe, although the process is part of an overall packaged deal assembled by the aircraft manufacturer. The aircraft manufacturer provides a warranty for the installation of the engine; further warranty responsibilities are assumed by the engine manufacturer.

The Government usually negotiates for warranty coverage after the initial procurement contract has been signed, as in the case of new developmental items. It relies heavily on warranties that are explicitly written and provide coverage in many areas, primarily in the area of essential performance requirements. The Government has extra layers of regulation mandating the use of warranty requirements beyond those of

industry. The Federal Acquisition Regulation (FAR) and the Defense Federal Acquisition Regulation (DFAR) are more explicit and demanding of warranties/guarantees than the Uniform Code of Contracting (UCC) used by industry.

United Airlines, as many others in the industry, relies on warranties, but places more emphasis on guarantees than the Government. Unlike the Government, they negotiate for warranties and guarantees prior to signing the contract. United is not restricted or bound by excessive regulations and, therefore, can more accurately tailor the terms of the warranty. They perform this fine-tuning process when negotiating service life extensions beyond the initial boiler plate warranty provided by the manufacturer. They negotiate with the contractor to determine a flat price rate for a specified extended service period. Any extension beyond that service period is pro-rated.

The current warranty policy used by the Government is significantly different from the practices just described for United. Presently, the Government negotiates for an engine warranty to cover a prescribed period (blanket warranty) based either on time, such as shelf-life, or on operational flying hours. Once that prescribed period expires, the warranty coverage ceases. The life management policy described in Chapter III is being considered by the Navy and should fix that problem.

Unlike the commercial engine fleet where there is sufficient field data available to allow for accurate forecasting of engine failures and associated cost risk analysis, the military does not have such information available. This is due to the limited context in which weapon systems operate and the finite number of them produced. It is only after extended use, often beyond the scope of the warranty period, that the actual reliability of a weapon system's engine can be determined. With life management, the unknown reliability factors are estimated in advance allowing for provision of warranty coverage incrementally over a number of years.

Life management is an effective way to adapt a commercial industry warranty policy to a Government setting. It is to the Government's advantage to accept and adopt this life management approach to warranty implementation.

When contracting for warranty coverage, United knows up front how much warranties will cost them; the Navy does not. United negotiates with the manufacturer for the cost and coverage of warranted items. The Navy can only estimate the cost of their warranty coverage because of its "no cost warranty" philosophy. This is a misnomer because the Navy actually does pay for warranty coverage. Instead of having a separate line entry detailing the cost of the warranty specified on the contract, the contractor tacks the warranty

costs to other cost centers within the contract. Therefore, the Navy loses visibility on the cost factor of warranties.

C. OPERATIONAL COMPARISONS AND APPLICATIONS

The warranty area lending itself to the greatest number of comparisons and applications between the Government and a commercial industry is that of the day-to-day operational environment. While the Government and commercial airlines may differ significantly in their procurement and contracting processes, many of their operational functions are similar, but often performed in very different ways. By examining in detail the differences between the Navy and United's daily warranty procedures we may be able to glean viable alternatives from which to apply a commercial warranty to a Government setting. Those functions being compared are maintenance operations; warranty tracking and administration; warranty management; on-site technical representatives; and warranty reimbursement provisions.

1. Maintenance Operations

a. United

United operates only one maintenance facility at the San Francisco International Airport. The Maintenance Operating Center (MOC) performs all levels of maintenance although cursory inspections and minor adjustments are conducted on-line at the various airports United serves. Conducting maintenance operations at a central location allows

United to maintain complete visibility and control over their warranty program and, thus, effective administration and implementation are assured.

b. Navy

There are three levels of maintenance in the Navy; organizational, intermediate, and depot. These maintenance facilities are located at naval air stations around the globe and on board aircraft carriers deployed at sea. The recent drawdown of DoD base facilities has caused the closure and consolidation of some maintenance operations, primarily at the depot level. Additionally, there has been some consolidation of effort between the Services as well. As mentioned in Chapter III, the Navy sends its T-700 engines to the Corpus Christi, Texas, Army Depot and F-110 engines to Tinker Air Force Base in Oklahoma for overhaul.

2. Warranty Tracking and Administration

a. United

Key to on-site verification is the Warranty Notice developed by United's warranty coordinator. The notice contains all pertinent information needed to validate the claim and verify the contractor's authorization for repair and reimbursement. Although the Warranty Notice adds an additional layer of paperwork on floor inspectors, it is essential to qualify the warranty claim. Once the notice is completed and signed by all parties, it is entered into a

computer program where it is tracked until reimbursement is received and the item is closed off the books.

United has incorporated warranty tracking for specific high dollar value components into their automated maintenance tracking system (EPM) which allows for easy identification of warranted items. Additionally, they provide their maintenance mechanics with written documentation of warranty coverage for items not entered in their automated maintenance tracking system. These two systems aid United in identifying warranted items.

b. Navy

The maintenance record keeping functions in the Navy at the "I" and "D" levels are largely automated. Record keeping functions at the "O" level are generally performed manually or with some automation (i.e., personal computer (PC)) backed up by a paper copy. Nevertheless, the software the Navy uses for maintenance planning does not have the capability to track or identify parts under warranty. It does have a place for manual entry on the Maintenance Action Form (MAF) to identify items under warranty per OPNAVINST 4790.2E. Our research has shown, however, that the annotations to the MAF for warranty identification are of little value when validating a warranty claim using the 3-M reporting system.

Additionally, relying solely on engine data plates, containers and log books for warranty information does not

provide an adequate means for identifying items still under warranty. As noted in Chapter III, engine components/parts are taken from the engine during rework and are replaced with parts from other engines, engine containers are swapped around when engines are turned in for rework, and engine log book entry sheets are often missing from the log book or are missing important historical data.

c. Application

United appears to have a more effective way to track warranted items. If the Navy desires a truly worthwhile warranty program, a more comprehensive software system for tracking warranties should be developed. Determining the cost of an automated system for the Navy which would be similar to United's is beyond the scope of this thesis.

3. Warranty Management

a. United

The key to United's engine warranty program is the fact that they have assigned the resources and manpower necessary to administer it. United management recognized the need and benefit to having a strong warranty program and dedicated the efforts of two people full-time to develop and implement the program. Their undertaking has proved to be extremely fruitful.

b. Navy

While there are many offices at NAVAIR who have a finger in the warranty pie, there is not a central person or office designated as warranty coordinator or administrator. Nor are there any such designations at the fleet level. There is no documented, formal requirement for information on warranty reimbursement to be filed at NAVAIR by either the Contracting Officer (CO) or his on-site Administrative Contracting Officer (ACO). Consequently, there is little data available on warranty claims at NAVAIR.

At NAVAIR, AIR-211 is responsible for compiling an annual report detailing the warranty claims submitted and processed during the year, but must rely on submission of the information from various components within NAVAIR HQ. Since those same components are not required to track warranty data, negative responses have been submitted three out of the past four years. [Ref. 20]

c. Application

Assigning responsibility for a major program is certainly no more indigenous to a commercial airline than it is to the Navy. United has credited the successes of their warranty program, in large part, to the efforts of their warranty managers. Should the Navy desire similar results with its warranty program, assigning responsibility and

accountability at a sufficiently high level should give the program the "teeth" it needs.

4. On-site Manufacturer's Technical Representatives

a. United

The contractor technical representatives at United are empowered with the authority to verify and validate warranty claims identified by United's maintenance personnel. On-site contractor verification of warranted items allows United to submit warranty claims for reimbursement in a timely manner.

b. Navy

All Navy intermediate and depot level maintenance facilities have on-site technical representatives provided by the manufacturer. However, tech reps at Navy locations have only limited capability in the warranty arena. Those interviewed admitted lacking sufficient knowledge of warranties to provide more than technical assistance in identifying warranty items. Most stated they would need to contact their company warranty manager for additional information before processing warranty claims.

Currently, warranty claims against a contractor are filed either by the CO or ACO based, in part, on information submitted through the 3-M system.

c. Application

Some Navy contractor tech reps have mentioned, during the course of our interviews, that their statement of work (SOW) could be written into the contract in such a manner as to give them the authority they need to identify, verify, and validate warranty claims. The Navy may wish to consider this as an option to ensure claims are properly justified and submitted in a timely manner, consistent with the terms of the contract warranty clause.

5. Warranty Reimbursement

a. United

The most tangible evidence of the effectiveness of United's warranty program is in the direct monetary reimbursement and replacement of parts and labor expenses it has realized since the program's inception. United has the ability to take the money it receives from the engine manufacturers and use it without restrictions or accounting encumbrances. At United, as in the rest of civilian industry, there is only one color of money -- green.

b. Navy

Section 2403 to Title 10 United States Code, Weapon Systems Warranty Act stipulated mandatory written guarantees and warranties for major weapon systems procured after 1 January 1985. When this law was enacted, no further consideration was given to amending existing laws governing

military appropriations and U. S. Treasury Department regulations. In effect, Congress required the Navy to include warranty provisions in all new weapon system procurement contracts but, at the same time, required no new provisions allowing the Navy to receive direct compensation or reimbursement from claims submitted against warranted items. All payments made by contractors on warranty claims submitted by the Navy are made payable directly to the U. S. Treasury and not the U. S. Navy, hence removing any motivation to enforce warranties. Furthermore, the Treasury Department, upon receiving payment from a contractor, does not, in turn, reimburse the Navy.

