NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA

THESIS

COMMERCIAL TECHNOLOGY
FOR
AVIATION CONFIGURATION MANAGEMENT

by

P. Scott White

June, 1997

Thesis Co-Advisors: Donald Eaton
                             William Haga

Approved for public release; distribution is unlimited.

DTIC QUALITY INSPECTED 3

19971121 036

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE June 1997	3. REPORT TYPE AND DATES COVERED Master's Thesis	
4. TITLE AND SUBTITLE COMMERCIAL TECHNOLOGY FOR AVIATION CONFIGURATION MANAGEMENT		5. FUNDING NUMBERS	
6. AUTHOR White, P. Scott			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey CA 93943-5000		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.			
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.		12b. DISTRIBUTION CODE	

13. ABSTRACT *(maximum 200 words)*

This thesis examines the current policy and procedures used to manage naval aviation configuration control. It recommends that the Navy consult with SABRE Decision Technologies, or a company with a similar background, to re-engineer the process for approving configuration changes and create an information technology system to manage the process.

During this study, I have identified two major challenges to naval aviation configuration policy. They are: (1) the process used to review and approve Engineering Change Proposals (ECPs) is too complex and has too many stakeholders and (2) the current method for management of approved configuration changes is man-hour intensive, has potential for administrative error, and requires physical inspection to positively verify aircraft and equipment configurations.

Finally, this study presents the theory that there are many common requirements between naval aviation maintenance and commercial airline maintenance. We should take advantage of the experience and technological innovations of industry and use them to make our configuration policy, and our entire maintenance effort, more effective for the users in the fleet.

14. SUBJECT TERMS Aviation, Configuration Management, Engineering Change Proposal, ECP, SABRE Decision Technologies, Information Technology, IT, Decision Support System, DSS.			15. NUMBER OF PAGES 79
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18 298-102

COMMERCIAL TECHNOLOGY
FOR
AVIATION CONFIGURATION MANAGEMENT

P. Scott White

Lieutenant Commander, United States Navy

B.S., Virginia Military Institute, 1982

Submitted in partial fulfillment
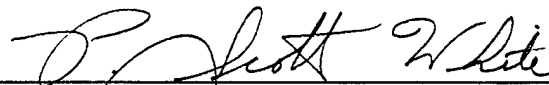
of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
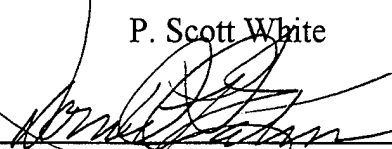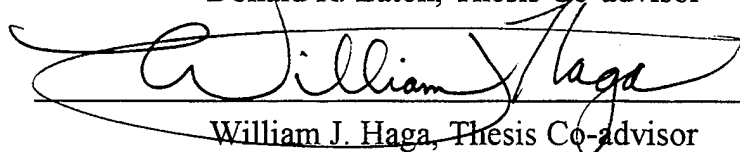### June 1997

Author: _____

P. Scott White

Approved by: _____

Donald R. Eaton, Thesis Co-advisor

_____

William J. Haga, Thesis Co-advisor

_____

Reuben T. Harris, Chairman,

Department of Systems Management

iii

DTIC QUALITY INSPECTED 8

ABSTRACT

This thesis examines the current policy and procedures used to manage naval aviation configuration control. It recommends that the Navy consult with SABRE Decision Technologies, or a company with a similar background, to re-engineer the process for approving configuration changes and create an information technology system to manage the process.

During this study, I have identified two major challenges to naval aviation configuration policy. They are: (1) the process used to review and approve Engineering Change Proposals (ECPs) is too complex and has too many stakeholders and (2) the current method for management of approved configuration changes is man-hour intensive, has potential for administrative error, and requires physical inspection to positively verify aircraft and equipment configurations.

Finally, this study presents the theory that there are many common requirements between naval aviation maintenance and commercial airline maintenance. We should take advantage of the experience and technological innovations of industry and use them to make our configuration policy, and our entire maintenance effort, more effective for the users in the fleet.

TABLE OF CONTENTS

ACKNOWLEDGMENT

I. INTRODUCTION

A. BACKGROUND

As aviation technology becomes more complex, the Navy must find new ways to meet the challenge of controlling the many different operating configurations of aircraft, avionics systems and maintenance support equipment found in the fleet. For example, in the F/A-18 A/B/C/D aircraft, there are 21 production lots of aircraft. [Ref. 1] By definition, every production lot of F/A-18 aircraft will have a different configuration. Added to this problem is the fact that there are concurrent upgrades to the avionics systems and computer software while the aircraft are in production and after they have been purchased by the government. Therefore, in the case of the F/A-18, every production aircraft may have a slightly different configuration depending on which lot it was produced in and the changes/modifications that have been incorporated into that particular aircraft.

The Navy's Aviation System Configuration Management Policy is governed by the Naval Air Systems Command (NAVAIR) Instruction 4130.1C. By NAVAIR's definition,

> Configuration management is the discipline involving technical and administrative direction and surveillance for:
> a. Identifying and documenting the functional and physical characteristics of a configuration item.
> b. Auditing configuration items and their related documentation to verify conformance to specifications, interface control documents ...(compatibility requirements)..., and other contractual requirements.
> c. Controlling changes to configuration items and their related documentation.
> d. Recording and reporting information which is essential for managing configuration items effectively, including the status of all proposed and approved changes. [Ref. 2: p. 2]

1

A configuration item is any "aggregation of hardware/software, or any of its discrete components, which satisfies an end use function and is designated by the Government for configuration management." [Ref. 2:p. A-1] The current configuration item change process requires that all proposed changes, known as Engineering Change Proposals (ECP), Rapid Action Minor Engineering Changes (RAMEC), or requests for major/critical deviation and waivers affecting configuration items be submitted to the NAVAIR Change Control Board (CCB) for approval.

At times, ECPs involve critical safety of flight issues and can be hand carried to the chairmen and the four voting members of the CCB for authorization and approval. [Ref. 2:p. 6-7,8] However, the normal procedure requires the proposed changes to pass through a ten step process that includes staffing the change through, at a minimum, seven different competencies and the program office before a decision is made to forward the proposal to the CCB. If the proposal is forwarded, it is assembled into a package that for a Class I ECP, as defined by MIL-STD-480B, can contain up to twelve separate forms. The proposed change then goes before the CCB for final approval. [Ref. 2:p. 6-7] Once the proposed change is approved by the CCB, the ECP becomes a directive from COMNAVAIR to the office of primary responsibility (usually the Program Office), all affected NAVAIR codes and the fleet. [Ref. 2:p. 6-9]

As would be expected, any change to an aviation configuration item has the potential to affect the designed performance of the system. This could lead to disastrous consequences in the demanding flight environment of Naval Aviation. For this reason, the ECP process is subject to close scrutiny by the chairman and voting members of the Change Control Board.

Membership on the NAVAIR Change Control Board will consist of experienced, qualified representatives from configuration management, systems engineering, production management, logistics support, contracts, aviation training, and other areas as may be required. [Ref. 2:p. 5-8]

The process requires extensive coordination between the program office and the competencies of the voting members and support staffs at NAVAIR that were described above. Under the current process, the average ECP takes 128 days to be approved. [Ref. 3] After approval, there is still a high level of coordination required to make the approved changes in the fleet and document the new change to the previous configuration. According to Captain Steve Heilman, Director of Naval Aviation Maintenance Programs and Policy, "current estimates suggest that it takes an average of twelve years for an approved Depot-level TDC mod kit to be installed in every target BuNo"(aircraft). [Ref. 4:p. 2] Clearly, there is still much work to be done even after the change is approved. Additionally, until every system affected by the change has been modified, there will be systems in the fleet that have different configurations.

Once the change has been approved, the Program Manager (PM), or in some cases the contractor, is responsible to develop the configuration management plan which will define the configuration item and procedures for configuration management application, tailoring, tasks, participants and their roles. [Ref. 2:p. 2-1] In short, the PM must develop the plan and manage the implementation of the change throughout the life cycle of the configuration item.

Managing the administrative processing and actual incorporation of ECPs presents a challenge to Naval Aviation. The Naval Aviation Logistics Command Information System (NALCOMIS) was developed to assist in this effort but according to a representative from the

3

F/A-18 Program Office [Ref. 5] and a fleet representative [Ref. 6], configuration management problems persist. These problems will be discussed in detail in Chapter III.

However, we are not alone. The commercial airline industry is faced with the same problems. According to Heizer and Render (1996), "For a complex product that has a long manufacturing cycle, such as a Boeing 747 jumbo jet, the changes may be so numerous that no two 747s are built exactly alike – which is indeed the case. [Ref. 7:p. 228]

Several commercial airlines including American, Northwest, Canadian, and Cathay Pacific use an information technology (IT) product developed by SABRE Decision Technologies to control their aircraft configurations and maintenance records. It may be possible for the Navy to use a similar system to manage our configuration control process.

B. METHODOLOGY

Data have been gathered for this study from current Navy instructions, Navy maintenance manuals, newspaper and magazine articles, textbooks, and classroom lectures. Additionally, the F/A-18 Program Office has provided data on the ECP process and problems associated with implementing ECPs, the draft requirements document that describes requirements for a proposed Automated Maintenance Environment (AME), and various instructions and memos regarding configuration management. A representative from Commander, Naval Air Force, Pacific Fleet (COMNAVAIRPAC) has provided more data on current issues and problems with configuration management and other data has been gathered from searches conducted on the worldwide web

Also, personnel from the SABRE Decision Technologies have assisted me with the collection of various forms of data concerning their configuration management system, its'

4

operation, and benefits and costs of using IT to perform configuration management. Additionally, they provided answers to my specific questions via telephone or e-mail. SABRE also visited with the students and faculty at the Naval Postgraduate School on 6 February, 1997 to discuss the capabilities of the CM system.

Finally, a representative from the RAND National Defense Research Institute made data available on Electronic Data Interchange (EDI) and discussed process re-engineering as it relates to organizations plans to adopt any new IT system to manage complex processes.

The data will be used to define the Navy's Configuration Management process, identify problems with the current process and identify requirements for future configuration management systems. For this study, I have identified an information system developed by SABRE Decision Technologies for Aircraft Configuration Management. The system is used by the commercial airlines to maintain their aircraft configuration control.

I intend to study SABRE's Configuration Management system and make recommendations regarding its' utility to the Navy for managing our configuration control policy.

II. NAVY CONFIGURATION MANAGEMENT

A. CURRENT PROCESS

The Navy's current configuration management policy is a top level process managed by the NAVAIRSYSCOM. NAVAIR sets the policy, governs the operation of all Change Control Boards (CCBs), and approves/disapproves all configuration management plans. [Ref. 2:p. 2-3] Additionally, NAVAIR delegates authority to the Office of Primary Responsibility, usually the Program Offices, to provide configuration management of assigned configuration items throughout their life cycle. [Ref. 2:p. 2]

The change approval process at NAVAIR is a 10 step process generally depicted in Figure 1. From the figure, it can be seen that the NAVAIR change process has five distinct phases. They are:

1. Proposed Change Receipt and Evaluation

2. Proposed Change Coordination & Formal Staffing

3. CCB Preparation, Approval & Direction

4. Implementation of Approved Change

5. Change Status

There are 10 steps in the change process that govern the processing of all changes brought before NAVAIR for approval.

STEP 1: The first step occurs when a change to a configuration item, proposed by a contractor or government agency, is delivered to AIR-1006. The proposed change processing
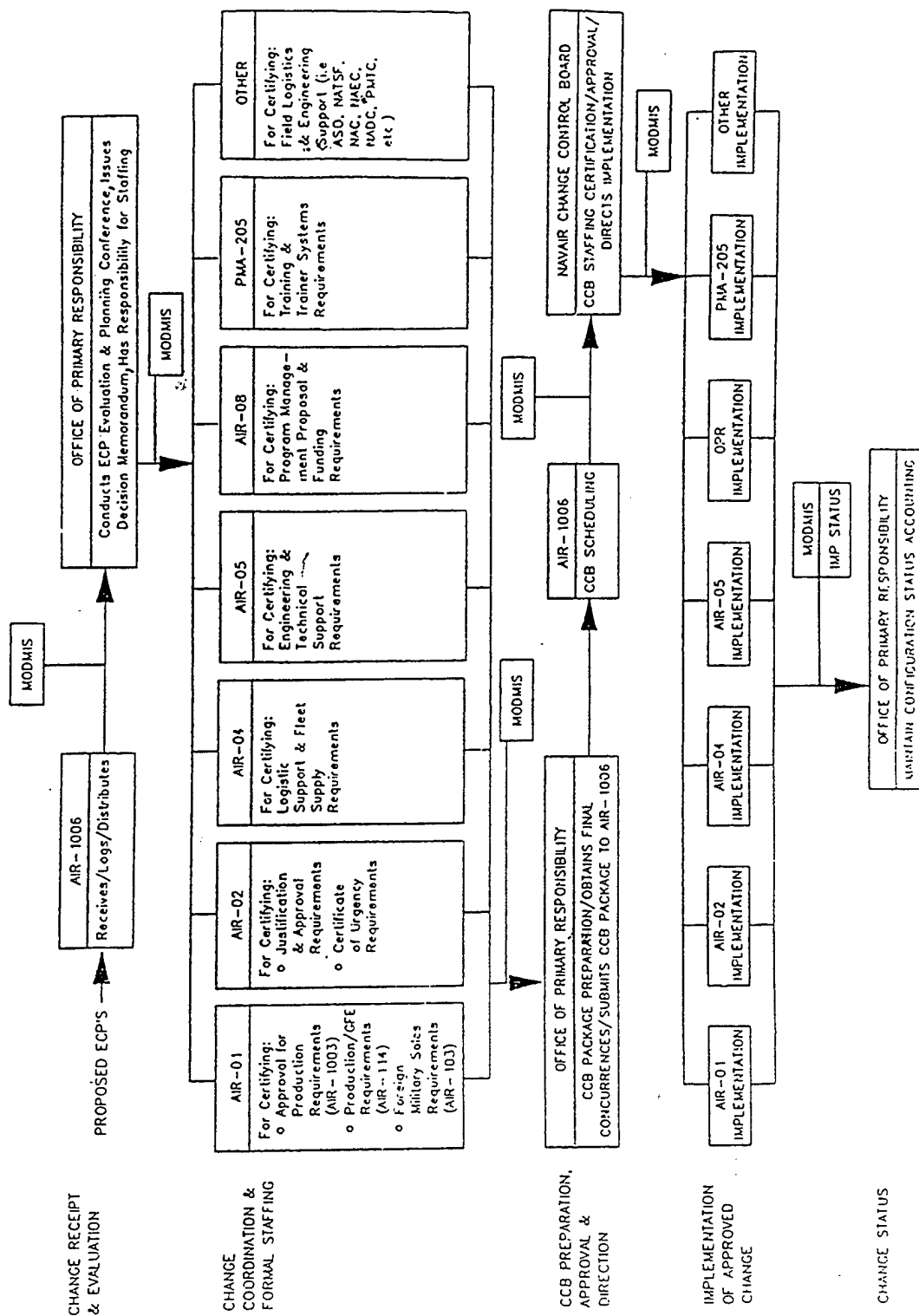
Figure 1. ECP Process at NAVAIRSYSCOM From Ref. [2].

