UNITED STATES MARINE CORPS
MARINE FORCES RESERVE
2000 OPELOUSAS AVE.
NEW ORLEANS LA 70114

IN REPLY REFER TO
5830
CMFR
6 Sep 18

SECOND ENDORSEMENT on LtCol (b) (6) ltr 5830 of 30 Aug 18

From: Commander, Marine Forces Reserve
To: File

Subj: COMMAND INVESTIGATION INTO THE CLASS A AVIATION MISHAP WITHIN MARINE AERIAL REFUELER TRANSPORT SQUADRON 452 ON 10 JULY 2017

Encl: (77) MFR SJA Memo dtd 6 Sep 18
(78) MARSOC Memo dtd 30 Aug 18

1. There are numerous errors and inconsistencies within the investigation and endorsement that require clarification or correction. Enclosure (77) provides all legal or procedural updates and corrections regarding this command investigation.

2. I concur with the findings of fact, opinions, and recommendations as corrected by enclosure (77) and this matter is closed.

3. I join Brigadier General James and Major General Yoo, enclosure (78), in expressing my deepest sympathy and sincerest condolences to the families, friends, and loved ones of those heroic Marines and Sailor that were tragically lost on 10 July 2017 in Itta Bena, Mississippi. The entire Marine Forces Reserve, mourns the abrupt and tragic loss of these Marines and Sailor; and they will never be forgotten by me or this command.

4. I would like to commend the efforts of the federal, state, and local first responders for their diligence, proficiency, and commitment, to supporting this command with the recovery of our fallen Marines and Sailor as well as the protection and recovery of the Government property in the fields outside of Itta Bena, Mississippi.

5. I would like to send my appreciation to the local community and all businesses that welcomed our team with their generosity and cooperation while we were conducting our investigation and recovery efforts. Their outpouring of support will forever be appreciated.

6. I would like to thank the U.S. Air Force for their acknowledging the discrepancies and deficiencies that have been brought to light by this JAGMAN investigation as well as the other investigations. The U.S. Air Force having convened an Independent Review Team (IRT) shows

how proactive they are at reviewing the blade overhaul process and implementing multiple updates and upgrades. It is my hope that these upgrades can prevent any further tragic loss of life or aircraft.

7. A copy of this investigation will be sent to the Department of the Air Force; Deputy Commandant for Aviation; Director, Commandant of the Marine Corps, Safety Division; Commander, U.S. Marine Corps Special Operations Command; and Commanding General, 2d Marine Logistics Group for their review and action.

REX. C. MCMILLIAN

Copy to:
USAF
DC Aviation
Dir, CMC Safety
Cmdr MARSOC
CG 2d MLG

UNITED STATES MARINE CORPS
4TH MARINE AIRCRAFT WING
2000 OPELOUSAS AVE.
NEW ORLEANS LA 70114

IN REPLY REFER TO:
5830
(b)
6 Sep 18

MEMORANDUM

From: Staff Judge Advocate,
To: Commander, Marine Forces Reserve

Subj: COMMAND INVESTIGATION INTO THE CLASS A AVIATION MISHAP WITHIN MARINE AERIAL REFUELER TRANSPORT SQUADRON 452 ON 10 JULY 2017

Ref: (a) LtCol (b) (6) CI 5830 (b) dtd 30 Aug 18
(b) JAGINST 5800.7F (JAGMAN)

1. This memorandum is to memorialize the structural and substantive issues discovered within the subject command investigation (CI), reference (a), which was conducted in accordance with reference (b).

2. 4th Marine Aircraft Wing (4th MAW) Endorsement:

a. Paragraph three of the endorsement discusses the line of duty (LOD) determinations. These LOD determinations were not part of this investigation and only stated in the preliminary statement to declare that they were conducted in separate command investigations. The paragraph should have only stated that these determinations were completed in a separate command investigation.

b. Subparagraph (a) of paragraph ten shall have the words "endorsement and" removed as the Commander of Marine Special Operations Command (MARSOC) does not have an endorsement role within this investigation.

3. Preliminary Statement:

a. Paragraph three list service members without the use of their Electronic Data Interchange Personal Identifier (EDIPI), military occupational specialty (MOS), and branch of service. These Marines are: General Robert B. Neller, (b) (6) /8003 USMC, Commandant of the Marine Corps; Lieutenant General Rex C. McMillian, (b) (6) /8003 USMCR, CMFR; and Brigadier General Bradley S. James, (b) (6) /8003 USMCR, 4th MAW CG.

4. Findings of Fact - Warner Robins Air Logistics Complex (WR-ALC):

a. Paragraph 161 is **legally insufficient** as currently written. The Finding of Fact shall now read: "No evidence exists depicting the relationship between growth rates of the fatigue, radial, and circumferential cracks which formed on P2B4. The development of

existing pits and IGC started prior to P2B4's 2011 overhaul at WR-ALC by evidence of the presence of anodization in the pits and IGC. This development caused the blades ultimate liberation by a circumferential fatigue crack on 10 July 2017. [Encls (22), (24), (27), (30)]"

b. Paragraph 238 references enclosures (29) and (37) that do not support the fact stated. Additionally, the phrase "existing business processes between NAVSUP and NAVAIR" is not in any of the referenced enclosures. The noted enclosures and language shall be removed.

c. Paragraph 241 shall remove the sentence: "Per business processes between NAVSUP and NAVAIR, unless a negative trend is observed these reports will not be passed to NAVAIR." This sentence is not supported by the referenced enclosures.

d. Paragraph 243 will add the word "technical and engineering" in front of the word "content" in the first sentence. Additionally, add the word "technical and engineering" in front of the word "changes" in the second sentence.