By not providing a process which allows direct reimbursement to the services, Congress inadvertently placed a stumbling block in DoD's way that has had an adverse effect on the overall warranty objective. Because there is no avenue for the Navy to receive any reimbursement for warranty claims, the fleet is less likely to expend their scarce resources to investigate, annotate, and file claims on warranted items. This was the prevailing point of view of almost all Navy personnel we interviewed at the squadron, intermediate, and depot maintenance levels.

(1) Warranty "Arrangements"

At the "O" and "I" levels of maintenance, it is often easier and more timely to work an "under the table"

arrangement with the on-site contractor technical representative to resolve repair part problems associated with engine failures. Such arrangements might include issuing replacement parts or reworking parts at the contractor's expense but not officially reporting or documenting them through Navy channels. A study to eliminate the need for such arrangements will be suggested in Chapter VI.

(2) Color of Government Money

Another problem related to the reimbursement issue is centered around the color of Government money, which is determined by appropriations. Military appropriations are divided into five funding categories: Operations and Maintenance, Procurement, Research and Development, Military Construction, and Other. With each category of funding, there is a finite time period for obligating and expending the monies. The fiscal category of most concern is Operations and Maintenance.

The Operations and Maintenance category is funded based on annual appropriations from Congress. The funds in this category are earmarked for daily operations and maintenance activities. The funds for personnel pay and repair parts acquisition come from this category. "Any reimbursement received from the contractor for military labor expended must be received within the year the labor was charged; and any reimbursement for material must be received

within three years." [Ref. 21] Additionally, the issuance of "free parts" to the Government is illegal, although such issuance occurs fairly often [Ref. 21].

D. SUMMARY

The Warranty Guidebook provides the best summation of the differences between government and commercial warranties. An excerpt from this book highlights the critical differences.

> The differences between commercial and military warranties are profound and their understanding bears on the potential success in weapon system applications. The requirements of commercial warranties are defined by competitively self-determined marketing considerations. The requirements of weapon system warranties are specified by the customer (Government). Commercial warranties enjoy the benefits of extensive market research whereas weapon system warranties do not. Commercially warranted items are manufactured prior to sale; warranted weapon systems are manufactured after sale. Commercial warranties are generally provided in lieu of other rights and entitlements of the customer; weapon system warranties are generally provided in addition to other rights and entitlements of the Government. Commercial warranties enjoy utility by spreading small risk increments over massive numbers of consumers; weapon system warranties cannot spread incremental risks beyond one massive customer (Government). [Ref. 1:p. 1-2]

There are, however, several applications the Navy can incorporate into its warranty program which may provide benefits beyond their expense in time and resources. These applications include using the life management theory when negotiating warranties, changing the law to allow direct reimbursement to the Navy for warranty claims, developing a maintenance software program to provide identification and

tracking of warranted parts, and assigning the responsibility for administering a warranty program at all levels.

VI. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The main objectives of this thesis were to evaluate the Navy's current aircraft engine warranty program in terms of overall manageability and effectiveness; to evaluate a commercial airline's engine warranty program to determine what aspects could be applied to the military; to determine, if possible, the costs and benefits of the Navy's warranty program; to identify deficiencies in the program; and to provide topics within the warranty framework for further research and analysis by Naval Postgraduate School students.

A. SUMMARY

The background and research information compiled and analyzed for this thesis was presented in Chapters II through V. Chapter II examined the background history of warranty use in the acquisition of weapon systems and detailed the requirements laid down by the 1985 Warranty Legislation.

Chapter III depicted the Navy's engine warranty program through the procurement, contracting and operational phases of a weapon system's life cycle. The warranty program in the operational environment was described in detail in order to draw conclusions and make recommendations on its effectiveness. Chapter IV addressed and presented the

commercial engine warranty program at United Airlines in a similar format to Chapter III to facilitate comparison.

Chapter V contrasted the Navy's warranty program with United's and analyzed the similarities and differences between the two programs. The analysis highlighted areas of United's warranty program which could be favorably applied to a military environment. Where these applications would require modification to fit a Government setting, suggestions were made for how to do it.

B. CONCLUSIONS

The answers to the five subsidiary research questions posed in Chapter I summarize the conclusions of this thesis research.

1. What is the 1985 warranty legislation and what does it require?

The 1985 warranty legislation was Congress's attempt to ensure that the Government receives its money's worth from defense contractors for the weapon systems it procures for the military. The legislation requires all new major weapon systems procured after 1 January 1985 to be warranted for design and manufacturing requirements, defects in materials and workmanship, and essential performance requirements. The details of that legislation were presented in Chapter I.

2. Are claims being filed against warranted items?

Claims have been filed and continue to be filed against warranted items by the Navy. Unfortunately, there is no formal reporting or tracking process that gives any visibility to the actual number of claims or associated dollar value attached to them. Refer to Chapter III for a discussion of these claims and the problems associated with obtaining warranty information needed for filing claims.

3. Is the Navy's program cost-effective or are improvements required?

The most simplistic answer to this question is that the Navy's program does not work at all. Obviously, then, it is not cost-effective and drastic improvements are needed. The Navy needs to go back to the drawing board and develop a different warranty program because what they currently have in place in the fleet is neither workable nor credible. Recommendations on how to improve the program are listed at the end of this chapter.

4. Are there more effective programs currently being used by the civilian sector (i.e., United Airlines)?

There are more effective warranty programs being used by the civilian sector. One possible model is United Airlines'. United has an effective engine warranty program in place that realized monetary results of approximately $14

million in direct cash reimbursements and another $8 to $10 million in parts and labor for last year.

United is able to realize such tangible results because they operate one consolidated maintenance facility and have dedicated the resources and manpower required to run an effective program. They are also aided in this effort by an automated maintenance system giving them visibility on high dollar warranty items. Additionally, they forged a relationship with the engine manufacturers allowing them to receive timely reimbursement on claims.

5. Can a commercial program be adapted by the Navy for their use?

First, without major revisions in the laws that govern military appropriations and reimbursement issues, a commercial adaptation would be extremely difficult. Second, new software applications would have to be developed for the 3-M Data System to allow for better integration of warranty information. The possibility exists that the 3-M system may not be the appropriate vehicle for tracking warranty data and another program may have to be written. Last, responsibility for the program must be assigned within the naval air community at a level where the program will get the visibility and support to make it effective. Implementation and involvement at all levels is key to a successful program.

C. RECOMMENDATIONS

Basic recommendations for action by NAVAIR and the aviation community in general with regard to aircraft engine warranties are as follows:

1. Develop an effective and enforceable engine warranty program.

The Navy should consider those facets of a commercial engine warranty program adaptable to Navy warranty practices. This may entail transitioning Navy thinking to the reliability theory of life management in weapon system acquisitions as discussed in Chapter III to extend the service life of the engine. In addition, maintenance record keeping software must be upgraded to allow for identification and tracking of warranty engine components. Recommendations 2 through 4 highlight other specific improvements to the Navy's program.

2. Assign responsibility for warranty management at every level of maintenance.

Warranty Coordinator/Manager should be a primary duty assignment at NAVAIR and at each of the organizational, intermediate, and depot maintenance activities. There must be accountability at each level to encourage the proper administration of the warranty program.

3. **Involve the CFA engineer in the initial engine contract negotiations and logistic support planning.**

Presently, the Cognizant Field Activity engineer is not involved in the acquisition process of determining warranty requirements or follow on logistic support, although he is the individual who will often be involved in handling maintenance problems associated with warranties. NAVAIR should designate a CFA engineer at the depot level early in the initial engine contract negotiations, particularly during the warranty planning and testing phase, rather than assigning these responsibilities to a NAVAIR engineer.

4. **Require the contractor technical representatives at the AIMDs to play a greater role in warranty identification, verification, and certification.**

Currently, the contractor technical representatives at the AIMDs are not specifically required to play a role in identifying warranty items that come in for repair. By stipulating this requirement in their statement of work (SOW) more items under warranty will be identified as they come in for repair.

D. THESIS STUDY RECOMMENDATIONS

The authors recommend three specific areas for further research to be conducted by students at the Naval Postgraduate School.

1. **Address potential ways to revise the current laws governing appropriations and government reimbursement.**

The purpose of this study would be to find and/or make changes allowing the Services direct monetary compensation as a result of the valid warranty claims submitted.

2. **Develop a computer model for warranty cost-effectiveness analysis that includes all modular engine components and all direct and indirect costs associated with their repair.**

The current models developed and used by the NAVAIR Cost Analysis Division (AIR-524) do not provide a thorough analysis of engine components and costs associated with their repair. This thesis would greatly assist NAVAIR's Propulsion and Power Division (AIR-536) in their analysis of warranty-related costs.