8

information is entered in the Modification Management Information System (MODMIS) where

the proposed change is assigned a tracking number that is used to determine status.

[Ref. 2: p. 6-1]

STEP 2: After the proposed change is logged into the MODMIS tracking system, it is

forwarded to the Office of Primary Responsibility for action.

STEP 3: The Office of Primary Responsibility has responsibility for staffing the proposed

change through all appropriate competencies. Then the Office of Primary Responsibility conducts

an ECP Evaluation and Planning Conference and makes the decision on whether or not to

proceed with the proposed change. The Evaluation and Planning Conference will include, as a

minimum, representatives from the following functional areas; AIR-02(Contracts),

AIR-04(Logistics), AIR-05 (Engineering), AIR-1003(Automated Systems Analysis),

AIR-114(Production Management), and PMA-205(Aviation Training Systems Program Office).

Others may attend if required. [Ref. 2:p. 6-2]

STEP 4: Once the decision is made to process the proposed change, the Office of Primary

Responsibility issues a Decision Memorandum to AIR-1006, AIR-02, AIR-1003,

AIR-08P(Budget), AIR-04, AIR-05, PMA-205 and all other concerned parties. A sample

Decision Memorandum is contained in Appendix A. Copies of the proposed ECP will be

forwarded with the Decision Memorandum. [Ref. 2:p. 6-3]

STEP 5: The Office of Primary Responsibility prepares the Change Control Board

package to be submitted to the NAVAIR CCB via AIR 1006. The contents of this package will

vary, depending on the type of change being requested. In the case of an ECP, up to 12 different

forms are required to prepare a complete CCB Change Package. A list of the forms required for the preparation of CCB change packages appears in Appendix B. [Ref. 2:p. 6-3, 6-4]

STEP 6: The NAVAIR competencies identified in STEP 4 provide their inputs to the Office of Primary Responsibility who compiles the inputs and presents the complete package to AIR-1006. [Ref. 2:p. 6-5, 6-6]

STEP 7: AIR-1006 verifies the CCB change package, updates the MODMIS, and schedules the proposed change for a formal CCB hearing. [Ref. 2:p. 6-6]

STEP 8 & 9: The NAVAIR Change Control Board meeting is held and the proposed change is approved/disapproved. [Ref. 2:p. 6-7]

STEP 10: After approval of the change, the Office of Primary Responsibility must notify the change originator and all implementing codes that the proposed change has been approved. Additionally, the Office of Primary Responsibility must ensure that all approved actions are carried out as directed by the CCB and maintain configuration status accounting of the weapons system modification process. [Ref. 2:p. 6-9, 6-10]

B. CHANGE INCORPORATION

Once the change has been approved, it is released to the fleet for incorporation and inclusion in applicable maintenance manuals and/or procedures. The change can be distributed via message or letter, depending on the urgency of the requirement for the change. An example of an Avionics Change (AVC) for the F/A-18 aircraft is contained in appendix C.

Using the F/A-18 AVC as an example, it can be seen that it contains:

1. Cognizant Codes and Points of Contact

2. Category of the Change

3. Documentation Affected

4. Purpose of the Change

5. Application (Affected Equipment/Trainers/Spares)

6. Compliance

7. Man-Hours Required

8. Supply Data

9. Reidentification

10. Detailed Instructions

11. Weight and Balance

12. Records Affected

13. Verified By

14. Rescission Date

15. Related Instructions/Information

An example of a maintenance publications change for the T58-GE-16 engine on the CH-46 is contained in Appendix D.

The F/A-18 message and the CH-46 publication change have similar formats. Both changes require that a Visual Identification System/Maintenance Action Form (VIDS/MAF) be submitted to document compliance with the technical directive. Additionally, the changes require a logbook entry in the technical directives section to document that the change has been incorporated.

C. CONFIGURATION STATUS ACCOUNTING

In addition to documenting changes to configuration items on VIDS/MAFs and updating the technical directive section of the logbook, a report describing the modification must be made to the Technical Directive Status Accounting (TDSA) Program. The TDSA "was developed to gather data on technical directive application and incorporation status as related to aircraft, engines, support equipment, maintenance trainers and serial numbered weapons system components." It is managed by the Naval Aviation Maintenance Office. [Ref. 2:p. 7-2]

III. CONFIGURATION MANAGEMENT PROBLEMS

A. BACKGROUND

As the technical complexity of new weapons systems increases, Naval Aviation is faced with an increasingly challenging task of managing configuration control. Ultimately, the consequences of failing to maintain accurate configuration control of assets will result in a degraded state of Operational Readiness. Specific examples of the effects on configuration control breakdowns are that:

1. Product documentation no longer reflects the characteristics of the actual products being procured because of unapproved/undocumented changes that were made after the design phase.

2. Logistics support data no longer corresponds to configuration items making it difficult for the fleet to properly maintain and operate the equipment.

3. Products are immobilized while corrected supporting documentation can be published.

4. Increased scrap, rework, and stock result. [Ref. 8:p. 3]

Configuration Management breakdowns also have significant affects on aviation support equipment in the fleet. Commander Mike Hardee, the Maintenance Officer at Commander, Naval Air Force, Pacific Fleet, described an example of a breakdown in configuration control of Automatic Test Equipment (ATE). Hardee (1996) noted that "for aircraft, components and rolling stock, much of the lack of configuration control is attributable to a loss of discipline on the part of engineering, logistics and maintenance personnel relative to the established processes." He states that "the problem with ATE's is that there is no formal process to track configuration

control." Therefore, each ATE custodian must contact the ATE's Cognizant Field Activity to determine if the ATE has the most current documentation/software. [Ref. 6:p. 1]

Finally, Hardee (1996) believes that the larger problem with our management of configuration control is that the Navy has demonstrated "...a failure to get information to user activities in a manner that is: timely (so that it stays abreast of configuration updates), comprehensive and accurate (so that it precludes maintenance malpractice) and controlled (so that it can be inventoried and accounted for)." The Navy's determination to provide the fleet with the most up to date equipment has overcome our ability to provide the necessary logistic support. These problems have caused disruptions in the logistics pipelines and have, in some cases, jeopardized the safety of personnel in the fleet. [Ref. 6:p.1]

The previous paragraphs give general examples of problems with configuration management. It can be seen that failure to maintain configuration control at the Systems Command level and in the fleet can result in serious consequences. Here are two specific examples where a breakdown in configuration management resulted in potentially life threatening situations.

B. AV-8B HARRIER EJECTION SEAT FIRING CONTROL HANDLE

On 1 March 1991, Aircrew Systems Change (ACC) No. 537 was issued for the T/AV-8B aircraft. The purpose of this change was to change the shape and the flexibility of the lower ejection handle for the ejection seat in the aircraft. A hazard had been identified where it was possible for the ejection control handle to become entangled with the control stick when the seat was in the full upright position. ACC 537 would eliminate the possibility of an inadvertent

ejection caused by interference with the control stick by reducing the circumference of the ejection control handle and making the ejection control handle material less flexible. [Ref. 9:p. 2]

This change should have corrected the hazard that was identified by the operators in the fleet. However, a breakdown in the configuration management process occurred which allowed the original handle to remain in the aircraft. In this case, the problem was not identified until 1996. Although the part numbers of the firing control handles were different, the National Stock Number (NSN) remained the same. Squadrons that thought they had complied with the ACC 537 may have been flying aircraft with the old firing control handle instead of the new one. Fortunately, this problem was identified by an alert maintenance technician who promptly informed his chain of command. A hazardous material report was released and the Systems Command and Type Commanders were notified of the problem. [Ref. 10]

Once the Naval Air Systems Command was informed of the problem, they developed a method to ensure that the handles were removed from the aircraft and purged from the supply system. The fleet was required to physically inspect every seat to verify that the correct handle had been installed. If the correct handle had not been installed, the fleet was directed to make the correct change to the seat using the redesigned handle. Additionally, the supply system was directed to screen all NSNs in the system and eliminate all of the original firing control handles. [Ref. 11]

After a complete physical inspection of the aircraft, 15 original handles were discovered. [Ref. 10] [Ref. 12] This action was completed five years after ACC 537 was originally issued.

C. F/A-18 POWER SUPPLY FOR AIR DATA COMPUTER

On 27 April 1993, Avionics Change (AVC) No. 4399 was released to provide instructions to F/A-18 Organizational (O-level) and Intermediate (I-level) maintenance activities to correct a problem with the Air Data Computer (ADC) in the aircraft. This change was designed "to reduce ADC power supply circuit noise that may induce aircraft to pitch up/down." [Ref. 13:p.1]

This change required O-level maintenance to remove the ADC from the aircraft for return it to I-level maintenance where it would be changed. The change would eliminate power transients that were thought to be causing the aircraft to pitch up/down when certain modes of the autopilot were being used. This potential for aircraft pitch up/down resulted in the following flight restrictions for all Lot XIII and below aircraft:

> Do not engage barometric altitude hold feature when:
> 1. Flying below 5000 ft
> 2. IMC flight
> 3. Formation flight [Ref. 14]

However, AVC 4399 contained erroneous maintenance procedures that were discovered after the change was issued. In order to correct discrepancies found in the original change, Interim Avionics Change (IAVC) No. 4242, Revision A was issued on 27 April 1993. IAVC 4242 corrected the erroneous procedures found in AVC 4399 and added a ferrite bead to the ADC power supply to contain noise that was generated by the electronics in the system. This bulletin was to be completed not later than 60 days after receipt of the directive. [Ref. 15]

Unfortunately, the problem with locating, identifying and modifying ADCs continued. On 6 July 1995, Avionics Bulletin (AVB) 512, Revision A was issued to "ensure correct installation of ferrite bead noise suppresser in ADC power supplies." [Ref. 16:p. 1] In August and September of 1995, Commander, Naval Air Force, Atlantic and Commander, Naval Air Force,

Pacific required their units to conduct physical inventories of all ADC assets to ensure that they had been updated in accordance with the bulletins. [Ref. 17:p.1] [Ref. 18:p.1] These procedures were initiated because the Type Commanders had concerns that "100 percent compliance had not been accomplished to date." [Ref. 19]

On 16 January 1996, AVB 512 was canceled by the Naval Aviation Depot at North Island. [Ref. 20] It was replaced with Avionics Bulletin (AVB) 561 on 18 January 1996. AVB 561 was issued "to ensure that all P/N 4031000-902 ADC power supplies have been replaced with P/N 4031003-915 power supplies." [Ref. 21:p. 1]

This is clearly an example of a breakdown in management's control over incorporation of a change to the ADC. In this case, management's lack of total asset visibility required multiple physical inspections to ascertain where the assets were located and to ensure that the required changes had been incorporated. Furthermore an additional requirement for the fleet to provide monthly reports were generated to track assets and verify change incorporation. [Ref. 17] [Ref. 18] According to the bulletins, the total time required for avionics technicians to complete the actions described in each of the above technical directives was approximately 13 hours (O and I-level labor) per computer. This does not include administrative time to check/update logs and records. In addition to the man hours required to complete these actions, all Lot XIII and below F/A-18 aircraft remained under the flight restrictions in effect from [Ref. 14]. Those flight restrictions have been in effect for three years.

D. SUMMARY

The previous situations are glimpses at the potential ramifications of breakdowns in the configuration management process. These are only two examples of problems that are being faced every day in the fleet. In both cases, it was necessary for the fleet to conduct physical inventories of all affected components to positively verify that the correct changes had been incorporated. We have placed the burden on the users in the fleet to compensate for our inability to manage configuration control. The time and effort expended by maintenance and support personnel to solve problems such as these is detracting from their ability to focus on other mission critical areas and detracting from the overall maintenance effort on our aircraft. There must be a better way to manage this process.

In the next chapter, I will look at a commercial information technology (IT) system that is used by the airline industry for managing the configuration control process.

IV. SABRE DECISION TECHNOLOGIES (SDT) CONFIGURATION MANAGEMENT SYSTEM

A. BACKGROUND

In 1991, American Airlines Decision Technologies (AADT) developed computerized decision support tools to plan maintenance tasks and calculate the optimal number and location of spare parts. [Ref. 22] In their first year of operation, the maintenance planning system and the inventory control system saved American Airlines over $15 million. Saving money was not the only benefit from creating these systems. There was a reduction in the time required to plan and analyze alternatives. Mark Tedone, a director of the development effort, described the effect of the time savings on the organization at American Airlines.

> In addition to the fact that you can now generate a plan for our entire fleet in half an hour or less, as opposed to taking two or three weeks in the past, you can use that spare time to look at alternatives. It gave the analyst time to say: 'What can I do to make better use of what we have'. It essentially turned the analyst, who in the past was a number cruncher, into a real analyst. [Ref. 22]

The effectiveness of using information technology (IT) to assist with the maintenance and engineering efforts of the commercial airlines created demand for a single integrated product to manage the entire maintenance effort.

In 1995, AADT became SABRE Decision Technologies, a Division of the SABRE Group, Inc. They developed the EMTECH system which was designed to be a "state-of-the-art maintenance and engineering system." [Ref. 23] According to the manufacturer, the system was designed to:

1. Increase efficiency and productivity in all major functional areas.
2. Provide an accurate tracking system.
3. Improve management effectiveness.
4. Streamline the business process.

5. Facilitate customization for any size airline and repair station through modular design features. [Ref. 23]

EMTECH is composed of four separate application modules as shown in Figure 2.
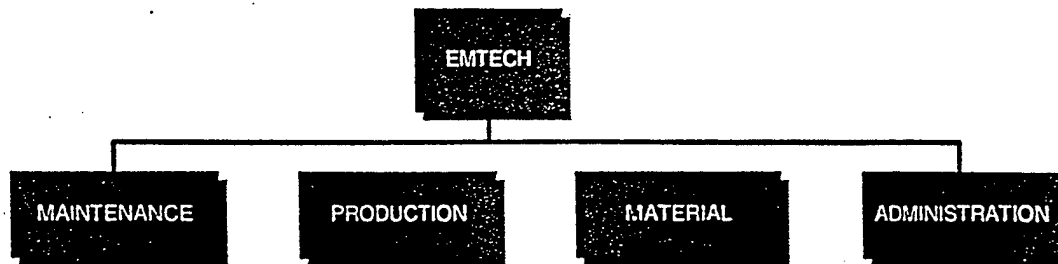
Figure 2. EMTECH Application Modules From Ref. [23]

This grouping of application modules is "aimed at providing the client complete automation in all mainstream activities, and assures the connectivity of information among functional areas." [Ref. 23:p. 2] Each module is broken up into various sub-modules as determined by functionality. For this study, my focus will be on the Configuration Management Module. This module is part of the EMTECH Maintenance Module that is displayed in Figure 3.
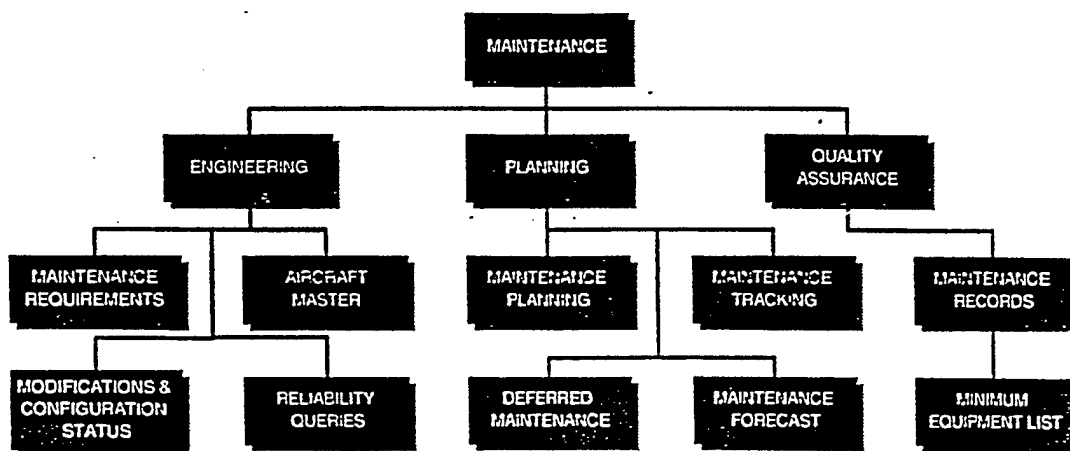
Figure 3. EMTECH Maintenance Module From Ref. [23]

Figure 3 shows the Configuration Management Module as it is integrated into the

EMTECH system. While it was designed to work with an EMTECH core data base, the

Configuration Management Module can be utilized as a stand-alone system with an existing

maintenance data base. [Ref. 23:p. 10]

B. SDT CONFIGURATION MANAGEMENT MODULE

The commercial airline industry has recognized that management of configuration control

is critical for the safe operation of aircraft. Additionally, failing to accurately manage aircraft and

component configurations can result in inefficient asset allocation and increased maintenance

costs. According to SDT,

> Ensuring correct aircraft configuration and service records of critical aircraft components
> are two of the difficult and time consuming tasks necessary for safe operation. Failing to
> perform these assignments can shorten the life of expensive components and increase
> aircraft downtime. [Ref. 24:p. 1]

SDT's answer to configuration management was an electronic decision support tool that

would manage the complexity of maintaining configuration control while using the benefits of

computer technology to allow managers to quickly and accurately monitor status of critical parts

and create tailored reports for specific items of interest.

SDT's Configuration Management Module "runs in a client-server environment using a

UNIX file server, Oracle relational database management system, and a Windows-based PC

workstation." [Ref. 24] The graphic user interface (GUI) looks similar to other Windows

applications. It uses a mouse driven interface with pull-down menus, pop-up dialog boxes, and

fast keys. [Ref. 24] An example of the Configuration Management display showing an assembly

parts screen that is used for configuration management is displayed in Figure 4.

Figure 4. SDT Assembly Parts Screen From Ref. [25]

The assembly parts screen has four sub-sections that are used for configuration

management. Starting from the top of the display, they are; the assembly logical build section, the

current component information section, the attached service bulletin section and the unattached

parts section.

1. Assembly Logical Build Section

The assembly logical build section, located at the top of the assembly parts screen display,

is used to display configuration items by serial number from the assembly level to the individual

piece parts that make up that particular assembly. An example of a assembly logical build section

for a jet engine is contained in Figure 5.

Assembly		Modules		Sub-Assemblies		Piece Parts	
IIN	MFG S/N	IIN	MFG S/N	IIN	MFG S/N	IIN	MFG S/N
000	709918	98C	K9918C	200	K9918N1	150	BLA1918
		98E	K9918E	300	K9918CS	201	KK1200
		98G	K9918G	666	K09918	201	KK3135
Usg Cd Displayed		98H	K9918H	750	K9918LT	201	KK3559
ALL PARTS		4		5		38	

Figure 5. SDT Assembly Logical Build From Ref. [25]

In Figure 5, an engine assembly with serial number 709918 has been selected for viewing.

The display shows that this particular assembly contains four modules. In this case, since none of

the four modules have been highlighted, the system defaults to display the sub-assemblies for the

top module with manufacturer's serial number K9918C. Therefore, we can see that module

K9918C has five sub-assemblies. Once again, the system defaults to display the piece parts of the

top sub-assembly if no other sub-assemblies have been highlighted. In this case, there are thirty-

eight piece-parts associated with sub-assembly number K9918N1.

The maximum number of modules, sub-assemblies, and piece parts that can be displayed at

one time is four. However, the operator is cued to the fact that there are more modules, sub-

assemblies or piece parts to be viewed by the numbers (when greater than four) at the bottom of

each column and the checkerboard pattern in the scroll boxes to the left of the columns.

[Ref. 25:p. 4]

2. Current Component Info Section

The center section of the assembly parts screen contains current component information. This information is broken up into two parts. The first part of the display contains information that was current on the selected part at the time the part was installed. This section is displayed in Figure 6.

Figure 6. SDT Current Component Info From Ref. [25]

In this example, it can be seen that the highlighted part with manufacturer's serial number M53643 is installed on base engine number 709918 in position 2 on an aircraft with tail number 259. At the time the part was installed, it had 67,207 hours and 6,337 cycles remaining in its' service life. [Ref. 25:p. 6]

The second part of the current component information section displays information on the selected part that is valid for the time that is entered in the effective date portion of the display. This section is displayed in Figure 7.

Figure 7. SDT Current Component Info From Ref. [25]

In this example, as of 05/02/95, there are 81,752 hours and 15,408 cycles remaining on

the selected part. Additionally, using actual operations data from the central database, the system

calculates the average usage of the part and uses that information to forecast the estimated date

for expiration of service life. In this case, the part averages 8.27 hours and 4.16 cycles per day.

Based on that usage, the part will last for another 3,700 days. Its' estimated expiration of service

life at those rates will be on 06/18/95. [Ref. 25:p. 6]

3. **Attached Service Bulletin Section**

The attached service bulletin section of the configuration management system contains

pertinent information on open and closed service bulletins for the selected part. All service

bulletins (open and closed) that pertain to the selected part are automatically displayed. An

example of the Attached Service Bulletins section is contained in Figure 8.

In this example, there are twenty-five service bulletins associated with the selected part.

This section displays the service bulletin number, the accomplishment code (how/when the service

bulletin should be accomplished), and the date that the service bulletin was accomplished. If more

information on the service bulletin is desired, the operator can select the Run SB box on the lower

Figure 8. SDT Attached Service Bulletins From Ref. [25]

right hand portion of the display. This will bring up the Service Bulletin Screen displayed in

Figure 9.

Figure 9. SDT Service Bulletin Screen From Ref. [26]

The service bulletin screen gives the operator an in-depth look at the service bulletins that were displayed in the Attached Service Bulletins section on the assembly parts screen. Additionally, the operator can view other service bulletins, edit service bulletins, query parts associated with service bulletins and detach parts, as desired. [Ref. 26:p. 3-13]

The system will allow the operator to change virtually everything about the desired service bulletin except four critical fields. These four fields are the Industry Identification Number (IIN), the Type Equipment (Type Eq) code, the service bulletin number, and the accomplishment code (ACM CD). These fields can only be created or altered by a central database manager. This function protects the system from corruption by inadvertent operator errors. [Ref. 26:p.4] Figure 10 displays a warning that would be displayed to the operator if he/she tried to enter a service bulletin number of an already existing service bulletin.
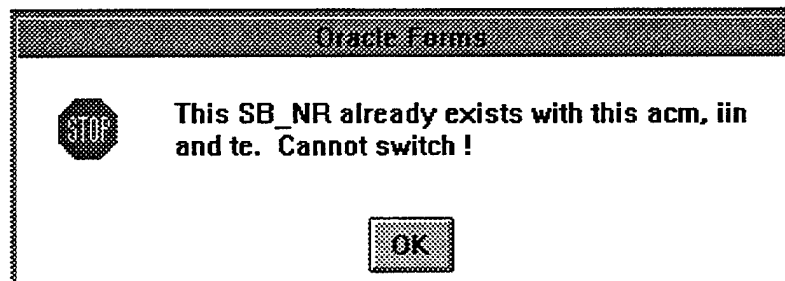
Figure 10. SDT Service Bulletin Conflict Warning From Ref. [26]

4. Unattached Parts Section

When changes are made to configuration items, the unattached parts section is used to update the current configuration. The unattached parts section is displayed in Figure 11.

Unattached Parts

	UA	MFG S/N	NHA	NHA MFG S/N
	407	1B6857	400	
	407	3A1058		
	407	6A8565	400	

UA Part Info		Attach Part

Figure 11. SDT Unattached Parts Section From Ref. [25]

Using the unattached parts section, the operator highlights the part that he/she wants to attach to a configuration item. Then the assembly that will be modified is selected and the part is moved to its' new position. Once the action is saved, the configuration is instantaneously updated. [Ref. 25:p. 12]

C. BENEFITS

The commercial airline industry uses this system to maintain accurate aircraft configuration and maintenance records. It provides an accurate tracking tool for all parts and allows planners to quickly and accurately forecast part service life and estimate dates for critical component service requirements. Additionally, the system tracks current information on service bulletins, engineering change orders and airworthiness directives. [Ref. 24:p. 1]

Another benefit of the system is that it allows the operator to quickly retrieve and sort data to verify configurations, forecast maintenance requirements, and determine what maintenance tasks have been accomplished. Users can generate regular reports to allow maintenance managers to monitor configuration control status, make plans for regular service, and monitor life history of configuration items throughout their life cycle. [Ref. 24:p. 1-2]

The system protects operators from inadvertently entering data incorrectly. This is accomplished through the use of alerts to notify the operator of "illegal configurations, invalid data entries, or significant changes to part age information (measured in hours, cycles, and days)." [Ref. 24:p.2] Additionally, by using a central database, the system eliminates the potential for data discrepancies by eliminating redundant data that exists in organizations that maintain separate databases. This function reduces the problems associated with simple mistakes in documentation that can lead to a loss of configuration control. [Ref. 24:p. 2]

Finally, SDT's Configuration Management system has a standard Windows graphic user interface which operators are likely to be familiar with. It allows operators to quickly update the database and complete transactions with the standard menus and point-and-click functions found on other Windows software products. [Ref. 24:p. 2]

The next chapter will describe how the SDT Configuration Management System could have prevented the problems with Navy Configuration Control that were discussed in Chapter III.

V. BENEFITS OF SABRE DECISION TECHNOLOGIES (SDT) CONFIGURATION MANAGEMENT SYSTEM

A. GENERAL

The commercial airline industry uses information technology to manage many critical aspects of aircraft maintenance, including incorporation and tracking of configuration changes to their aircraft. Driven by a strong profit motive and desire to reduce costs while increasing capacity, the industry has seen the benefits of using a computer system to maintain configuration control.

At this point in my study, I wanted to present a cost benefit analysis to illustrate the potential cost savings and benefits to be realized through the use of a configuration management system. I asked two members of the SDT group to help me obtain data that had been used to convince the top level decision makers in industry to accept the relatively high costs of implementing a computer network to manage an entire commercial airlines maintenance effort.