3. **Help devise a more detailed tracking program for aircraft engine warranties.**

Emphasis should be placed on enforcement of the warranty program at the lowest level. The warranty program developed should emphasize the critical high dollars items to be tracked and managed.

APPENDIX A

DEPARTMENT OF THE NAVY

NAVAL AIR SYSTEMS COMMAND

NAVAL AIR SYSTEMS COMMAND HEADQUARTERS

WASHINGTON, DC 20361-0001

IN REPLY REFER TO

NAVAIRINST 13070.7

AIR-516

9 Dec 85

NAVAIR INSTRUCTION 13070.7

From: Commander, Naval Air Systems Command

Subj: POLICY GUIDANCE FOR WARRANTY APPLICATION ON NAVAL AIR SYSTEMS COMMAND WEAPON SYSTEM PROCUREMENTS

Ref: (a) Section 794, Public Law 98-212
(b) Section 2403, Title 10, United States Code
(c) DoD Federal Acquisition Regulation Supplement 46.770, Use of Warranties in Weapon System Procurements

1. Purpose. To set forth objectives, establish policies, and assign responsibilities for the application of warranty provisions as part of contracts for the development, production, and modification of Naval Air Systems Command (NAVAIR) weapon systems in compliance with references (a), (b), and (c).

2. Scope. This instruction applies to all echelons of command and all weapon systems under the management control of the Commander, Naval Air Systems Command (COMNAVAIR).

3. Objectives. To ensure that each weapon system and subsystem contract contains warranties covering design and manufacturing requirements, defects in materials and workmanship, and essential performance requirements which will provide NAVAIR with sufficient time after delivery to determine that the weapon systems and subsystems have indeed achieved requirements specified in the contract and are free from defects in materials and workmanship.

4. Policy. It is the policy of COMNAVAIR in complying with referenced legislation to:

a. Obtain warranties on weapon systems following the provisions of reference (c), unless it is determined that the warranties are not cost effective or are not in the best interest of the Government. In assessing the best interests of the Government, ensure that fleet readiness and mission effectiveness are given the highest priority. If it can be shown that a warranty is not cost effective or is not in the best interest of the Government, a waiver should be requested following reference (c).

b. Ensure that all weapon system warranties contain provisions requiring the contractor to furnish data on warranty repairs.

c. Ensure that all acquisition plans address the planned use of warranties and their associated impact on fleet user maintenance operations and the NAVAIR logistics support system.

d. Ensure that methods are established to identify all warranted items, including marking both warranted material and shipping containers as appropriate.

e. Ensure that the time period of warranty coverage is clearly established, is reasonable, and is sufficient to cover the types of defects and nonconformances that are likely to occur during service use.

5. Responsibilities

a. Naval Air Systems Command Headquarters (NAVAIRHQ)

(1) Assistant Commander for Systems and Engineering (AIR-05) will exercise overall management and administrative control of NAVAIR warranty programs by performing the following functions:

(a) Serve as principal spokesman and contact within NAVAIRHQ, and coordinator throughout NAVAIR, for all matters related to weapon system warranties.

(b) Provide technical advice, guidance, and general interpretations concerning warranty applications to all requiring NAVAIRHQ divisions.

(c) Provide a capability through the Cost Analysis Division (AIR-524) for warranty life cycle cost analysis.

(d) Maintain a general overview of Navy warranty applications, making independent evaluations in order to assess the net benefits of each warranty to the Navy.

(e) Serve as the NAVAIR spokesman to higher levels on warranties as required.

(f) Serve as the coordinating agent with the Secretary of the Navy (SECNAV) and the Secretary of Defense, or their designated representatives, for the processing and approval of all warranty waiver requests on NAVAIR weapon systems or subsystems.

(2) Assistant Commander for Logistics/Fleet Support (AIR-04) will provide administrative services, training, advice, and guidance on matters involving warranties. These responsibilities will encompass the following functions:

(a) Establish a single point of contact within AIR-04 for matters involving warranties.

(b) Provide advice and guidance on warranty applicability, in matters relating to weapon systems or subsystems maintenance, modifications, and repairs.

(c) Provide requirements on matters pertaining to logistics support and maintenance engineering for the transition of warranted equipment from development to production and also for the transition to Navy organic support.

(d) Perform analyses of all NAVAIR warranties with respect to economics and logistic support impacts.

(e) Provide for the logistic support analysis process to determine the impact of proposed warranties before issuance of the maintenance plan as required by NAVAIR Instruction 4790.4A.

(f) When a NAVAIR weapon system warranty is incorporated in a contract, ensure integration of that warranty into the appropriate weapon system maintenance plan.

(g) Ensure that warranty provisions are considered in all logistics planning actions.

(h) Establish an effective fleet data feedback system to support the administration of all NAVAIR procurement warranty programs.

(i) Develop and provide a training program for logistics support and fleet user personnel on the proper implementation and administration of warranty programs.

(3) Assistant Commander for Contracts (AIR-02) will

(a) provide advice and guidance in the development of contractual warranty provisions for NAVAIR weapon system procurement programs;

(b) establish procedures to track and accumulate data relative to warranty costs;

(c) ensure proper and complete coverage of warranty requirements in all NAVAIR contractual documents associated with the procurement of NAVAIR weapon systems; and

(d) act as the prime point of contact with contractors on contractual matters relating to weapon system warranty provisions.

(4) Office of Counsel (AIR-00C) will review all warranty clauses and related contract wording for proper form and legal sufficiency.

(5) Comptroller (AIR-08) will provide advice and assistance to program and logistics managers in budgeting for and justifying funding in support of warranty applications prior to the execution of a contract involving warranties.

(6) Cognizant program manager or coordinator will

(a) plan and budget for warranty applications unless SECNAV has determined that the warranty is not advantageous to the Navy;

(b) be the final authority within NAVAIRHQ for evaluation of warranties as they affect their program with particular emphasis on the period of the warranty and, where applicable, the essential performance requirements that must be warranted;

(c) if deemed necessary, following coordination with AIR-02 and AIR-05, make a final recommendation through the appropriate Navy chain of command to request a waiver of warranty provisions in contracts pertaining to their program; and

(d) review and determine the effectiveness of warranty provisions on their program in terms of warranty costs and improvements to fleet readiness and mission effectiveness.

b. NAVAIR Field Activities and Inventory Control Points (ICPs). Heads of NAVAIR field activities and ICP directors and officers who execute or are the procuring activity for contracts that purchase or modify NAVAIR material will be responsible for administering, budgeting, funding, and applying warranty provisions which meet the intent of this instruction in all purchase actions and requests.

c. Naval Aviation Logistics Center will provide advice and guidance regarding warranty applications to naval air rework facilities or other depot maintenance activities as they become involved in the program. These activities should be coordinated with AIR-05, AIR-04, and AIR-02.

6. Action

a. Addressees will

(1) take action to implement the provisions of this instruction, which incorporates direction provided by reference (c) effective 2 January 1985, on all new procurements and equipment modification contracts;

(2) in those cases where evaluation indicates that the application of a warranty as required under references (a), (b), and (c), is not advantageous to the Navy, participate in the

preparation of a waiver request, with a detailed written justification attached, for submittal to SECNAV or the designated Assistant Secretary, via the chain of command; and

(3) take action to evaluate cognizant NAVAIR instructions and military standards and revise them as appropriate for compatibility with this instruction.

b. When a NAVAIR weapon system or subsystem (including support equipment) has been selected for warranty application, the cognizant acquisition manager (NAVAIRHQ, field activity, or ICP) will so apprise AIR-05 and provide AIR-05 with a copy of the proposed contract warranty clause(s).

R. V. JOHNSON
Deputy Commander

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DEPARTMENT OF THE NAVY
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20350-1000

SECNAVINST 4330.17
SO-4 (CBM)
18 SEP 1987

SECNAV INSTRUCTION 4330.17

From: Secretary of the Navy

Subj: NAVY POLICY ON USE OF WARRANTIES

Ref: (a) Navy Acquisition Regulations Supplement (NARSUP) SUBPART 46.72
(b) Federal Acquisition Regulation (FAR) SUBPART 46.7
(c) DoD FAR Supplement (DFARS) SUBPART 46.7

1. Purpose. To ensure that the Department of Navy (DON) obtains and administers warranties that enhance the quality, reliability and performance of systems, subsystems and materials.

2. Scope. This instruction applies to all Fleet, Fleet Marine Force and Shore activities involved in logistics support for DON systems, subsystems and materials.

3. Policy. It is DON Policy to:

a. Ensure that Navy obtains warranties for:

(1) all weapons systems used directly by the armed forces. This applies to weapons systems which will have a unit cost greater than $100,000, or for which the eventual total procurement cost will be more than $10,000,000, unless such warranties are determined not to be cost effective.

(2) all other supplies and services (i.e., non-weapons systems), when the contracting officer determines that obtaining a warranty is advantageous to the Government. Such warranties must equal or exceed the requirements of DFARS 46.770.

b. Ensure that Systems are established for:

(1) reporting failed items under warranty

(2) user return of warranted products

(3) collecting and analyzing actual warranty use and claim data

4. Action. Addressees will implement and provide copies of implementing instructions to ASN (Shipbuilding and Logistics) Contract Business Management within 120 days. Detailed directives should address the issues presented in reference (a).

a. The Chief of Naval Operations will:

(1) establish procedures to ensure that warranties are obtained for:

(a) weapons systems meeting the thresholds specified here.

(b) all other supplies and services (i.e., non-weapons systems) per references (b) and (c).

(2) establish procedures to ensure maximum use of warranted products before expiration of the warranty periods.

(3) establish a customer/user notification system which provides for feedback information on failed items under warranty, minimizing reporting requirements of fleet activities and maintenance personnel.

(4) develop procedures for immediate issuance of credit to the end item user, when appropriate, when requisitioned products under warranty are found to be defective upon installation.

(5) develop a system for collecting actual warranty use and claim data, and for performing an analysis of the data on an annual basis with the first analysis to be performed on 30 June following implementation of this instruction, and annually each June thereafter. Provide copies of annual warranty data analyses to the Assistant Secretary of the Navy (Shipbuilding & Logistics) (ASN(S&L)) within 60 days of the end of each annual analysis period.

b. The Commandant of the Marine Corps will develop warranty policy for Marine Corps acquisitions, and establish procedures for processing warranty claims.

c. The Comptroller of the Navy will ensure that procedures are available to collect funds under warranties and that those funds are properly credited to the appropriate accounts.

Everett Pyatt

EVERETT PYATT
ASSISTANT SECRETARY OF THE NAVY
(SHIPBUILDING AND LOGISTICS)

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(Assistant Secretary of the Navy (Financial Management))

APPENDIX C

DEPARTMENT OF THE NAVY

NAVAL AIR SYSTEMS COMMAND

NAVAL AIR SYSTEMS COMMAND HEADQUARTERS

WASHINGTON, DC 20361 -0001

Canc frp: May 90
IN REPLY REFER TO
NAVAIRNOTE 4855
AIR-515
17 May 89

NAVAIR NOTICE 4855

From: Commander, Naval Air Systems Command

Subj: WARRANTY GUIDANCE

Ref: (a) NAVAIRINST 13070.7 of 9 Dec 85
(b) Section 2403, Title 10, United States Code
(c) Federal Acquisition Regulation Subpart 46.7
(d) DOD Federal Acquisition Regulation Supplement, Subpart 246.7
(e) NARSUP 46.702
(f) SECNAVINST 4330.17 of 18 Sep 87
(g) SECNAV memo of 3 Sep 86

Encl: (1) NAVAIR Warranty Administration Program Approach For OPNAV Instruction 4790.2D Items (Aircraft and Aircraft Equipment)
(2) NAVAIR Warranty Product Line Subgroup Leaders
(3) Form NAVAIR 13070/1, NAVAIR Warranty Appliction Checklist

1. Purpose. To clarify the warranty policies and responsibilities of reference (a). This notice is intended to complement, not replace, reference (a).

2. Background. Reference (a) established the Naval Air Systems Command (NAVAIR) warranty policy as a result of references (b) and (c). This notice incorporates the provisions of references (d) and (e) that were issued subsequent to reference (a) as well as refinements and clarifications that have evolved as the NAVAIR warranty program has matured. (It does not provide the detail language required in a warranty. That guidance will be provided by subsequent generic warranty provisions and approach documentation.) To implement reference (a), consistent and nonintrusive methods of administering warranties for NAVAIR equipment in the fleet are required and those methods must be reflected in the warranty language. Fleet warranty processing procedures for aircraft/aircraft equipment and airborne weapon systems are delineated in OPNAV Instruction 4790.2D (and described in enclosure (1)) and OPNAV Instruction 8600.2 respectively.

3. Policy. The policy of the Commander, Naval Air Systems Command, in addition to reference (a), is to:

a. Obtain warranties on all items where the cost benefit analysis demonstrates a warranty to be cost effective or otherwise in the best interest of the Navy. The results of the cost benefit analysis will be placed in the contract files.

b. Minimize the burden to the fleet resulting from warranty administration by using existing reporting systems to the maximum extent possible.

c. Subject to organic repair capability, permit organic repair without voiding the warranty. The warranty will embrace NAVAIR's maintenance philosophy/approach.

d. Pursue a no cost warranty per reference (f).

e. Identify warranted items by individual marking and/or a notation in the item's logbook. Marking, as a minimum must include the statement "WARRANTY ITEM", expiration of the warranty, contract number, and where to ship while under warranty if location is other than that indicated by the Master Repairable Index List (MRIL). Containers will be marked per MIL-STD-129J, appendix C, paragraph 20.23.

f. The duration of the warranty period will be a minimum of one year in-service. Warranty duration/administration methods must consider anticipated lead time/shelf time required for Government Furnished Equipment (GFE)/spares to be incorporated into a delivered end item.

4. Responsibilities. The following provides clarification of selected responsibilities as stated in reference (a) paragraph 5:

a. Assistant Commander for Systems and Engineering (AIR-05)

(1) Product Integrity Management Division (AIR-516) will:

(a) Exercise overall management of the NAVAIR warranty program. AIR-516 will chair the NAVAIR Warranty Policy Committee (NWPC). The NWPC, which consists of the warranty points of contact for AIR-05, the Assistant Commander for Fleet Support and Field Activity Management (AIR-04), the Assistant Commander for Contracts (AIR-02), the NAVAIR Acquisition Executive and Deputy Commander for Operations (AIR-01), and the Office of Counsel (AIR-00C), is an advisory group that will develop policies/implementing procedures and provide Command guidance.

(b) Periodically review warranties in Procurement Requests (PR's) to assess compliance with Command policy and to identify adjustments to the warranty program as needed.

(2) AIR-05 divisions will assign/select warranty subgroup leaders and monitor subgroup activity. Subgroups will include AIR-04 and AIR-02 representation. The subgroups will be organized along product lines, as described in enclosure (2). The subgroup will develop, maintain, and ensure the appropriate application of generic warranty approaches, support Program Managers during warranty development, and review PR's using the enclosure (3) warranty application checklist to ensure compliance with NAVAIR warranty policy. The subgroup leaders will obtain approval from the NWPC for the generic warranty approaches and will provide feedback to the NWPC with regard to the effectiveness of the generic warranty approaches and Command policy/procedures.

b. AIR-04

(1) Logistics and Maintenance Policy Division (AIR-411) will participate on the NWPC, act as the main focal point on all warranty policies and issues that apply to logistics and maintenance procedures, and provide advice and guidance to the Assistant Program Manager for Logistics (APML)/Logistics Manager (LM), field activity, and fleet personnel regarding warranty administration procedures.

(2) Supply Policy, Management and Financial Programs Division (AIR-412) will implement policies and procedures related to interim and initial/replenishment spares.

(3) Product Support Directorates (PSD) and Product Support Advocates (PSA) will perform the functions assigned in reference (a), paragraph 5c, by providing advice and guidance regarding warranty applications on programs under their cognizance. These activities will submit their efforts through AIR-411 and the appropriate Product Support Program Office (AIR-41P) and the Deputy Assistant Commander for Aviation Depots (AIR-43) point of contact for coordination with the NWPC and the cognizant program manager.

(4) APML/LM will ensure that the maintenance plan, technical manuals, and all appropriate documents contain warranty information necessary to provide sufficient guidance for effective administration.

c. AIR-02

(1) Policy and Management Division (AIR-211) will participate on the NWPC, coordinate AIR-02 warranty policy, and advise the Principal Contracting Officers (PCO's) regarding warranty implementing procedures.

(2) PCO's or their duly authorized representative will negotiate and contractually administer the warranty and any resulting remedies.

d. AIR-00C will participate on the NWPC, coordinate AIR-00C warranty policy, and establish Command procedures for ensuring compliance with statutory and regulatory requirements.

e. AIR-01

(1) NAVPRO Management Division (AIR-119) will participate on the NWPC, provide guidance, and coordinate warranty policy and implementing procedures with all contract administration services.

(2) Cognizant Program Managers will:

(a) Ensure that a warranty cost benefit analysis is performed with advice provided by the Cost Analysis Division (AIR-524) as supported by the administration contracting offices (ACO's) and PCO, and the results of the cost benifit analysis are provided to the PCO for inclusion in the contract file.

(b) Develop the warranty using enclosure (3), form NAVAIR 13070/1, NAVAIR Warranty Application Checklist, and provide a completed checklist when processing the PR, and coordinate the warranty development with AIR-02 and AIR-00C.

(c) Assess the effectiveness of each warranty.

(d) Develop/establish a warranty implementation plan in coordination with the APML/LM, AIR-119/contract administration office/ACO, PCO, and the contractor.

(e) Coordinate the warranty with related initial/replenishment spare procuring agencies to ensure compatibility with future initial/replenishment spare procurements, ensure that requirements necessary to minimize the cost of implementing initial/replenishment spare warranties are addressed, and provide guidance with regard to the type and extent of program related initial/replenishment spare warranties. This effort will be accomplished in conjunction with AIR-412 and the APML/LM.