Interestingly, there was never a formal cost benefit analysis or post-implementation review. The benefits were so obvious to the maintenance personnel and top level managers that the system basically sold itself outright. In fact, according to one of the engineers at SDT, "...this was a quantum leap...the issue from the start was 'can it be done' rather than 'should it be done'. [Ref. 27:p. 2]

In general, while there has been no formal report of the benefits of using decision support systems, there are some informal measures of effectiveness that have been observed. The largest impact of implementing the configuration management system has been in the allocation and distribution of materials. The configuration management system has given maintenance planners

the capability to forecast upcoming requirements for assets and ensure that the proper materials are available to maintenance technicians at the proper time. Total asset visibility (TAV) is a competitive advantage for industry because they can use TAV to reduce total inventory of material by accurately forecasting requirements and ensuring that only the necessary parts are ordered to make the required configuration changes. Because the system allows the users to forecast the exact requirements for parts, there is no need to create excess inventories to guard against unexpected demand. If there is no unexpected demand for parts, the costs associated with holding excess inventory for "unexpected demand insurance" can be eliminated. [Ref. 28]

Another benefit of implementing the configuration management system has been in the area of time savings. In one example, a 30 year old system that used overnight batch processing was replaced with the real time system, developed by SDT, using a graphic user interface. When the clerks saw that they could input data faster and more reliably, they were impressed. However, in addition to reducing the time required to perform data entry and editing, the clerks found that they could also reconcile differences in data much more quickly with a real-time system rather than having to wait for the next days audit report from the old system. According to Lillo, "Maintenance is taken seriously at American Airlines and it was clear this system would help the clerks do their job better." [Ref. 27:p. 2]

Another example of time savings has been realized at the commercial depots where the time to update records for aircraft coming out of depot level maintenance has been reduced from 10-18 days to a maximum of two days. [Ref. 28]

The airlines saw the potential to increase their efficiency and effectiveness in managing the complex requirements of aviation maintenance by using information technology to their

advantage. In the following examples, I will discuss how the use of a configuration management system could have prevented the Navy's problems with configuration control that I identified in chapter III.

B. SPECIFIC

In this study, I have identified two specific examples of breakdowns in configuration control. In both cases, the fleet was required to conduct a physical inventory of all configuration items in question to positively identify their current configuration. This "last ditch" method to maintain configuration control could have been avoided if the SDT Configuration Management system had been in place. In the examples that follow, I will show how SDT's system could have prevented the specific examples of configuration management breakdowns on the AV-8 Harrier and the F/A-18 Hornet.

1. AV-8 Harrier Ejection Seat Firing Control Handle

The ejection seat firing control handle for the AV-8 was re-designed to protect aircrews from the possibility of inadvertently ejecting from the aircraft when the pilot's control stick became entangled with the Ejection Seat Firing Control Handle. Unfortunately, both the old and new ejection seat firing control handles were given the same National Stock Number (NSN). This created a situation where old handles were still in inventory, and in 15 instances, still found installed in operational aircraft. [Ref. 10] [Ref. 12]

The problem and the ensuing requirement for a physical inventory to verify current configurations could have been avoided by using SDT's Configuration Management system. Although the ejection seat firing control handles had the same NSN, they had different part

numbers. The SDT system would have alerted the operator that a potential problem existed because the database will not accept two different part numbers with the same NSN that are not interchangeable. This alert would have given a "heads up" to the operators and the logistic support pipeline personnel that the old handles needed to be purged from the system and/or the new handles needed an new NSN. Regardless of those facts, the new service bulletin (ACC in this case) could only have been accomplished by installing the correct ejection seat firing control handle with the new part number. [Ref. 29]

With the SDT system, even if the initial conflict had not been identified, there would never have been a requirement to conduct a physical inventory to positively determine the configuration of the fleet's ejection seats. Using SDT's Configuration Management system, an exception report could have created that would scan the current configuration status of all ejection seats and print out a list of the seats that had not received the modified ejection seat firing control handles. Once the assets that had not been modified were identified, the correct handles could have been sent to the squadrons who had aircraft that needed to be retrofit. [Ref. 29]

2. F/A-18 Power Supply for Air Data Computer (ADC)

In this example, configuration control was lost because of a lack of asset visibility. Many of the power supplies had been modified in accordance with an AVC and then corrected with an IAVC. However, the problem was that without physically checking the ADCs, the operators in the fleet and the logistics support personnel could not positively determine which boxes had received the proper "fix". In this example, a Configuration Management system could have been used to track the status of updates to the computers. The configurations of the ADCs on the aircraft and in the shops would be in the database. Each computer could be identified by its serial number. Additionally, the sub-assemblies and in some cases, the piece parts could be positively

34

identified. As described in the first example, by running an exception report, the ADCs that had

not been modified correctly could be identified, modified, and returned to service.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

I conclude that there are two fundamental challenges that confront the current Naval Aviation Configuration Management Policy: **(1) the process used to review and approve Engineering Change Proposals (ECPs) and (2) the management and control of the configuration changes once they are approved and released to the fleet for incorporation.**

1. ECP Review and Approval Process

The process is too complex and has too many stakeholders that must be satisfied independently.

For example, for a Class I ECP, there are up to twelve different forms that must be completed and staffed through at least seven NAVAIR staffs for their concurrence. These staffs route the ECP through their organizations and take input from the Type Commander. Once the staffs have acknowledged their concurrence with the proposed ECP, the entire package is collected by the program manager and submitted to the Configuration Change Control Board (CCB) for final approval. The average time to complete this process, from ECP proposal to approval, is 128 days. [Ref. 3]

This process is similar, on a smaller scale, to a challenge that the nation of Singapore was facing when it resolved to control the entire nations import/export industry by using Electronic Data Interchange (EDI). In 1987, Singapore's trade governing agencies were executing about 10,000 transactions per day. Each transaction required at least four documents to be completed. In some cases, as many as twenty forms were required to complete a transaction. All

documentation was hand carried by courier and the average turnaround time for each transaction was two days. "Swedish and U.S. studies of the costs of trade documentation in those countries estimated that the cost at 4% to 7% of the value of goods shipped." [Ref. 30:p.192]

Singapore created a joint government/commercial trade information system called TradeNet. They took all of the forms required for import/export transactions and consolidated them into one form. Not only did they consolidate the forms required to approve import/export transactions, they created a new process, supported by an EDI system, that was capable of accepting and approving a transaction in less than 10 minutes. [Ref. 30:p. 203] If an entire country can work together to create an electronic system that can approve and document import/export transactions on one electronic form, we should be able to consolidate our ten different ECP staffing/concurrence forms into one electronic form and distribute it electronically through our organization, in parallel, for approval.

The current ECP process at NAVAIR is undergoing an internal review as the NAVAIR organization shifts to the new Competency Aligned Organization (CAO) structure. This is a first step in creating a new approach to configuration management policy. We must change the process before we try to adapt new technology to an old process. According to RAND, "if you use EDI only to transfer information electronically, but along the same lines of a previous manual process (paving cowpaths), you may not see any improved responsiveness." [Ref. 31]

While I applaud NAVAIR's initiative to re-engineer this process, I am concerned that an internal review of the current process by the people who manage configuration policy on a daily basis will only result in recommendations for incremental changes to the existing policy. The people who have been charged with this review have been placed in an unenviable position. They

have been asked to determine if the jobs that they perform on a day to day basis are required. It is difficult enough to be objective when other people's jobs are at stake, but almost completely impossible for any one to eliminate their own position. Furthermore, by asking them to perform this study, we are reducing their effectiveness at performing their primary responsibilities by placing new demands on their time to complete this study. We must find a neutral third party to study the current process, interview the customers in the fleet and the program managers who support them to find out what is really needed, and make recommendations to create fundamental changes to support configuration management policy to guide us into the twenty-first century.

2. Configuration Change Management

Our method of managing configuration changes is man-hour intensive and has potential for human error with every report that is transmitted through the chain of command. It is a tribute to the dedication and hard work of the men and women at NAVAIR and in the fleet who make the system work on a daily basis.

Once the CCB approves the ECP, the program office is charged with supporting implementation of the change and tracking change incorporation for the rest of the configuration items life cycle. For the F/A-18 program office, this involves tracking 568 ECPs contained in approximately ten file cabinets that are located at NAVAIRSYSCOM in Washington, D.C. [Ref. 32] F/A-18 uses a government contractor to manage configuration control. The fleet makes the changes in accordance with the published ECP and reports incorporation of the change by completing a VIDS/MAF and making the required annotations in the technical directives section of the configuration item log book. This process is man-hour intensive and has potential for operator error with every report that is transmitted through the chain of command. It is truly

39

remarkable that the logisticians have been able to use the system at all. However, as described in chapter III, when a configuration breakdown occurs, the consequences can be severe. Naval aviation is an inherently dangerous business. Loss of configuration control can, at least require physical inspection of all affected assets to positively ascertain their configuration. At worst, it may lead to a loss of life and/or an inability to perform an assigned mission. As our resources for logistics support continue to shrink, we must find ways to maximize the productivity of our personnel and to minimize the costs associated with maintaining configuration control.

The Navy is currently developing the Automated Maintenance Environment (AME). It is designed to contain a configuration management module. SDT's configuration management module, or one like it, could be incorporated in AME. By incorporating SDT's Configuration Management system into AME we may be able to contribute to the Navy's goal of maintaining "affordable readiness" by using a system that has already been developed and has proven its' merits to the civilian world. The Navy does not need to purchase another hardware system. There have already been many systems fielded with varying levels of success. We should be pursuing software solutions that are compatible with existing personal computers. Why should we develop our own system when we can profit from the lessons learned by the commercial world and not repeat their mistakes? Additionally, we should look to the commercial world for assistance with the development of our requirements for our follow on aviation maintenance support systems. In many cases, they are performing research on new technologies that we have just begun to think about. When it comes to aircraft maintenance, our missions are astonishingly similar. Whether the mission is carrying bombs over the beach to a target or passengers to their destination, the requirement for an operational aircraft with full logistic support that will perform

the mission and return to base safely is the same for all of us. We should take advantage of these similarities with industry and use them to make our maintenance support more effective and efficient.

B. RECOMMENDATIONS

I have five specific recommendations.

1. **NAVAIRSYSCOM should consult with members of industry, such as SABRE Decision Technologies, who have demonstrated experience in successfully re-engineering commercial aircraft maintenance support processes to study the Configuration Management Policy at NAVAIR.** The goal of the study would be to re-engineer NAVAIR's Configuration Management Policy to streamline the process, eliminate redundancy, improve communication and serve the needs of the customer in the fleet.

2. **Program Managers must be given a tool to ensure that they have accurate asset visibility to effectively manage all configuration changes that affect their programs.** The Program Manager has been given the responsibility of managing his/her program from "cradle to grave". I recommend that the Program Manager, with support from the Logistics and Engineering competencies, be given a process that is supported by an information system like the SDT Configuration Management system to manage his/her program's configuration management policy to meet the needs of the fleet.

3. **Configuration changes that are not mandatory to meet an Operational Requirement and/or are not mandatory for safety of flight should not be considered for incorporation.** I recommend that proposed changes to any configuration be reviewed by the

program office and the fleet to ensure that they are required for safety of flight or to meet an existing operational requirement (OR) before configuration change request packages are prepared. Any changes that do not meet one, or both of those criteria should not be brought before the Program Manager for forwarding to the Configuration Change Board (CCB).

4. **Solicit support from SABRE Decision Technologies, or a similar firm, to assist with the integration of a configuration management module to The Automated Maintenance Environment (AME).** AME is in the developmental stages. I recommend that the SDT Configuration Management System, or one like it, be integrated to operate with AME. This would be an excellent test to determine the potential for adapting commercial software applications to future military maintenance management systems.

5. **Stop using precious resources to perform research and development on maintenance management systems that already exist in the commercial world.** I recommend that we eliminate funding for research and development of decision support systems for maintenance/logistics support. Our professional operators and support staffs know the requirements of the fleet. They should define the requirements and then look to industry to show us how to maximize our future capabilities. As discussed earlier, there are strong parallels between the U.S. military aviation maintenance procedures and procedures used for commercial aviation. The commercial processes have evolved to maximize capacity/output and minimize cost/downtime. **Can we afford to do anything less?**

APPENDIX A. SAMPLE DECISION MEMORANDUM

MEMORANDUM

From: PMAXXX
To: Distribution

Subj: DECISION MEMORANDUM FOR GRUMMAN ECP NO. GR-EA-6B-270;
        CANOPY JETTISON HANDLE SAFETY LATCH DATED 1 TUBER 1988

        Note: Subject matter will be unclassified and must
                include the name of the ECP Originator and the
                configuration item affected.

Ref: (a) NAVAIRINST 4130.1C

Encl: (1) Draft Milestone Chart

1. The purpose of the subject ECP is to prevent inadvertent
jettison of the EA-6B canopy during normal flight operations.

2. As required by reference (a), an ECP evaluation/planning
conference was held on 10 October 1988 with representatives from
the Contracts Division (AIR-2XXX), the Aviation Systems Training
Program Office (PMA205XXX), the Logistics Management Division
(AIR-4XXX), and the Systems Engineering Division (AIR-5XXX).
Since the proposed ECP addressed both production and retrofit
requirements and would require government furnished equipment, a
representative from the Production Management Division (AIR-114)
was also in attendance. It was also determined that a Program
Management Proposal (PMP) and Approval for Production (AFP)
would be required prior to this change being approved and
incorporated.

3. As a result of this ECP evaluation/planning conference the
following actions were assigned:

    a. PMAXXX (configuration manager, etc.) will be responsible
for coordinating program management proposal and production
approval requirements with AIR-801 and AIR-1003, and obtaining
the required concurrences.

    b. PMAXXX will also be responsible for preparing the draft
Justification and Approval (J&A) in narrative form and monitor
its approval status. Technical program personnel will assist
the program office as may be required.

c. AIR-02XXX will prepare the smooth J&A utilizing the draft inputs provided by the program office. AIR-02XXX will also assist PMA XXX in obtaining the required approvals.

d. AIR-04XXX will staff the change following AIR-04 internal procedures and will prepare and provide PMA XXX the applicable Cost and Funding Summary and Milestone Chart for inclusion into the formal CCB Change Request/Directive. The APML will also coordinate the proposed change with AIR-552 (Support Equipment) and PMA 205 (Aviation Systems Training).

e. AIR-05XXX will staff the change following AIR-05 internal procedures and will prepare and provide PMAXXX the CCB Change Request Directive (NAVAIR 4130/1). AIR-05XXX will also coordinate with AIR-04XXX, AIR-114 and PMA205 as applicable.

f. PMA205XXX will coordinate and provide all aviation training inputs to AIR-04.

g. AIR-114XXX will provide AIR-05XXX with a completed GFE requirements form for supporting the proposed change.

5. The staffing and implementation of the subject ECP will be based on the following guidance:

a. NAVAIRHQ Routing Priority: Routine

b. Desired Production Effectivity: Serial No. P-72

c. Funding identified and reserved:

APN-1 thru 4	$ XXX,XXX.XX
APN-5	$ XXX,XXX.XX
APN-6	$ XXX,XXX.XX
O&MN	$ XXX,XXX.XX

6. This change will be presented to the NAVAIR Change Control Board on XX/XX/XX. Staffing of the subject ECP must be completed and all inputs provided to PMA XXX by XX/XX/XX.

7. A draft milestone chart (NAVAIR 4130/3) identifying the planned implementation of the change is provided as enclosure (1).

PMA XXX

Distribution: (see next page)

Distribution:
AIR-1006   (Configuration Management Branch)
AIR-1003   (Automated Systems and Analysis Support Branch)
AIR-02XX   (Cognizant PCO/Contract Specialist)
AIR-04XXX   (Cognizant APML)
AIR-05XXX   (Cognizant Engineer/Class Desk)
AIR-114X   (Cognizant Production Manager)
PMA205X   (Aviation Training Systems)
AIR-801X   (Program and Budget Policy)

Copy to:
AIR-211   (CCB Representative)
AIR-410C   (O&MN RFM)
AIR-410C1   (CCB Representative)
Naval Air Technical Services Facility (NATSF)
   (CCB Representative)
Cognizant Field Activities (NAC, NAEC, PMTC, etc.)

ENDORSEMENTS:

APPENDIX B. FORMS REQUIRED FOR THE PREPARATION OF CCB CHANGE PACKAGES

A Change Control Board change request/directive must be prepared and processed for all Class I engineering change proposals (including value engineering change proposals), requests for major/critical deviations or waivers, RAMEC's, MGFEL's, work completion date extensions, and revisions and/or documents thereto. The chart below identifies which forms or documents must be completed and included in a final change request/ directive package, when processing one of the following types of change control board actions.

		TYPES OF CHANGES			
CCB CHANGE REQUEST/DIRECTIVE FORMS:	ECP	RFD	RFW	RAMEC	MGFEL
1. NAVAIR CCB Change Request/Directive (NAVAIR 4130/1) Exhibit 6-5	X	X	X	X	X
2. Cost and Funding Summary (NAVAIR 4130/2) Exhibit 6-6	X			X	* X
3. Milestone Chart (NAVAIR 4130/3) Exhibit 6-7	X	X	X	X	X
4. Implementing Instructions (NAVAIR 4130/4) Exhibit 6-8	X	X	X	X	X
5. CCB Change Request/Supplement (Government Furnished Equipment Requirements (FY__)) (NAVAIR 4130/5) Exhibit 6-9	* X				
6. Master Government Furnished Equipment List (MGFEL) Change (NAVAIR 4130/6) Exhibit 6-10	* X				X
7. Support Equipment Requirements Form (NAVAIR 4130/7) Exhibit 6-11	* X				
8. CCB Change Request/Directive AIR-04 Staffing/Concurrence Form (NAVAIR 4130/8) Exhibit 6-12	X	X	X	X	X
9. CCB Change Request/Directive AIR-05 Staffing/Concurrence Form (NAVAIR 4130/9) Exhibit 6-13	X	X	X	X	X
10. Controlling Custodian (TYCOM) ECP Incorporation Plan Form (NAVAIR 13061/9) Exhibit 6-14	** X				X
11. CCB System Safety Assessment Form (NAVAIR 4130/10) Exhibit 6-15	X				
12. Decision Memorandum, Exhibit 6-3	X	X	X		X

```
*   If Affected
**  O & I Level Installations Only
```

ECP: Engineering Change Proposal
RFD: Request for Deviation
RFW: Request for Waiver
RAMEC: Rapid Action Minor Engineering Change
MGFEL: Master Government Furnished Equipment List

47

APPENDIX C. SAMPLE AVIONICS CHANGE MESSAGE

```
RTTUZYUW RUEOMCA1335 0162020-UUCX--RUWLAA.
ZNR UUUCX ZUI RULSSAZ1102 0161102
R 161102Z JAN 96 ZYB PSN 174186Q27
FM PEOTACAIR WASHINGTON DC//PMA265//
TO AIG ONE SIX FIVE
AIG SIX NINE EIGHT SIX
INFO RULSNAA/COMNAVAIRSYSCOM WASHINGTON DC
      //4.1.1/3.1.1C1/4.5.1.1/3.1.8A//
BT
UNCLAS//N13052//
MSGID/GENADMIN/PEOTACAIR/PMA265//
SUBJ/AVIONICS CHANGE NO. 4651/TD CODE 54/F/A-18 AIR DATA
COMPUTER (ADC) CP-1334/A/PROM UPDATE FROM P/N 4031000-912 TO P/N
4031000-915/(RAMEC NORIS 03-95) WUC 56X2800//
REF/A/DOC/A1-F18AC-LMM-000/CHGD 15JUL94/OR SUBQ//
REF/B/DOC/A1-F18AC-PCM-000/CHGD 15MAR94/OR SUBQ//
REF/C/DOC/A1-F18AC-LMM-010/15AUG94/OR SUBQ//
REF/D/DOC/A1-F18AC-560-300/CHGD 15JUL94/OR SUBQ//
REF/E/DOC/NAVAIR 01-1A-23/1FEB94/OR SUBQ//
REF/F/DOC/A1-250AC-560-000/CHGD 10DEC91/OR SUBQ//
REF/G/RMG/COMNAVAIRSYSCOM WASHINGTON DC/271940Z/271941ZAPR93//
REF/H/RMG/NADEP NI/130731ZOCT95/-/NOTAL//
NARR/REF A IS LINE MAINTENANCE PROCEDURES.  REF B IS PLANE CAPTAIN
MANUAL.  REF C IS LINE MAINTENANCE ACCESS DOORS.  REF D IS AIR DATA
COMPUTER SYSTEM.  REF E IS ELECTRONIC ASSEMBLY REPAIR.  REF F IS AIR
DATA COMPUTER. REF G IS AVC 4399.  REF H IS RAMEC.WRAPUP SUBMITTAL
FOR NAVAIR PROCESSING.//
RMKS/
1.  COGNIZANT CODE:
      A.  ENGINEERING:  LCDR DAVE CULBERTSON, AIR 4.5.1.1, DSN
642-6240, EXT 8648 OR COML (703) 604-6240 EXT EXT 8648
      B.  LOGISTICS:  CAPT J. COPPOLA, AIR-3.1.1C, DSN 642-3160, EXT
2480 OR COML (703) 604-3160 EXT 2480.
      C.  ENGINEERING:  NADEP NORIS CODE 4.3.5MS, M.J. SCHMIDT, DSN
735-3804 OR COML (619) 545-3804.
      D.  LOGISTICS:  NADEP NORIS CODE 3.1.1.1.B7, G. WHITELOCK, DSN
735-3837 OR COML (619) 545-3837.
2.  CATEGORY: ROUTINE
 3.  DOCUMENTATION AFFECTED:
      A.  A1-F18AC-560-300, DTD 15 APR 93
      B.  A1-F18AC-560-500, DTD 1 MAY 93
      C.  A1-250AC-560-000, DTD 15 APR 86
  4.  PURPOSE: TO MODIFY ADC, P/N (07187) 4031000-912 TO P/N (07187)
4031000-915.  THIS CHANGE IS TO BE ACCOMPLISHED IN CONJUNCTION WITH
F/A-18 AVB 561, WHICH REQUIRES INSPECTION FOR ADC POWER SUPPLY, P/N
4031003-915 AND REQUIRES MODIFICATION OF ALL 4031003-902 POWER
SUPPLIES TO THE -915 CONFIGURATION.
  5.  APPLICATION: (FMS REFER PARA 15.C)
     A.  BASIC EQUIPMENT: (LESS ATTRITION)
NOMEN TYPE         PART NR          NSN          CAGE  SER NRS QTY   NOTE
      DESIG
ADC   CP-1334/A 4031000-912 6610-01-156-9314 07187  ALL    280    (1)
NOTE (1):  ADC, P/N 4031000-912 IS INSTALLED ON F/A-18A AIRCRAFT
BUNOS 161353 THRU 162909 AND F/A-18B AIRCRAFT BUNOS 161354 THRU
162885 (A17-A300, B5-B37).
      B.  TRAINERS:  N/A
      C.  SPARES:
NOMEN TYPE         PART NR          NSN          CAGE  SER NRS QTY
      DESIG
ADC   CP-1334/A 4031000-912 6610-01-156-9314 07187 ALL      2
  6.  COMPLIANCE:
```

MAINTENANCE NLT 180 DAYS AFTER RECEIPT OF THIS TECHNICAL DIRECTIVE,
PARTS AND MATERIALS, AND IN CONJUNCTION WITH AVB-561.
    B.   TRAINERS: N/A
    C.   SPARES: ASO TAKE THIS RAMEC FOR ACTION AND ENSURE

COMPLIANCE FOR ALL RETAIL AND WHOLESALE LEVEL ASSETS.
  7.   MAN-HOURS REQUIRED:

	NO. OF MEN	SKILL	TOTAL MAN-HOURS
A. BASIC EQUIPMENT			
ORGANIZATIONAL LEVEL	1	AE	1.0
INTERMEDIATE LEVEL	1	AT	3.5
B. TRAINERS: N/A			
C. SPARES:			
INTERMEDIATE LEVEL	1	AT	3.5

  8.   SUPPLY DATA:
    A.   REQUIREMENTS FOR BASIC EQUIPMENT:
       (1)   PARTS/MATERIAL REQUIRED: REFER TO SI SOURCE NOTE.

QTY	PART NO.	CAGE	NOMENCLATURE	NSN	SOURCE
1	M39003/01-6209	81349	CAPACITOR	5910-01-365-9399	S1
1	RNC55H1433FS	81349	RESISTOR	5905-00-419-2831	S1
1	RNC55H5111FS	81349	RESISTOR	5905-00-138-7399	S1
1	4031017-10	07187	ID PLATE	N/A	S1
1	AA4034246-621	07187	PROM	5962-01-260-6641	S1
1	AA4034246-622	07187	PROM	5962-01-260-6642	S1
1	AA4034246-623	07187	PROM	5962-01-264-8789	S1
1	AA4034246-624	07187	PROM	5962-01-260-6643	S1
1	AA4034246-625	07187	PROM	5962-01-260-6644	S1
1	AA4034246-626	07187	PROM	5962-01-260-6645	S1
1	AA4034246-627	07187	PROM	5962-01-260-6646	S1
1	AA4034246-628	07187	PROM	5962-01-260-6647	S1
1	AA4034246-629	07187	PROM	5962-01-260-6648	S1
1	AA4034246-630	07187	PROM	5962-01-339-4897	S1
1	AA4034246-641	07187	PROM	5962-01-341-5880	S1
1	AA4034246-642	07187	PROM	5962-01-341-5881	S1
A/R	MIL-I-46058 TYPE AR	81349	INSULATING COMPOUND	5970-01-029-7961	S2
A/R	O-A-51	81348	ACETONE	6810-00-223-2739	S2
A/R	HCFC-141B	0WU71	CLEANING COMPOUND	6850-01-386-8415	S2
A/R	QQ-S-571E	81348	SOLDER	3439-01-169-4842	S2
A/R	TT-I-735 GRADE A	80244	ISOPROPYL ALCOHOL	6810-01-127-4246	S2
A/R	TX-710	21994	FOAM SWAB	7045-01-325-0536	S2
A/R	MIL-I-43553 BLACK	81348	INK, BLACK STENCIL	7510-01-109-8201	S2
A/R	ASTM D 740 OR EQUIVALENT	81346	METHYL ETHYL KETONE (MEK)	6810-00-985-7098	S2
A/R	MIL-I-43553 WHITE	81348	INK, WHITE STENCIL	7510-00-105-0071	S2

SOURCE:
       (S1)   OBTAIN FROM FLEET READINESS ACTION GROUP (FRAG),
RECEIVING OFFICER, NAS NORTH ISLAND, NAVAL AVIATION DEPOT, BLDG 94,
SAN DIEGO, CA 92135-5000, ATTN: EMMETT SALINDONG, CODE 3.5.2, DSN
735-3892 OR COML (619) 545-3892.   REFER TO HONEYWELL P/N 8520420
PARTS BAG WHICH INCLUDES ALL SI SOURCE MATERIAL.
       (S2)   REQUISITION THROUGH NORMAL SUPPLY CHANNELS
       (2)   PECULIAR GROUND SUPPORT EQUIPMENT REQUIRED: NONE
       (3)   PARTS/MATERIAL REMOVED:

QTY	PART NO.	CAGE	NOMENCLATURE	NSN	DISPOSITION
1	M39003/01-2288	81349	CAPACITOR	5910-01-284-9035	D1
1	RNC55H1243FS	81349	RESISTOR	5905-00-229-7699	D1
1	RNC55H2001FS	81349	RESISTOR	5905-00-477-9176	D1
1	4031017-10	07187	ID PLATE	N/A	D1
1	AA4034246-511	07187	PROM	5962-01-157-8760	D1
1	AA4034246-512	07187	PROM	5962-01-154-7548	D1