5. Forms. NAVAIR 13070/1, NAVAIR Warranty Application Checklist, is available from the NAVAIR Forms Stock Room.

6. Cancellation. The notice remains in effect until incorporated into a NAVAIR Instruction.

J. B. WILKINSON

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NAVAIRNOTE 4855
17 May 89

NAVAIR WARRANTY ADMINISTRATION PROGRAM APPROACH FOR
OPNAV INSTRUCTION 4790.2 ITEMS
(AIRCRAFT AND AIRCRAFT EQUIPMENT)

1. Background. With the passage of warranty legislation, the Naval Air Systems Command's (NAVAIR) basic form of warranty administration reporting, the use of Quality Deficiency Reporting system, was reassessed. At that time, OPNAV Instruction 4790.2C required organizational (O) and intermediate (I) levels of maintenance to report failures of warranted equipment by the Quality Deficiency Report (QDR). With the increased emphasis on warranties, the number of contracts and the length of warranties would significantly increase. The annual number of fleet QDR's was estimated to increase from approximately 14,000 to 300,000. This increase would have a significant impact on the fleet's ability to report warranty and quality deficiencies and have an adverse effect on QDR management at the Contract Administration Services (CAS) and NAVAIR. As a result, NAVAIR developed a new Naval aviation warranty administration reporting system that minimizes fleet burden, minimizes the impact to the QDR system, and improves warranty administration capabilities.. The following is a description of the warranty administration system and associated responsibilities:

2. Approach. Reporting failures of warranted equipment in the fleet will be via the Maintenance Action Form (MAF)/3-M Data System. The MAF is the basic fleet document for all maintenance actions at O and I levels of maintenance. Maintenance personnel at O and I levels are required to complete the MAF for all maintenance actions regardless of the warranty program. Therefore, data on failures (and repair actions) for warranted items will be routinely collected with no additional fleet impact. OPNAV Instruction 4790.2D, which was effective on 1 January 1988, implements these warranty reporting changes. The basic warranty system changes and approaches are as follows:

a. OPNAV Instruction 4790.2D changes.

(1) The MAF has been expanded to collect warranty related data. The length of the warranty period will be recorded in blocks E47 and G43, prefixed by a "W" to indicate that the item is under warranty. Blocks 552 and G48 will contain the last 4 characters of the contract number. The user obtains the information from the marking on the item or, if the item is not marked, the information is obtained from the miscellaneous history section of the logbook.

(2) The MAF will be used to document failures and repairs of warranted equipment. As in the past, the fleet will submit QDR's to report defective new or newly reworked items or other failures perceived to be attributed to a quality deficiency. If the equipment is warranted and is perceived to be a quality deficiency, both the QDR and the MAF will be completed.

b. Basic aircraft administration changes/approach.

(1) For equipment returned to the Cognizant Contractor Facility (CCF) packaging will be conspicuously marked as a warranty exhibit and contain the MAF. A QDR will be provided only if a quality deficiency was perceived.

(2) All MAF data for warranted equipment will be compiled into a Naval Aviation Maintenance Support Office (NAMSO) Navy Aviation Warranty Program Report (NAWPR). The report will be used to notify the contractor of a warranty breach and will contain warranted equipment failure data and organic repair data. The organic repair information is the basis for remedy negotiation with the contractor for those equipments repaired by Navy activities and not returned to the CCF. The report is further described under NAMSO responsibilities below. The cognizant PCO or their duly authorized representative is responsible for conducting remedy negotiations.

(3) Equipments installed on the aircraft as government furnished equipment (GFE) will be separately marked and/or identified in their associated logbooks as to warranty status, expiration date, and contract number. Contractor furnished equipment (CFE) provided for use on the end item (aircraft/engines) will assume the warranty of the end item. Prime contractor furnished production spares (interim spares) will assume the warranty of the end item (aircraft/engines) on which it is installed. Initial/replenishment spares will be individually marked.

(4) Contracts containing warranties will include terms and conditions permitting Navy organic repair of defective exhibits, when organic repair capability exists during the warranty period, without voiding the warranty. Organic repair will be allowed without mandatory contractor witnessing. The contractor may witness retrogrades and their repair if it can be accomplished without interfering with the fleet's mission and operations. Additionally, in order to resolve disputes, it may be in the government's interest to make special arrangements for the contractor to witness a repair.

3. Fleet Reporting.

a. When failure of equipments is detected at O and I level, fleet personnel will continue to use the MAF to record the failure and repair actions, with some additional information recorded if the equipment is under warranty.

b. The equipment will follow the exisiting processing procedures as any equipment does, warranted or not warranted. The Master Repairable Index List (MRIL) provides shipping instructions and the Individual Component Repair List (ICRL) details I level repair capability. The APML will ensure that any special warranty processing procedures will be provided in these documents and any other documents such as the maintenance plan or the warranty implementation plan as appropriate.

c. If the equipment is forwarded to organic depot level for repair, the 3-M data will be updated via the Depot Management Data System (DMDS).

d. The 3-M data, whether it be through the MAF or DMDS, is sent to NAMSO on a monthly basis. The data includes the maintenance actions that occurred between the first and last day of the month before.

e. Until organic depot level reporting changes are made, organic depots will continue to use the QDR for reporting warranted equipment failures that are first detected at depot level.

4. Navy Warranty Status Report

a. NAMSO

(1) Upon receipt of the 3-M and DMDS data, NAMSO prepares the NAWPR. This report is used for notification of O and I Level warranty equipment failures and provides organic repair data which is used for remedy negotiations. The report is sent monthly to each affected PCO/representative who is administering a warranty with the Navy. The report is sent within 60 days of receipt of the data at NAMSO. Hence all contracts must have a minimum of 90 day notification period.

(2) The report consists of four parts. The first part contains the initial maintenance action and will be used for warranty breach notification. The second part provides status for those equipments forwarded to a higher maintenance level for repair action. The third part provides data on I level organic repair actions and a summary of the removal/repair hours and parts/materials used. The fourth part provides data on depot level organic repair actions delineating repair hours and parts/materials used. The third and forth parts are used for remedy negotiation. The NAWPR will provide an individual data page for each reported maintenance action. Because organic depots can update MAF data via the DMDS, but cannot originate MAF forms, repair of warranted equipments whose failure is first detected at the depot will be reported by the QDR or information QDR (and hence will not be reflected in the NAWPR).

(3) Failure data on warranted equipment that is reported at O or I level and repaired at I level will be included in parts 1, 2, and 3 of the NAWPR. Failure data on warranted equipment reported by O or I level and repaired at organic depot facilities will be included in parts 1, 2, and 4. Failure data on warranted equipment where the equipment is returned to the CCF will be included in parts 1 and 2. When items that fail under warranty are reported and repaired during the same reporting period, the warranty failure and organic repair data will be provided in parts 1 and 3 or 4.

(4) A part five to the NAWPR is being developed. This part will provide close-out actions/remedies provided for each failure reported in the previous parts.

b. CAS/PCO/CCF Actions and Responsibilities

(1) The CAS will continue to use the QDR to report failures of received GFE under warranty.

(2) The responsibility of the PCO/representative is to administer the warranty. The NAWPR provides the PCO/duly authorized representative with the fleet warranty failure and repair data necessary to negotiate remedies. The PCO/duly authorized representative should forward the report to the contractor in order to fulfill the requirement of notification and repair data submittal, and negotiate in a timely manner the remedy per the terms and conditions of the contract.

(3) There are several possible contract responses that may result from claim submittal. They include:

(a) Agreement with Navy Status Report Claim: If the equipment is returned to the CCF the item will be repaired or replaced, and returned per the terms of the contract, or if the equipment is organically repaired the PCO/duly authorized representative will obtain a remedy per the contract.

(b) Disagreement with the Navy Warranty Status Report Claim: If the contractor does not agree with the organic repair claim and the PCO/duly authorized representative disagrees with the contractor, the PCO/duly authorized representative should invoke the disputes clause of the contract, or if the PCO/duly authorized representative agrees that it is not a warranty failure, no action will result.

c. Assumptions. The contract supports the above warranty administration system. Necessary elements of the warranty are:

(1) Organic repair is allowed without voiding the warranty and without mandatory contractor witnessing.

(2) NAWPR, MAF, QDR, and PCO/ACO letters are all acceptable methods of notification and claims.

(3) The contractor is required to provide a warranty status report. The recommended Data Item Description is DI-A-1025 and the requirement must be established in the Contract Data Requirements List package.

(4) Marking is required such that all the necessary information is easily available to the user for proper warranty documentation.

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(202) 692-7153

GSE

R. RITTER

AIR-55213G

(202) 692-3044

SHIP AND SHORE INSTALLATION EQUIPMENT

J. PETTY

AIR-5514F

(202) 692-2154

SUBSYSTEMS EQUIPMENT

D. ST. JEAN

AIR-53031

(202) 692-3646

STRUCTURES

M. ECHERT

AIR-5302B

(202) 692-3595

PROPULSION AUXILIARY EQUIPMENT

M. WITTMANN

AIR-5353

(202) 692-2553

ELECTRICAL POWER SYSTEMS

M. WITTMANN

AIR-5353

(202) 692-2553

MINESWEEPERS

K. HAAS

APC-210C1

(202) 692-7697

CREW SYSTEMS

C. BENTLEY

AIR-5311B

(202) 692-3691

(See NAVAIRNOTE 4855 of 17 May 89)

WARRANTY APPLICATION CHECKLIST

An acceptable warranty will have "yes" checked in each block unless the item is not acceptable. All "no" answers must be accompanied with an explanation. All questions must be answered and guidance followed. If not, state rationale.

(The following questions are provided to guide the developer of the warranty to include the necessary provisions in the warranty.)

	YES	NO
1. Does the warranty clause specifically address the following:		
a. Adequately defined essential performance?	___	___
b. Conformance to specifications?	___	___
c. Defects in material and workmanship?	___	___
2. a. Is the duration of the warranty clearly defined (i.e., date, hours, cycles, etc.)?	___	___

(NOTE: The duration of the warranty should be based on the type of equipment, designed use, operational environment, and other information. The duration of the warranty should be a minimum of one year in service where in service time begins with the Government acceptance of the aircraft. For GFE, the duration of the warranty should be equal to a minimum of one year plus the installation lead time from Government acceptance of the GFE item until Government acceptance of the end item (i.e. aircraft) in which it is installed. Shelf time and storage warranty time must be specified as appropriate.)

b. Is the duration of the warranty sufficient enough to assess essential performance requirements in service but not less than one year in service?	___	___
3. a. Does the warranty clearly define the method of warranty breach notification?	___	___

(NOTE: QDR, Aircraft Discrepancy Report (ADR), Visual Information Display System (VIDS)/MAF, Navy Aviation Warranty Program Report (aviation 3-M data report), and letter from the PCO or PCO designated representative are all required to be included in the warranty as notification methods. However the VIDS/MAF and aviation 3-M data report notification is only applicable to equipment covered by OPNAVINST 4790.2D.)

b: Does the notification period allow at least 6 months? ___ ___

4: Does the warranty present a clearly defined remedy for breaches? ___ ___

(NOTE: Redesign and retrofit of in-warranty items must be included as part of the remedy: Remedies for material and workmanship failure must be provided 100% of the time as they occur:)

5: a: Does the warranty allow organic repair without voiding the warranty? ___ ___

(NOTE: If these capabilities will not exist for the duration of the warranty period, enter not applicable: The warranty is not the driver for the maintenance philosophy and will not interfere with expeditious repair needs:)

b: Are remedies for item 5a repairs provided without the requirement for contractor witnessing? ___ ___

(NOTE: Contractor witnessing on a case by case basis is acceptable when special situations arise resulting from disputes: Special situations arise resulting from disputes: Special methods of contractor witnessing are allowed as long as they do not interfere with fleet's mission and operations: For example, if contractor representatives are on the repair site, that representative can be allowed to monitor incoming warranted items, witness failure and/or repair, and issue a report of his conclusions to the contractor with a copy to the Government: That information would be reflected in the contractor's status report and used during remedy negotiations/warranty board discussions:)

c: Is there a method for remedies for 5a included in the warranty? The following statement should be included in the warranty and replaces the part and labor credit statements in the previous checklist:

If the Government performs organic repair, the Government shall be entitled to an equitable adjustment or refund or the reasonable cost incurred to correct the deficiency: ___ ___

6: Marking Provisions

a: Are the marking requirements clearly stated in the warranty per MIL-STD-129 and MIL-STD-130? As a minimum the markings will be as follows:

(1) "WARRANTED ITEM" - Bold letters approximately two times larger than the letters for the remaining information: ___ ___

(2) Expiration of the warranty. ___ ___

(3) Contract number ___ ___

(4) Shipping instructions while under warranty if different from the MRIL ___ ___

b. Are all Weapons Replacement Assemblies (WRA) marked? ___ ___

(NOTE: For items with logbooks such as aircraft and engines, if the Miscellaneous History Records (e.g. OPNAV 4790/25A) of the logbook is marked per item 6a above, the contractor furnished WRA's procured as part of the aircraft need not be marked.)

c. Are the logbooks marked per item 6a above? ___ ___

d. Are the Assembly Service Records (ASR), Module Service Records (MSR), Equipment History Record (EHR), and Scheduled Removal Component (SRC) cards marked per item 6a above? ___ ___

e. Are containers marked per item 6a above? ___ ___

7. Do provisions exist that ensure that all unmarked contractor furnished items that comprise the basic item being procured will assume the warranty of the basic item? ___ ___

(NOTE: For example, contractor furnished aircraft equipment will assume the warranty of the aircraft; SRA's, e.g. circuit boards, will assume the warranty of WRA, e.g. avionics box.)

8. Are contractor furnished spares (interim spares) warranted? Are they marked per 6a above or is there a provision that allows them to assume the warranty of the basic item on which they will be installed? ___ ___

9. Does the warranty clearly define the transportation liability costs? ___ ___

10. Does the warranty clearly define turnaround time? ___ ___

11. Is a CDRL for a contractor warranty status report included in the Procurement Request package? ___ ___

(NOTE: DI-A-1025 is the required reporting method: Addressees are to include the cognizant PCO, APML/LM, cognizant Program Manager, AIR-5162 and any other personnel deemed necessary to receive the report: Quarterly reporting is the required minimum: A provision is the warranty and a Form DD 1423 is required:)

12: Is the following provision included in the warranty? ___ ___

(NOTE: "When an item is required to be processed for a QDR investigation and a warranty claim, the contractor shall be required to fulfill both requirements: If a QDR investigation of a failed part delays warranty repairs, the contractor may submit a waiver to the PCO/ACO for the warranty turnaround time":)

13: If a warranty board is necessary, are the responsibilities clearly defined? ___ ___

(NOTE: A warranty board is set up to assess reliability status remedies, assess whether the warranty breach is material and workmanship or design related, address disputes, and determine actions required to assure proper control and administration of the warranty: The warranty board would be led by the PCO or designee and have the necessary representative from the CAS, Reliability and Maintainability, Quality, Engineering, Program Office, and cataract counterparts to resolve the issue at hand: Special case witnessing of organic repairs would be one such issue that could be discussed and setup: Meetings should be called as needed but at least every 6 months:)

(The following questions are provided to guide the developer of the warranty towards taking necessary warranty development and assessment steps:)

14: Is a generic warranty approach being used for the product line in question, and is the approach used with the appropriate tailoring? (Contact the appropriate subgroup leader:) ___ ___

15: Has a cost benefit analysis been performed and placed in the contract files? (Contact AIR-524 for guidance:) ___ ___

16: Does the PR include a warranty per clause FAR 46:7? ___ ___

17: Was the CAS contacted to discuss their concerns with administration of the warranty and have those concerns been addressed in the warranty? Will the CAS have copy of the warranty? ___ ___

18: a: Is a failure-free warranty avoided? ___ ___

(NOTE: Remedies must always be obtained for all material and workmanship failures: Then to avoid a failure-free warranty; remedies for other types of failures should be obtained only for those above what is expected:)

b: Are reliability factors used to avoid failure free warranties? Is removal rate used for avionics when Built-In-Test (BIT) is an integral part of the design? ___ ___

19: Is appropriate and sufficient authority delegated to the PCO's duly authorized representative in the warranty provisions? ___ ___

20: Is the special fleet administration system for the subject product compatible with the warranty provisions? (Fleet warranty administration procedures are delineated in OPNAVINST 4790:2 or OPNAVINST 8600:2:) ___ ___

21: a: Does the warranty avoid unnecessary logistical fleet burden? ___ ___

b: Has the existence of the warranty and necessary fleet/logistics information been properly documented in the ICRL, MRIL, maintenance manuals, logbooks, or all other appropriate documents? ___ ___

22: Are there any special warranty administration instructions required for fleet activities? Have they been issued? (Deviations from OPNAVINST's 4790:2D and 8600:2 must have CNO approval prior to release with AIR-5162 and AIR-41112 concurrence:) ___ ___

23: Has the initial/replenishment spares procuring agency's warranty point of contact or item manager been provided with a copy of the warranty and have they been contacted to resolve any concerns/problems for future spare buys? ___ ___

(NOTE: For ASO, the point of contact is Mr: Oscar Wilsker, EFE-3-1, (Commercial 215-697-2055:)

24: Is the contractor required to have the CAS present upon receipt of the warranted item? ___ ___

25: Does a warranty implementation plan exist or is it being developed? ___ ___

26. Is the warranty concept included in the Maintenance Plan? ___ ___

27. COMMENTS:

28:a: SIGNATURE 28:b: DATE

PROGRAM/ACQUISITION MANAGER

(EXAMPLE 2)
NAVY'S SAMPLE WARRANTY

ENGINE WARRANTY

A. Definitions. The following terms shall have the following meanings when used in this warranty provision.

1. **Acceptance.** Execution of the acceptance block and signing of DD Form 250, Material Inspection and Receiving Report, by an authorized Government representative.