(6) REMOVE THE (2) FROM PART NUMBER 4031005-912 ON THE
MEMORY CCA WITH ACETONE. CLEAN AREA WITH CLEANING COMPOUND. ALLOW
A FEW MINUTES FOR EVAPORATION. USING BLACK STENCIL INK, CHANGE PART
NUMBER OF MEMORY CCA TO 4031000-915 BY MARKING (5) IN AREA WHERE (2)

WAS REMOVED.
(7) APPLY INSULATING COMPOUND TO ALL MODIFIED AREAS ON
MEMORY CCA PER REF E WP 006 00.
(8) TEST MEMORY CCA REF DES A5 ON HTS, TPS ID 20414.
(9) REINSTALL MEMORY CCA REF DES A5 INTO ADC PER REF F WP
003 00.
(10) REMOVE OUTPUT DATA CONVERTER (ODC) CCA REF DES A10 PER
REF F WP 003 00.
(11) REMOVE INSULATING COMPOUND OVER CAPACITOR REF DES C3,
RESISTOR REF DES R52, AND LAST TWO NUMBERS (06) FROM PART NUMBER
4031010-906 WITH ISOPROPYL ALCOHOL AND FOAM SWAB PER REF E WP 006
00. REFER TO REF F WP 010 00 FOR LOCATION OF C3 AND R52 ON ODC CCA
REF DES A10.
(12) UNSOLDER AND REMOVE CAPACITOR REF DES C3 AND RESISTOR
REF DES R52 FROM OCD CCA A10 PER REF E WP 007 00.
(13) SOLDER CAPACITOR, P/N M39003/01-6209, IN C3 LOCATION AND
RESISTOR, P/N RNC55H1433FS, IN R52 LOCATION PER REF E WP 007 00.
(14) REMOVE THE (06) FROM PART NUMBER 4031010-906 ON THE ODC
CCA WITH ACETONE. CLEAN AREA WITH CLEANING COMPOUND. ALLOW A FEW
MINUTES FOR EVAPORATION. USING BLACK STENCIL INK, CHANGE PART
NUMBER OF ODC CCA TO 4031010-913 BY MARKING (13) IN AREA WHERE (06)
WAS REMOVED.
(15) APPLY INSULATING COMPOUND TO ALL MODIFIED AREAS ON ODC
CCA PER REF E WP 006 00.
(16) TEST ODC CCA REF DES A10 ON HTS, TPS ID 20418.
(17) REINSTALL ODC CCA REF DES A10 INTO ADC PER REF F WP 003
00.
(18) REMOVE POWER SUPPLY REF DES A3 PER REF F WP 003 00.
(19) DISASSEMBLE CHASSIS PER REF F WP 012 00 TO PROVIDE
ACCESS TO ELECTRONIC COMPONENT ASSEMBLY (ECA) A12A1.
(20) UNSOLDER AND REMOVE RESISTOR, P/N RNC55H2001FS, REF DES
A12A1R1, FROM TERMINALS A12A1-21 AND A12A1-22 PER REF E WP 007 00.
REFER TO REF E WP 012 00 FIGURE 8 TO LOCATE RESISTOR A12A1R1.
(21) SOLDER RESISTOR, P/N RNC55H5111FS, IN A12A1R1 LOCATION
BETWEEN TERMINALS A12A1-21 AND A12A1-22 PER REF E WP 007 00.
(22) REASSEMBLE CHASSIS PER REF F, WP 012 00.
(23) PERFORM AVB 561.
(24) REMOVE EXISTING ADC ID PLATE, P/N 4031017-10, BY
APPLYING A FEW DROPS OF MEK OR EQUIVALENT TO UPPER EDGE OF PLATE.
WORK MEK OR EQUIVALENT DOWN INTO ADHESIVE WHILE GRADUALLY PULLING ID
PLATE AWAY FROM CHASSIS.
(25) PREPARE SURFACE WHERE ADC ID PLATE IS TO BE APPLIED BY
CLEANING WITH CLEANING COMPOUND.
(26) REMOVE BACKING FROM NEW ID PLATE, P/N 4031017-10.
POSITION PLATE ON CHASSIS AND FIRMLY PRESS SURFACE TO ENSURE GOOD
ADHESION.
(27) MARK AVC 4651 ON ADC ID PLATE USING WHITE INK.
(28) INSTALL ADC TOP COVER AND TIGHTEN THE TWELVE CAPTIVE
SCREWS PER REF F WP 003 00.
(29) PERFORM ADC FUNCTIONAL TEST ON IATS OR ATS, TPS ID
74D050021.
C. ORGANIZATIONAL LEVEL:
(1) VERIFY AVC 4651 IS MARKED ON ADC ID PLATE AND AN AVB
561 DECAL IS APPLIED ON MODIFIED ADC, P/N 4031000-915.
(2) INSTALL ADC IN AIRCRAFT PER REF D WP 003 00.
(3) CLOSE DOOR 13R PER REF C WP 006 01.
(4) RETURN AIRCRAFT TO FLIGHT STATUS OR AS DIRECTED BY
MAINTENANCE CONTROL.
11. WEIGHT AND BALANCE: THE EFFECT ON WEIGHT AND BALANCE IS
CONSIDERED NEGLIGIBLE.
12. RECORDS AFFECTED:

```
1    AA4034246-524   07187  PROM           5962-01-154-7550   D1
1·   AA4034246-525   07187  PROM           5962-01-152-0899   D1
1    AA4034246-526   07187  PROM           5962-01-152-0900   D1
1    AA4034246-527   07187  PROM           5962-01-152-0901   D1


1    AA4034246-518   07187  PROM           5962-01-152-0894   D1
1    AA4034246-519   07187  PROM           5962-01-152-0895   D1
1    AA4034246-520   07187  PROM           5962-01-152-0896   D1
1    AA4034246-521   07187  PROM           5962-01-152-0897   D1
1    AA4034246-522   07187  PROM           5962-01-152-0898   D1
```
DISPOSITION: (D1) SCRAP
   B. REQUIREMENTS FOR TRAINERS: N/A
   C. REQUIREMENTS FOR SPARES: SAME PARTS/MATERIAL AS BASIC
EQUIPMENT
9. REIDENTIFICATION:

PREVIOUS PART NO.	PREVIOUS NSN	NOMEN	SUPERSEDING PART NO.	SUPERSEDING NSN
4031000-912	6610-01-156-9314	ADC, CP-1334/A	4031000-915	6610-01-278-9291
4031005-912	5998-01-154-7590	MEMORY CCA	4031005-915	5998-01-312-9488
4031010-906	5998-01-142-9002	OUTPUT DATA CONVERTER CCA	4031010-913	5998-01-226-8602

10. DETAILED INSTRUCTIONS:
   A. ORGANIZATIONAL LEVEL:
     (1) REMOVE ELECTRICAL AND HYDRAULIC POWER PER REF A WP 004
00 AND WP 009 00.
     (2) INSTALL APPLICABLE SAFETY AND PROTECTIVE DEVICES PER
REF B WP 022 00, WP 023 00 AND WP 024 00.
     (3) OPEN DOOR 13R PER REF C, WP 006 01.
     (4) REMOVE ADC, P/N 4031000-912, PER REF D WP 003 00;
INSTALL CONDUCTIVE DUSTCAP OR ANTISTATIC GRID TAPE TO ADC CONNECTOR
RECEPTACLE FOR ELECTROSTATIC DISCHARGE (ESD) PROTECTION; AND INDUCT
ADC INTO INTERMEDIATE LEVEL MAINTAINANCE FACILITY FOR MODIFICATION.
   B. INTERMEDIATE LEVEL:
                          CAUTION
          THE ADC CONTAINS ELECTROSTATIC DISCHARGE (ESD)
          SENSITIVE DEVICES WHICH CAN BE DAMAGED OR
          DESTROYED BY IMPROPER HANDLING, REPAIR, OR
          TESTING PROCEDURES. PERSONNEL SHALL BE FAMILIAR
          WITH THE REQUIREMENTS OF REF E WP 005 00.
     (1) LOOSEN THE TWELVE CAPTIVE SCREWS AND REMOVE THE TOP
COVER FROM THE ADC PER REF F WP 003 00.
     (2) REMOVE MEMORY CCA REF DES A5, P/N 4031005-912, PER REF
F WP 003 00.
     (3) REMOVE INSULATING COMPOUND FROM PROMS U1 THRU U12 AND
THE (2) OF PART NUMBER 4031005-912 WITH ISOPROPYL ALCOHOL AND FOAM
SWAB PER REF E WP 006 00. REFER TO REF F WP 006 00 FOR LOCATION OF U1
THRU U12 ON MEMORY CCA REF DES A5.
     (4) UNSOLDER AND REMOVE -511 THRU -522 EXISTING PROMS U1
THRU U12 FROM MEMORY CCA REF DES A5 PER REF E WP 007 00.
     (5) SOLDER NEW -621 THRU -642 PROMS U1 THROUGH U12 ON
MEMORY CCA REF DES A5 PER REF E, WP 007 00 AS FOLLOWS:
```
                 U1 - AA403246-621
                 U2 - AA403246-622
                 U3 - AA403246-623
                 U4 - AA403246-624
                 U5 - AA403246-625
                 U6 - AA403246-626
                 U7 - AA403246-627
                 U8 - AA403246-628
                 U9 - AA403246-629
                 U10 - AA403246-630
                 U11 - AA403246-641
```

A. SUBMIT VIDS/MAF, OPNAV FORM 4790/60, WHEN REPORTING
COMPLIANCE WITH THIS DIRECTIVE.
B. MAKE APPROPRIATE LOGBOOK ENTRY IN TECHNICAL DIRECTIVES
SECTION, OPNAV 4790724A AND/OR IN ATDR LIST NUMBER 2 AND LIST NUMBER
4, AS APPLICABLE.

13. VERIFIED BY: MALS ELEVEN PER THEIR MESSAGE 080301Z JUN 95 ON
ADC S/N NJR00009.
14. RESCISSION DATE: 30JUN2001
15. RELATED INSTRUCTIONS/INFORMATION:
A. NADEP N.I. RAMEC 03-95 SUBMITTED BY REF H WAS NAVAIR APPROVED
BY CCB 961-0084 ON 04JAN96.
B. THIS TD WILL NOT BE FORMALIZED. FILE THIS COPY IN
APPROPRIATE TECHNICAL DATA FILE.
C. MDA HAS REVIEWED THIS RAMEC WITH RESPECT TO FMS EFFECTIVITY
AND HAS FOUND:
(1) APPLICATION TO BASIC EQUIPMENT
(A) SAF

NOMEN	TYPE DESIG	PART NR	NSN	CAGE	SER NRS	QTY	NOTE
ADC	CP-1334/A	4031000-912	6610-01-156-9314	07187	ALL	9	(1)

(B) RAAF

NOMEN	TYPE DESIG	PART NR	NSN	CAGE	SER NRS	QTY	NOTE
ADC	CP-1334/A	4031000-912	6610-01-156-9314	07187	ALL	33	(2)

NOTE (1): ADC, P/N 4031000-912 IS INSTALLED ON EF-18 AIRCRAFT
CE.15-1 THRU CE.15-8 AND CE.15-13.
NOTE (2): ADC, P/N 4031000-912 IS INSTALLED ON AF/A-18 AIRCRAFT
A21-1 THRU A21-21 AND A21-101 THRU A21-114.
(2) APPLICATION TO SPARES
(A) SAF

NOMEN	TYPE DESIG	PART NR	NSN	CAGE	SER NRS	QTY
ADC	CP-1334/A	4031000-912	6610-01-156-9314	07187	ALL	3

(B) RAAF

NOMEN	TYPE DESIG	PART NR	NSN	CAGE	SER NRS	QTY
ADC	CP-1334/A	4031000-912	6610-01-156-9314	07187	ALL	2

D. MALS ELEVEN/REPORTING CUSTODIAN: MARK VERIFICATION ADC
S/N NJR00009 WITH AVC-4651.
E. PARTS/MATERIAL REQUIRED TO SUPPORT THIS CHANGE ARE AVAILABLE
IN THE SUPPLY SYSTEM. THE STOCK CHECK WAS CONDUCTED BY THE F/A-18
NADEP N.I. LOGISTICS MANAGEMENT OFFICE ON 13 OCT 1995.
F. NAVAVNDEPOT NORIS: (AS APPLICABLE)
(1) PROVIDE MICROFILM COPIES OF NEW/REVISED DRAWINGS TO
NATSF CODE 3122.
(2) PRPARE AND COORDINATE PUBLICATION UPDATES/PUB DATA
PACKAGES WITH NATSF CODE 21-1, AND
(3) PREPARE AND FORWARD DESIGN CHANGE NOTICES (DCNS)/SUPPLY
DATA TO ASO CODE 03611.
G. NAVAIRTECHSERVFAC:
(1) COORDINATE WITH NADEP NORIS AND MDA FOR TECH MANUAL/
PUBLICATION UPDATES AND ORDER AS REQUIRED.//
BT
#1335
NNNN
!!! N421B(1)...ACT FOR COMNAVAIRPAC SAN DIE(8)
!!! 00220/ 2/2148
!!!   SDO(1) N85(1) N422C(1) N421I(1) N421(1) MDC(1) FILE(1)
!!! RTD:000-000/COPIES:
FILE(ACT)
#

APPENDIX D. SAMPLE POWER PLANTS CHANGE DOCUMENT

ROUTINE ACTION

DEPARTMENT OF THE NAVY
NAVAL AIR SYSTEMS COMMAND
WASHINGTON, DC 20361-4100

AIR-53611G/PSD 360F
ISSUE DATE: 31 Dec 94
RESCISSION DATE: 31 Dec 02

DISTRIBUTION STATEMENT C. Distribution authorized to US Government agencies and their contractors to protect publications required for official use or for administration or operational purposes only (see issue date). Other requests for this document shall be referred to Commanding Officer, Naval Air Technical Services Facilities, 700 Robbins Avenue, Philadelphia, PA 19111-5097.

DESTRUCTION NOTICE. For unclassified, limited documents, destroy by any method that will prevent disclosure of contents or reconstruction of the document.