2. **Flight Hours.** A flight hour of an engine shall be deemed to begin when the aircraft in which an engine is installed first moves forward for a take-off run that results in airborne flight and to end when the aircraft is on the surface after such airborne flight. Such time shall be calculated per OPNAVINST 3710.7K-1010.

3. **Total Accumulated Cycles (TAC):**

$$TAC = LCFC + \frac{FTC}{4} + \frac{PTC}{40}$$

LCFC - Low Cycle Fatigue Cycle: Off - Int and above - Off as measured by the Engine Monitoring System (EMS).

FTC - Full Throttle Cycle: Idle - Int and above - Idle as measured by the EMS.

PTC - Partial Throttle Cycle: Cruise - Int and above - Cruise as measured by the EMS.

4. **Foreign Object Damage (FOD).** Damage to an engine resulting from ingestion of material not installed within the engine.

5. **Hot Parts:**
(list)

6. **Cold Parts:**
(list)

7. **Surge.** A response of the entire engine, which is characterized by a stoppage or flow reversal in the compression system. A nonrecoverable surge is a surge that requires the engine be shut down and restarted to restore satisfactory operation.

8. **Engine Operating Hours:** Total engine operating time as determined by the Engine Monitoring System Computer (EMSC).

9. **Design Deficiency:** Failure to comply with applicable specifications, even though material and manufacture is in accordance with pertinent drawings and referenced documents.

10. **Engine** - (list specific model)

B. Warranty. THE WARRANTIES EXPRESSED HEREIN ARE IN LIEU OF ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Notwithstanding inspection and acceptance by the Government or any other provision of this contract concerning the conclusiveness thereof, the contractor warrants that:

1. At the time of acceptance, each engine tendered for delivery under this contract shall be free from defects in material and workmanship, including those stemming from nonconformance to the drawings depicting the parts set forth in the then current approved engine parts list for that engine. This warranty will not apply to a particular breach unless the Contractor is notified of it within (_ _) after acceptance, within (_ _) flight hours or within (_ _) engine operating hours, whichever first occurs.

2. Each engine tendered for delivery and accepted under this contract shall meet the following requirements of the engine model specification for (_ _) flight hours, (_ _) engine operating hours or 1 year after acceptance, whichever first occurs.

(a) Thrust and specific fuel consumption as specified in tables I and II of the engine model specification.

(b) Afterburner light-off and operation as specified in the _ _ engine model specification.

(c) Engine acceleration and deceleration times as specified in the _ _ engine model specification.

(d) Altitude starting as specified in the engine model specification.

3. Each engine tendered for delivery and accepted under this contract will operate for a period of years or _ _ TACs after acceptance, whichever first occurs, without any hot section part experiencing failure or requiring repair or replacement.

4. Each engine tendered for delivery and accepted under this contract will operate (a) for a period of _ years or _ _ TACs after acceptance, whichever first occurs, without any cold section part requiring repair and (b) for a period of years or TAC after acceptance, whichever first occurs, without any cold section part experiencing failure or requiring replacement.

5. Each engine tendered for delivery and accepted under this contract shall operate without experiencing a nonrecoverable engine surge (exclusive of surges caused by hardware failure or operation at sub-idle core speeds), as determined by an engine monitoring system, and without experiencing a discernable power loss due to engine surge for a period of years of TACs after acceptance whichever first occurs.

C. **Notification of Breach.**

1. Any paragraph B warranty will be enforceable only if the Contractor is notified of a breach of such warranty within the period specified for that warranty.

2. Such notification will be accomplished by (a) PCO letter or (b) a Quality Deficiency Report, which reports an engine infirmity that is subsequently determined to constitute a paragraph B warranty breach.

D. Government Rights:

1. The Government's rights under this contract, because of latent defects, fraud, or such gross mistakes as amount to fraud, are not limited by this clause.

2. For any breach of a paragraph B warranty, with respect to which timely notification is made in accordance with paragraph C, the Government shall be entitled to:

(a) Require the Contractor, at no increase in contract price, to accomplish all applicable remedies in accordance with paragraph E.

(b) Receive a credit computed in accordance with Paragraph D for any remedy or portion thereof accomplished by the Government.

(c) Compensation if the Government foregoes the exercise of its rights. Such compensation shall be equitable under the circumstances and shall be arrived at in accordance with the procedures applicable to change orders decreasing work required of a contractor. Such amount shall be applied to the total of the prices of the engines remaining to be accepted under this contract (if such total is as great as the reduction) or be paid to the US Treasury (if such total is not as great as the reduction).

3. All paragraph B warranties shall continue to apply to any engine (or portion of an engine) upon which a correction is made, except that all the warranty periods applying to that supply shall be shortened to the balance of such periods remaining at the time the Contractor receives each notification of a breach with respect to such supply.

E. Remedies.

1. For each paragraph B.1 warranty breach, the Contractor shall provide all replacement parts required to eliminate the cause of the breach.

2. For each paragraph B.2 warranty breach that will adversely affect the operability or readiness of the engine involved and that the PCO determines was caused by a design deficiency, the Contractor shall provide (a) all engineering and hardware necessary to complete a redesign that will eliminate the cause of breach, (b) engineering and redesign hardware support for development and qualification testing of the redesign, (c) all parts and labor necessary to incorporate the redesign in each engine for which there is a paragraph B.2 warranty breach and (d) technical data revisions occasioned by the redesign.

3. For each paragraph B.3 warranty breach, the Contractor shall provide all replacement parts required to eliminate the breach. If repeated paragraph B.3 warranty breaches show any hot section part to have a B10 life without repair of less than __ TAC, the Contractor shall, in addition, provide (a) all engineering and hardware necessary to complete a redesign that will achieve a life without repair of __ TAC and (b) engineering and redesign hardware support for development and qualification testing of the redesign. Further, if repeated paragraph B.3 warranty breaches show any hot section part to have a B10 life without repair of less than __ TAC, the Contractor shall also provide (a) all parts and labor necessary to incorporate the redesign in each engine for which there is a paragraph B.3 warranty breach and (b) techical data revisions occasioned by the redesign.

4. For each paragraph B.4 warranty breach, the Contractor shall provide all replacement parts required to eliminate the breach. If repeated paragraph B.3 warranty breaches show any cold section part to have a B 0.1 life without repair of less that __ TAC or a B 0.1 life with repair of less than __ TAC, the Contractor shall, in addition, provide (a) all engineering and hardware necessary to complete a redesign that will achieve a B 0.1 life without repair of __ TAC, and a B 0.1 life with repair of __ TAC and (b) engineering and redesign hardware support for development and qualification testing of the redesign. Further, if repeated paragraph B.4 warranty breaches show any cold section part to have a B 0.1 life without repair of less than __ TAC or a B 0.1 life with repair of less than __ TAC, the Contractor shall also provide (a) all parts and labor necessary to incorporate the redesign in each engine for which there is a paragraph B.4 warranty breach and (b) technical data revision occasioned by the redesign.

5. For each paragraph B.5 warranty breach that will adversely affect the operability or readiness of the engine involved and that the PCO determines was caused by a design deficiency, the Contractor shall provide (a) all engineering and hardware necessary to complete a redesign that will eliminate that breach, (b) engineering and redesign hardware support for development and qualification testing of the redesign, (c) all parts and labor necessary to incorporate the redesign in each engine for which there is a paragraph B.5 warranty breach, and (d) technical data revisions occasioned by the redesign.

6. All development and qualification testing of any paragraph E.2, E.3, E.4 or E.5 redesign will be funded or conducted by the Government and ...

Government will provide necessary engines for such testing.

7. If the Government performs all or any portion of any correction, the Government shall receive a credit for its work. If the total of the prices of supplies - other than provisioned items - remaining to be delivered under this contract is greater than the credit due the Government, such prices shall be reduced by the amount of the credit. If the credit is larger than such total, the Contractor will pay the amount of the credit to the US Treasury. The credit will be computed as follows:

(a) For repair or parts replacement

(i) A part credit for each part that the Government replaces, which shall be the most recent contractually agreed to price for a like part existing at the time the part is replaced; provided, however, that if a price for such part has not been contractually agreed to within a twelve (12) month period prior to the time the part is corrected or replaced, then the ACO and the Contractor shall promptly establish a price for such part, plus,

(ii) A labor credit, which shall be fully burdened hourly wage rate at the Government repair facility, as that rate is identified in the then current Budget, times the number of standard labor hours for making the correction. The labor hours will include those for disassembly, repair, parts replacement, reassembly, inspection, and test required to remedy the breach.

(b) For other corrections, the credit will be as determined by the PCO and shall be equitable and representative of the actual cost to the Government.

8. Any replacement or redesigned parts required to be provided by the Contractor to correct any paragraph B warranty breach shall be provided within __ days after direction by the PCO. Any incorporation of redesigned parts shall be completed by the Contractor within __ days after delivery of the engine to the Contractor's plant with PCO direction to incorporate. If the Contractor fails to meet any such requirement, liquidated damages are hereby established according to paragraph (f) of the "Default" clause appearing at DAR 7-105.5 as follows:

(a) For each engine, __ per calendar day but not to exceed __

(b) For each part or component of an engine, __ per calendar day but not to exceed __

9. The Contractor shall, notwithstanding any disagreement regarding the existence of a breach, comply with directions to correct that breach. If, after the Contractor undertakes correction, it is determined that a breach of a paragraph B warranty did not occur, the price and other affected provisions of this contract will be equitably adjusted in accordance with the procedures provided in the "Changes" clause to compensate the Contractor for any actions taken pursuant to this provision.