T58 POWER PLANT CHANGE NO. 158
(TDC 02)

SUBJECT: T58-GE-16 NO. 3 BEARING SUMP AREA -- IMPROVED O-RINGS
(WUC 22400)

REFERENCE: (a) General Electric ECP No. 58T-15 of 31 Aug 93
            (b) NAVAIR CCB No. 941-0094 approved 18 Jan 94
            (c) NAVAIR 02B-105AHE-6-1 Intermediate Maintenance Manual,
                Rapid Action Change 17 of 14 Dec 93

ENCLOSURE: Not applicable

DOCUMENTATION AFFECTED:

1. NAVAIR 02B-105AHE-4 Illustrated Parts Breakdown, Rapid Action
   Change 1 of 8 Apr 93
2. NAVAIR 02B-105AHE-6-1 Intermediate Maintenance Manual, Rapid
   Action Change 17 of 14 Dec 93
3. NAVAIR 02B-105AHE-6-2 Depot Maintenance Manual, Change 10 of
   15 Oct 91

PURPOSE OF DIRECTIVE: This directive introduces/preformed packings (O-rings) of improved material (Kalrez 4079) for the No. 3 Bearing Sump area of the T58-GE-16. Kalrez 4079 has characteristics more compatible with the engine sump environment, thus providing extended O-ring life and reducing the possibility of oil leakage due to high temperature degradation of the O-ring. This change was proposed by reference (a) and approved by reference (b).

APPLICATION:

1. BASIC EQUIPMENT:

    The following engines shall be modified by service activities.

TYPE/MODEL/SERIES	CONTRACT NO.	SERIAL NO.
T58-GE-16	N00019-90-G-0237	216001 - 216999

2. TRAINERS: Not Applicable.

3. SPARES: Not Applicable.

COMPLIANCE:

1. This change shall be accomplished by retrofit at Intermediate and Depot levels on next exposure to level required to incorporate.

0870LD6641580

T58-PPC-158

55

2. Incorporation shall be done by the following activities:

ORGANIZATIONAL MAINTENANCE ACTIVITIES: Information only.

INTERMEDIATE MAINTENANCE ACTIVITIES: Comply with detailed instructions on all engines at next exposure to level required to incorporate.

DEPOT MAINTENANCE ACTIVITIES: Comply with detailed instructions on all engines at next exposure to level required to incorporate.

SUPPLY ACTIVITIES: Provide normal support.

MAN-HOURS REQUIRED:

KIT IDENT NO.	KIT NO.	NO. OF MEN	SKILL	TOTAL M/HRS
9158LKA129778EQ (GE P/N 1935T72G01)	A1	1	Engine Mech	0.5

SUPPLY DATA:

1. REQUIREMENTS FOR BASIC EQUIPMENT:

   a. Kit required:

QTY	P/N	CAGE	NOMENCLATURE	SM&R	NSN	SOURCE
1	9158LKA129778EQ (GE P/N 1935T72G01)	99207	Retrofit Kit	6" X 12"	1 lb	(1)

Consists of:

QTY	P/N	CAGE	NOMENCLATURE	SM&R	NSN
2	4074T58P13	57280	Preformed Packing	PAGZZ2	5330-01-328-9905
2	4074T58P16	35709	Preformed Packing	PAGZZ2	5330-00-425-0649
1	4074T58P17	35709	Preformed Packing	PAGZZ2	5330-LL-W61-A606

   b. Other material that may be required depending on condition of removed parts but not supplied in kits.

QTY	P/N	CAGE	NOMENCLATURE	SM&R	NSN	SOURCE
2	2007T51P01	99207	Shield, Heat	PAGZZ3	2840-00-551-4052	(1)
1	4009T20P01	99207	Tube Assy, Scavenge	PAGZZ3	4710-00-003-8051	(1)
1	4018T02G01	99207	Tube Assy, Oil In	PAGZZ3	4710-00-556-6235	(1)
1	4023T80G01	99207	Nozzle, No. 3 Bearing Sump Oil	PAGZZ3	2840-00-554-4369EQ	(1)
2	R1468P007L	99207	Screw, Machine	PAOZZ	5305-00-904-5809	(1)
AR	MS9226-02	96906	Wire, Nonelec Steel (0.020 Inch)	NA	9505-01-104-6050	(1)
AR	MIL-L-23699	81349	Oil	NA	9150-00-985-7099	(1)

   c. Government furnished equipment (GFE) required: Not applicable.

   d. Support Equipment Required: Not Applicable.

   e. Source of Supply:

   (1) Requisition via procedures established by NAVAVNMAINTOFF.

f. Parts/Material Removed and Disposition:

QTY	P/N	NOMENCLATURE	SM&R	NSN	DISPOSITION
2	9169M40P106	Packing, Preformed	PAGZZ2	5330-01-072-6673	(A)
2	9169M40P108	Packing, Preformed	PAGZZ2	5330-01-076-4976	(A)
1	9169M40P223	Packing, Preformed	PAGZZ2	5330-01-072-6677EQ	(A)
2	2007T51P01	Shield, Heat	PAGZZ3	2840-00-551-4052	(B)
1	4009T20P01	Tube Assy, Scavenge	PAGZZ3	4710-00-003-8051	(B)
1	4018T02G01	Tube Assy, Oil-in	PAGZZ3	4710-00-556-6235	(B)
1	4023T80G01	Nozzle, No. 3 Bearing Sump Oil	PAGZZ3	2840-00-554-4369EQ	(B)
2	R1468P007L	Screw, Machine	PAOZZ	5305-00-904-5809	(B)

Disposition: (A) Dispose of through local Property Disposal Officer.
              (B) Retain for use, provided that part meets inspection
                   requirements of reference (c). If part does not meet
                   inspection requirements, replace part through normal
                   channels.

2. REQUIREMENTS FOR TRAINERS: Not applicable.

3. REQUIREMENTS FOR SPARES: Not applicable.

REIDENTIFICATION: Not applicable.

DETAILED INSTRUCTIONS:

1. Screen engine logbook for compliance with this directive. If this directive
has not been complied with, proceed as follows when installing oil nozzle, oil
scavenge tube, and oil-in tube in second stage turbine casing during engine
assembly.

2. Installation of No. 3 Bearing Sump Oil Nozzle, P/N 4023T80G01, and Preformed
Packing, P/N 4074T58P17.

NOTE

> Ensure oil nozzle meets inspection requirements of
> reference (c) prior to installation. If wear or damage
> exceeds limits, replace nozzle.

a. Lubricate new Preformed Packing (15, Figure 1), P/N 4074T58P17, with Oil,
MIL-L-23699. Install packing on Oil Nozzle (14), P/N 4023T80G01. Relubricate
packing and install nozzle in No. 3 Sump Bearing Housing (12), P/N
6012T65G02/G04. Secure nozzle with two Screws (13), P/N R1468P007L. Torque
screws to 13-16 in-lb.

CAUTION

> Safety wire must not obstruct the oil-in tube hole.

b. Safety wire (0.020 inch) the two screws, using the double twist method.

c. Continue processing in accordance with reference (c).

3. Installation of No. 3 Bearing Scavenge Tube Assembly, P/N 4009T20P01, and
Preformed Packings, P/N 4074T58P13.

NOTE

> Ensure heat shield and scavenge tube meet inspection
> requirements of reference (c) prior to installation. If
> wear exceeds limits, replace part. Replace any heat
> shields that contain holes.

a. Lubricate two new Preformed Packings (16, Figure 1), P/N 4074T58P13, with Oil, MIL-L-23699. Install packings in scavenge boss on No. 3 Sump Bearing Housing, P/N 6012T65G02/G04 (12), ensuring packings are not pushed past groove and into sump.

b. Proceed with Stage 2 turbine casing component buildup in accordance with reference (c), WP 030, paragraph 25, steps b through l, then proceed as follows.

CAUTION

Scavenge tube can cut packings if tool is not held securely against end of tube during tube installation.

c. Place Heat Shield (3, Figure 2), P/N 2007T51P01, on Scavenge Tube (6), P/N 4009T20P01. Lubricate Scavenge Tube Guide, P/N 21C4298G01 (7) and scavenge tube with Oil, MIL-L-23699. Install aft end of wire segment (8) of scavenge tube guide. Be sure conical plug segment (9) of scavenge tube guide is held securely against scavenge tube.

d. Using scavenge tube guide, insert scavenge tube and heat shield through stage 2 turbine casing (5), stage 3 nozzle (4), and preformed packings (2), at six o'clock position.

e. Remove scavenge tube guide and secure scavenge tube assembly, using coupling nut.

4. Installation of No. 3 Bearing Oil-in Tube, P/N 4018T02G01, and Preformed Packings, P/N 4074T58P16.

NOTE

Ensure heat shield and oil-in tube meet inspection requirements of reference (c) prior to installation. If wear exceeds limits, replace part. Replace any heat shields that contain holes.

a. Install Heat Shield (3, Figure 3), P/N 2007T51P01, over Oil-in Tube (5), P/N 4018T02G01. Lubricate two new Preformed Packings (6), P/N 4074T58P16, with Oil, MIL-L-23699, and install packings in groove on oil-in tube.

CAUTION

Heat shield can cut packing if shield is allowed to rest against packing during tube installation.

WARNING

Exercise caution during oil-in tube installation to prevent damage to preformed packings.

b. Lubricate packings with oil, MIL-L-23699. With casing raised so that shield will not contact packing, install oil-in tube in casing at four o'clock position. Secure with coupling nut on oil-in tube.

c. Continue processing in accordance with reference (c).

RECORDS AFFECTED:

1. Identify the change as T58 Power Plant Change 158. Make appropriate Power Plant logbook entry in the Technical Directive Section, OPNAV Form 4790/24A. Submit VIDS/MAF OPNAV Form 4790/60 when reporting compliance with this directive.

2. Component is not tracked by Scheduled Removal Component card. No SRC card entry required.

T58 POWER PLANT CHANGE NO. 158

TECHNICAL DIRECTIVES								1. TYPE DIRECTIVE			
2. AIRCRAFT MODEL/EQUIPMENT NAME							3. TYPE/MODEL/SERIES		4. BUNO OR SERIAL NUMBER		
5. TECHNICAL DIRECTIVE IDENTIFICATION							6. STATUS	7. TITLE/REMARKS	8. COMPLIANCE		9.
a. BASIC	b. INT	c. REV	d. AM	e. PT	f. KIT	g. PRJ			a. BY(Activity)	b. DATE	SIGNATURE
PPC	158					R	(Status)	T58-GE-16 Improved	(Activity)	(Date)	(Signature)
								O-ring, No. 3 Bearing			
								Sump Area			

OPNAV 4790/24A (Rev. 1-84)

INTERIM SUPPORT: Not Applicable.

LTCOL T. J. MEYERS
Director of Product Support
Cherry Point NC 28533-0021

PREPARED BY: Naval Aviation Depot, Cherry Point NC, PSD 363

VERIFIED BY: Naval Aviation Depot, Cherry Point NC, PSD 363, MALS-26, MCAS New River NC

59

1. Nut
2. Stage 3 Shroud Retainer
3. Stage 3 Shroud
4. Bolt
5. Outer Sump Cover
6. Inner Insulation Blanket
7. Stage 3 Turbine Nozzle
8. Bearing Retaining Ring
9. No. 3 Bearing Outer Race
10. Bolt
11. Nozzle Baffle
12. No. 3 Sump Bearing Housing
13. Screw
14. Oil Nozzle
15. Preformed Packing
16. Preformed Packing
17. Shoulder Stud
18. Stage 2 Shroud
19. Stage 2 Casing
20. Nut

Figure 1. Components of Stage 2 Casing, Stage 3 Nozzle, and No. 3 Sump

1. No. 3 Sump Bearing Housing
2. Preformed Packing
3. Heat Shield
4. Stage 3 Nozzle
5. Stage 2 Turbine Casing
6. Scavenge Oil Tube
7. Scavenge Oil Tube Guide 21C4298G01
8. Aft End of Wire Segment
9. Conical Plug Segment

000T58-776501
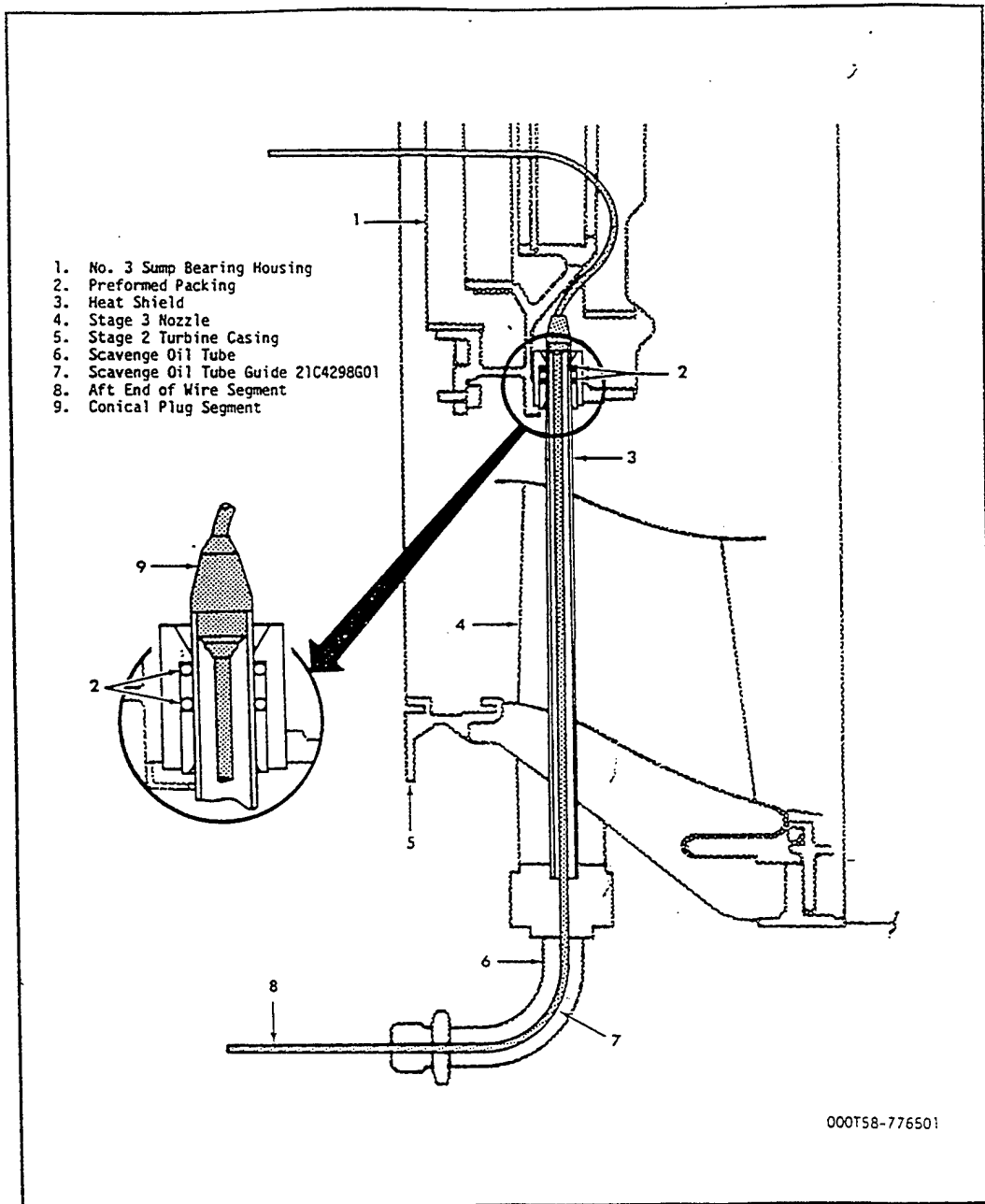
Figure 2. Installation of Scavenge Oil Tube Using Guide 21C4298G01

1. Air Tube Elbow
2. Air Tube
3. Heat Shield
4. Vent Tube
5. Oil-In Tube
6. Preformed Packing
7. Scavenge Oil Tube

A-7535-3

Figure 3. Stage 2 Casing External Components

LIST OF REFERENCES

1. Taylor, B.E., NAVAIRSYSCOM, F/A-18 Air Vehicles., E-mail response to configuration questions. 28 February 1997.

2. NAVAIRINST 4130.1C., *Naval Air Systems Command Configuration Management Policy*, Naval Air Systems Command, 31 January 1992.

3. Montilla, M.G., NAVAIRSYSCOM, AIR-3.1.8., E-mail response to ECP review/approval questions. 3 March 1997.

4. Heilman, S., *N881 GreenShirt #3: Perspectives on Configuration Management*, http://greenshirt.nalda.navy.mil/881-3.htm, September 1996.

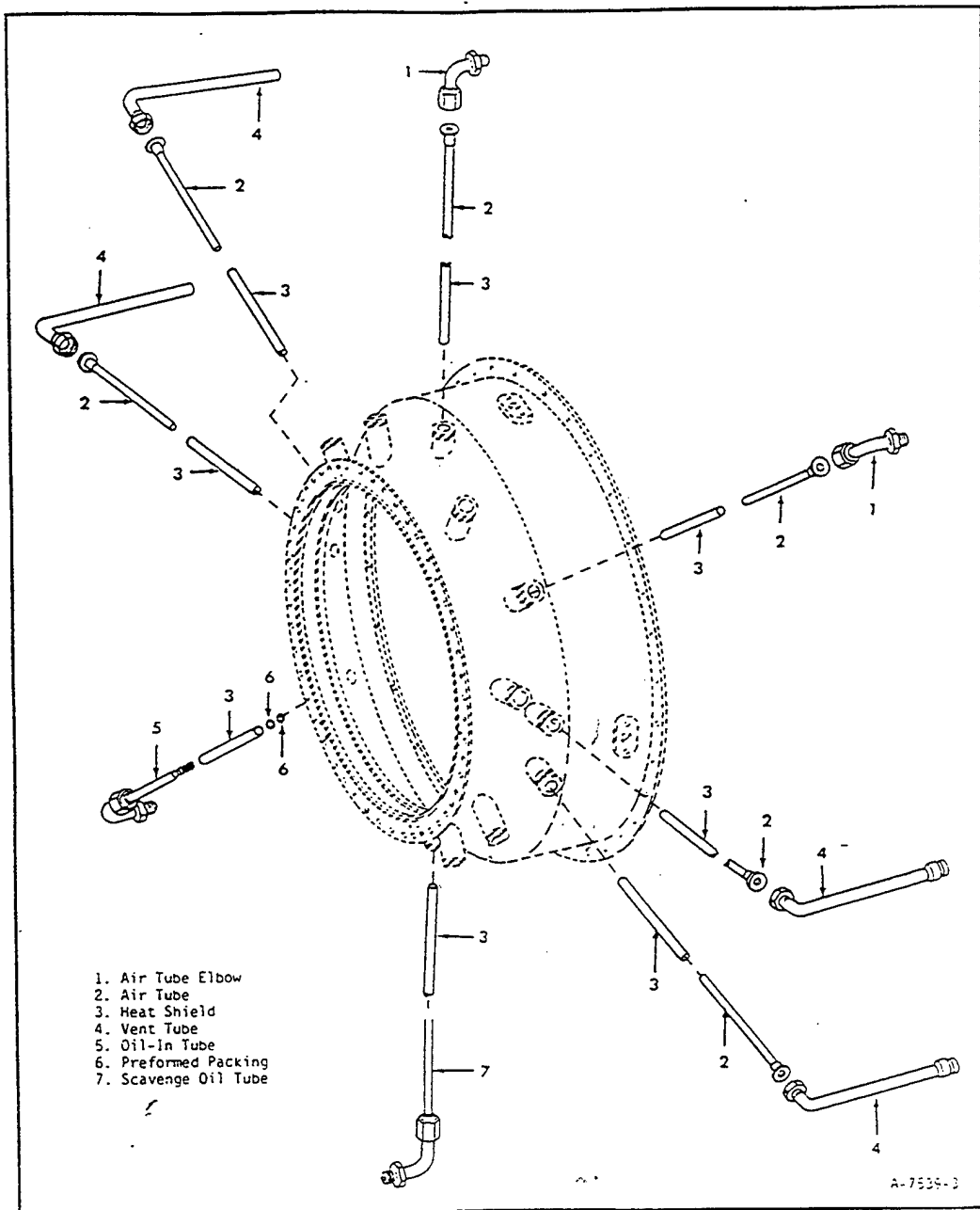5. Herl, A.M., NAVAIRSYSCOM, F/A-18 CALS Lead., E-mail response to configuration control questions. 21 January 1997.

6. Hardee, M.D., COMNAVAIRPAC, Maintenance Officer, Code N422C., *ATE Configuration Control*, 14 November 1996.

7. Heizer, J. and B. Render., *Production and Operations Management: Strategic and Tactical Decisions (Fourth Edition)*. Upper Saddle River, NJ: Prentice Hall, Inc. 1996.

8. Configuration/Data Management Division, AIR-1.3.3., *Naval Aviation Systems Team: Datagram No. 6*, Commander, Naval Air Systems Command, December 1996.

9. NAVAIRSYSCOM, AIR-41042C/AIR-5312I., *Aircrew Systems Change No. 537 (TDC 66): T/AV-8B Ejection Seat Improved Firing Control Cable Assembly, Incorporation of*, Commander, Naval Air Systems Command, 1 March 1991.

10. MALS THIRTEEN., *AV-8B Hazardous Material Report*, Message date time group 110404Z JUN 96.

11. NAVAVNDEPOT CHERRY PT NC., *Proposed Aircrew Systems Bulletin (ACB) XXX, TD Code 67, AV-8B/TAV-8B Ejection Seat Firing Control Cable Assy Inspection; Request for Verification*, Message date time group 022007Z JUL 96.

12. HMM ONE SIX THREE., *AV-8B Firing Control Handle Urgent Material Screen*, Message date time group 211500Z JUL 96.

13. COMNAVAIRSYSCOM WASH DC., *Avionics Change Nr. 4399, TD Code 54, Air Data Computer (ADC), CP-1334/A PROM Update and Power Supply Noise Attenuation in F/A-18 Aircraft (RAMEC NORIS 04-91) WUC 56X2800*, Message date time group 271940Z APR 93.

14. COMNAVAIRSYSCOM WASH DC., *Flight Restrictions on All Lot XIII and Below F/A-18 Aircraft*, Message date time group 131940Z OCT 92.

15. COMNAVAIRSYSCOM WASH DC., *Interim Avionics Change (IAVC) No. 4242, Revision A, (TD Code 54), F/A-18 CP-1334/A, Air Data Computer, A3 Power Supply Electrical Shielding (Ferrite) Bead, Addition of*, Message date time group 271942Z APR 93.

16. NAVAVNDEPOT NORTH ISLAND CA., *F/A-18 Avionics Bulletin (AVB) Nr. 512 Rev. A, (TD Code 55), Inspection of Air Data Computer (ADC) CP-1334/A, (WUC 56X2800) for Correct Power Supply Ferrite Bead Installation*, Message date time group 061458Z JUL 95.

17. COMNAVAIRLANT NORFOLK VA., *F-A-18 Air Data Computer (ADC) CP-1334/A*, Message date time group 031257Z AUG 95.

18. COMNAVAIRPAC SAN DIEGO CA., *Physical Inspection of Air Data Computers (ADC) for incorp of AVC-4242, AVC-4399, or AVB-512 (REV A)*, Message date time group 251315Z SEP 95.

19. COMNAVAIRSYSCOM WASH DC., *Sitsum Concerning Incorp of AVC-4242/4399*, Message date time group 241408Z AUG 95.

20. NAVAVNDEPOT NORTH ISLAND CA., *F/A-18 Avionics Bulletin (AVB) Nr 512, REV A, Amendment Nr. 1, (TD Code 55), Inspection of Air Data Computer (ADC) CP-1334/A, WUC 56X2800, For Correct Power Supply Ferrite Bead Installation*, Message date time group 160738Z JAN 96.

21. NAVAVNDEPOT NORTH ISLAND CA., *F/A-18 Avionics Bulletin (AVB) Nr 561, (TD Code 55), Inspection of Air Data Computer (ADC) CP-1334/A (WUC 56X2800) for Correct Power Supply Installation*, Message date time group 180734Z JAN 96.

22. Tobler, C. "A Fortune Saved by Overhaul Computer." *Interavia Aerospace Review*. May 1992.

23. SABRE Decision Technologies., *Product Marketing Proposal: EMTECH Maintenance and Engineering System*, January 1997.

24. SABRE Decision Technologies., *Product Marketing Proposal: Configuration Management System*, January 1997.

25. SABRE Decision Technologies., *User Guide for On-line TWD System Screens*, January 1997.

26. SABRE Decision Technologies., *User Guide for Service Bulletin Screen*, January 1997.

27. Lillo, N., SABRE Decision Technologies., E-mail response to configuration management questions. 3 January 1997.

28. Simmons, J., SABRE Decision Technologies., E-mail response to configuration management questions. 3 January 1997.

29. Simmons, J., SABRE Decision Technologies., E-mail response to configuration management questions. 19 February 1997.

30. Applegate, L.M., McFarlane, F.W. and J.L. McKenney., *Corporate Information Systems Management: Text and Cases,* Fourth Edition, Times Mirror Books, 1996.

31. Wang, M., RAND., E-mail response to electronic data interchange questions. 3 January 1997.

32. MacPhee, M.E., NAVAIRSYSCOM, F/A-18 Configuration Manager., Phone conversation with the author. 12 March 1997.

INITIAL DISTRIBUTION LIST

No. Copies

1. Defense Technical Information Center...2
   8725 John J. Kingman Rd., STE 0944
   Ft. Belvoir, Virginia 22060-6218

2. Dudley Knox Library..2
   Naval Postgraduate School
   411 Dyer Rd.
   Monterey, California 93943-5101

3. Defense Logistic Studies Information Exchange...1
   U.S. Army Logistics Management College
   Fort Lee, Virginia 23801-6043

4. RADM Donald Eaton, USN (Ret.), Code SM/ET...1
   Department of Systems Management
   Naval Postgraduate School
   Monterey, California 93940

5. Dr. William J. Haga, Code SM/HG...1
   Department of Systems Management
   Naval Postgraduate School
   Monterey, California 93940

6. Captain Joe Dyer..1
   F/A-18 Program Manager (PMA-265)
   Naval Air Systems Command
   1421 Jefferson Davis Hwy
   Arlington, Virginia 22242-5001

7. Commander J. Wieringa...1
   F/A-18 Project Coordinator
   Naval Air Warfare Center - Aircraft Division
   Patuxent River, Maryland 20670-5304

8. Commanding Officer...1
   Naval Aviation Depot, North Island
   San Diego, California 92135-7058

9.   Commander Larry Howard...1
     F/A-18 APML, Code 3.1.1.1C
     Naval Air Systems Command
     1421 Jefferson Davis Hwy
     Arlington, Virginia 22242-5001
     Attn: Please Route to Lieutenant Matt Herl

10. Commander M. H. Hardee..1
     COMNAVAIRPAC, Code N422C
     P.O. Box 357051
     San Diego, California 92135

11. Mr. John Simmons..1
     SABRE Decision Technologies
     P.O. Box 619616
     Dallas/Ft. Worth Airport, Texas 75261-9616

12. Dr. Mark Wang...1
     RAND
     1700 Main Street, P.O. Box 2138
     Santa Monica, California 90407-2138

13. Lieutenant Commander P. Scott White...1
     AV-8B Program Office (PMA-257)
     Naval Air Systems Command
     1421 Jefferson Davis Hwy
     Arlington, Virginia 22242-5001