10. The Government will bear the cost of transportation of those engines, or portions of engine, shipped to and from the Contractor's plant

F. Exceptions and Conditions.

1. The Government will service each engine in accordance with the prescribed maintenance manuals, and maintain operational and maintenance records, including engine monitoring system (EMS) data. In the event of EMS failure, other satisfactory proof of engine life usage may be substituted.

2. A paragraph B warranty shall not apply to an engine suffering damage caused solely by:

(a) Improper or negligent installation, operation, or maintenance by Government personnel.

(b) Foreign object damage;

(c) Combat damage, or

If the parties disagree as to whether damage arose solely from any of these causes, the Contractor shall have the burden of proving that the engine was damaged by that cause.

G. Government Unlimited Rights in Data. In recognition of the Government's substantial participation in the cost of effecting correction to breaches of paragraph B warranties in the operation of this clause, the parties agreed that no item, component, or process generated by redesign conducted under this clause will be deemed to have been developed at private expense and, as a result, the Government will have unlimited rights in all the revised portions of the technical data that is delivered in carrying out this clause.

H. Access to Maintenance and Operational Facilities.

1. The Contractor shall be notified of and at its election, may witness at the repair facility the disassembly or inspection of any engine contained or suspected of containing, a paragraph B warranty breach.

2. During the period of this warranty, and any extension thereof, the Contractor shall have reasonable access to existing Government records relating to operation, inspection, and maintenance of the engine at the place where such records are customarily maintained, and shall be entitled to copy and make copies, at its expense, of said records. The Contractor may also, from time to time, review pertinent maintenance and operational facilities.

I. Cost Tracking. The Contractor shall maintain a separate cost account, all costs that are asso-

with this clause. Such costs shall be segregated from any and all other costs associated with engines, tooling, provisioned items, or any other work, as well as from any costs associated with other contracts.

J. Risk of Loss.

1. The Contractor shall not be obligated, as a result of the application of this provision, to repair or replace any accepted engine, or portion thereof, which is later lost, destroyed, or damaged beyond feasible repair, regardless of whether (a) the engine, or portion therof, is in the possession of the Government or the Contractor at the time of such loss, destruction, or damage or (b) breach of a paragraph B warranty is the cause of such loss, destruction, or damage; provided, however, that the Contractor shall be obligated to perform such repair or replacement to the extent that such loss, destruction, or damage is occasioned by a risk that is in fact covered by insurance carried by the Contractor or for which the Contractor has established a reserve for self-insurance consistent with the usages of the aerospace industry.

2. Damage will be regarded as beyond feasible repair when either the time or cost to effect the repair would exceed 75 percent of the price of a new replacement engine.

3. The Contractor shall repair or replace any accepted engine, or portion therof, that is later damaged but not beyond feasible repair when such damage is caused by breach of a paragraph B warranty, regardless of whether the engine, or portion thereof, is in the possession of the Government or the Contractor at the time of such damage.

4. Nothing in this provision shall alter, vary, or affect any rights or obligations of the parties secured under other provisions of this contract.

K. Allowable Costs. (For Use in Fixed Price Incentive Contracts.) Unless otherwise provided, prior to the establishment of the total final price, all costs incurred, or to be incurred, by the Contractor in complying with this clause shall be considered as part of the total final negotiated cost under the incentive price revision clause. After the establishment of a firm fixed price or a total final price, Contractor compliance with this clause shall be at the Contractor's expense at no increase in the firm fixed price or total final price.

GENERAL SECTION

1. GENERAL

A. The purpose for this procedure is to provide instructions for the identification and processing of warranty claims.

B. The following two categories of parts are covered by this procedure.

1. New Engines and Modules.

2. Engine Parts (Piece parts).

C. All instructions provided herein are in accordance with United Airlines AOP's, and current Engine Warranty Contracts.

D. Warranty contracts are different for each OEM. A brief summary of each follows:

CFM 56-2/3 ENGINE PARTS.

- "New Engine" (see definitions): Parts up to 4k hrs.TSN are covered for scrap and rework.
- "Piece Part" (see definitions): Up to 2k hrs.TSN coverage is for scrap or rework.
  After 2k hrs. coverage is for SCRAP only.

CF6 ENGINE PARTS

- Up to 1K hrs.TSN. ALL parts are under warranty for scrap and rework.
- After 1k hrs. only ECL listed parts are covered, and then for SCRAP only.

ALL P&W ENGINE PARTS

- P&W parts that are under warranty are covered for both scrap and rework.

2. DEFINITIONS

A. New Engine - Any engine or module, whose Engine Total Time (ETT) or Time Since New (TSN) is less than the hours specified by the current contract for that Engine type. These hours are as follows:

PW4000 = 6,000 hrs.	901A APU = 2,500 hrs.
PW2000 = 7,000 hrs.	700 APU = 2,000 hrs.
CFM56-3= 4,000 hrs.	331 APU = 3,000 hrs.

B. Piece Parts - Parts specified by the OEM as being covered by warranty. They are listed on the ECL. These parts carry a warranty period separate from the "New Engine" warranty limits.

C. ECL - Engine Composition List - computer generated list of EPM tracked serialized parts. The list identifies whether a part is on Warranty and specifies Time Since New.

D. Engine Review Sheet - Sets up the initial work scope for an engine. Also communicates to inspection that this is a "New Engine". This sheet may be accessed via 'ENGRVW' in COSMO. A printed copy is on file for each module.

E. Work Request Sheet - Identifies work to be done to a module.

F. OEM - Original Equipment Manufacturer i.e., GE., Pratt & Whitney, Garrett etc,.

G. OSV - Outside Vendor - Any supplier of services or material to United Airlines. Includes OEM's.

H. RWKCMP - The Shop Floor Control computer transaction that is performed when rework operations have been completed.

I. Warranty Notice- Form used to report findings and conclusions, to the warranty department.

J. SERDIS - Display that shows the TSN and CSN of a serialized part.

3. ORGANIZATIONAL RESPONSIBILITIES:

A. SFOEP/WA

1. Application of "New Engine" (see definitions), warranty criteria will be made at the engine review meeting. If the engine is determined to be under warranty, the words "NEW ENGINE WARRANTY" will be entered at the BEGINNING of the comments field of the review sheet.

B. SFOPI - SUB-ASSEMBLY/STALLS/HOME SHOP.

1. Lead--Stamp "NEW ENGINE WARRANTY" on the WORK REQUEST sheet for each "New Engine" module.

NOTE: A "New Engine" warranty engine can be determined from the review sheet.

2. Complete full EID inspection requirements.

3. Determine if unservicable part is under warranty, by referring to either the ECL., SERDIS display, or is work request sheet stamped "NEW ENGINE WARRANTY",

NOTE: ALL parts from "New Engine" are under warranty. They do not have to be on the ECL.

4. Assign a 'WA' lot number tag to unservicable parts that have been identified as under warranty.

5. Complete and attach to the part the following.

A. If repairable---A completed JPC, the "Warranty notice" (Part "A" MUST BE COMPLETED), and a "WA" lot number tag.

B. If scrap---A completed HOOS tag (noting warranty), the "Warranty Notice" (Part "A" MUST BE COMPLETED) and a "WA" lot number tag.

6. Sub assembly or stalls MUST initiate "Warranty Notice".
Person accomplishing preliminary inspection must complete the "Warranty Notice".

7. Route to E42-01-WA for review by vendor rep.

8. NOTE:-If a Warranty covered part has mistakenly had a regular lot #. assigned. Request the PB planner to kill the original lot number, and initiate a new "WA" lot number.

9. If part serviceability is to be determined by the home shop inspection the TSN, & CSN of the part and engine can be obtained by using "SERDIS" AND "ENGRVW". This information MUST be entered on the warranty notice.

D SFOPB

1. Initiate the lot into SFC using the assigned "WA" lot number.

E. E42-01-WA

1. Hold parts in review area and notify vendor reps.

2. After review: Remove part from review area and route as required.

3. Send "WARRANTY NOTICE" to OSV-00-WA.

F. VENDOR REPRESENTATIVE

1. Within 24 hours of notification, review part in E42-01-WA review area and agree/disagree with PI findings and sign "WARRANTY NOTICE".

G. SFODC

1. If the vendor rep. disagrees with PI findings negotiate solution. At CONCLUSION have part routed per JPC.

H. OSV-00-WA

1. On Reworked Parts:--When the "WARRANTY NOTICE" is received file it in the "IN REWORK" file. When the "RWKCMP" report is received match it with the "WARRANTY NOTICE" previously filed. Determine the amount of labor, including OSV charges if applicable, and file the claim in the usual manner.
2. On Scrapped Parts:--Claim is filed upon receiving the "WARRANTY NOTICE".

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