5. Opinions:

a. Opinion four states that "P2B4 did not exit the aircraft"; however, there is no finding of fact stating or inferring this information. Additionally, the phrase "and the displacement of the aircraft to the right" is not supported by the referenced facts or any facts within the investigation and should be stricken. These two phrases are removed.

b. Opinion seven shall be removed as it states physiological forces and conditions that were suffered by the crew which are not identified or even discussed within the referenced facts or any facts within the investigation.

c. Opinion eight shall be removed as it states physiological forces and the phrase "induced a rapid G onset" which are not identified or even discussed within the referenced facts or any facts within the investigation.

6. Recommendations:

a. Recommendation seventeen should be stricken and rewritten as: "Forward a copy of this investigation to the Department of the Air Force for their review and appropriate action."

(b) (6)

UNITED STATES MARINE CORPS
U.S. MARINE CORPS FORCES SPECIAL OPERATIONS COMMAND
PSC BOX 20116
CAMP LEJEUNE NC 28542-0116

5830
SJA
AUG 30 2018

MEMORANDUM on Lieutenant Colonel (b) (6) CI ltr 5830 (b) dtd 24 Aug 18

From: Commander, U.S. Marine Corps Forces, Special Operations Command
To: Commander, Marine Forces Reserve

Subj: COMMAND INVESTIGATION INTO THE CLASS A AVIATION MISHAP WITHIN MARINE AERIAL REFEULER TRANSPORT SQUADRON 452 ON 10 JULY 2017

1. I have reviewed the subject investigation in its entirety and appreciate the thoroughness of the 4th Marine Air Wing (MAW) team designated to look into this matter.

2. I am satisfied with the findings and opinions of the investigation, and will consider all recommendations that apply to U.S. Marine Corps Forces, Special Operations Command planning and operations.

3. I am especially thankful for the comprehensive search and respectful recovery of our seven Raiders. Their absence is felt throughout this entire command on a daily basis. On behalf of the entire Raider community, I want to express my deepest sympathies and condolences to the families, loved ones and teammates of all sixteen service members lost that day.

D. D. YOO

Copy to:
CG, 4th MAW

UNITED STATES MARINE CORPS
4TH MARINE AIRCRAFT WING
2000 OPELOUSAS AVE
NEW ORLEANS LA 70114-1500

5000-38
CG
31 Aug 18

FIRST ENDORSEMENT on LtCol (b)(6) ltr 5830 JLB of 30 Aug 18

From: Commanding General, 4th Marine Aircraft Wing
To: Commander, Marine Forces Reserve

Subj: COMMAND INVESTIGATION INTO THE CLASS "A" AVIATION MISHAP WITHIN MARINE AERIAL REFUELER TRANSPORT SQUADRON 452 ON 10 JULY 2017

1. Readdressed and forwarded.

2. The findings of fact, opinions and recommendations are approved.

3. As stated in the JAGMAN Investigation, I found that the deaths of Major Cain M. Goyette, Captain Sean E. Elliott, Gunnery Sergeant Mark A. Hopkins, Gunnery Sergeant Brendan M. Johnson, Staff Sergeant Robert H. Cox, Staff Sergeant William J. Kundrat, Staff Sergeant Joshua M. Snowden, Petty Officer 1st Class Ryan M. Lohrey, Sergeant Chad E. Jenson, Sergeant Talon R. Leach, Sergeant Julian M. Kevianne, Sergeant Owen J. Lennon, Sergeant Joseph J. Murray, Sergeant Dietrich A. Schmieman, Corporal Daniel I. Baldassare and Corporal Collin J. Schaaff occurred in the line of duty and not due to their misconduct.

4. We mourn the tragic loss of our Marines and Sailor. On behalf of the Marines and Sailors of 4th Marine Aircraft Wing, I wish to express my deepest sympathy and sincerest condolences to the families, friends and loved ones. What we do as an institution is inherently dangerous. Understanding that fact does not lessen the impact on all of us when we have injuries or loss of life. These wonderful Marines and Sailor will not be forgotten.

5. On 10 July 2017 at approximately 1549 CDT, the mishap aircraft (MAC), bureau number 165000 with the call sign of "Yanky 72" experienced catastrophic failure at Flight Level 200 (20,000 feet). The initial incident that started the cascading failure was the liberation of a blade from the #2 propeller assembly. The subsequent events quickly led to structural failure of the aircraft. Neither the aircrew nor anybody aboard the KC-130T could have prevented or altered the ultimate outcome after such a failure.

6. After the mishap, many Federal, State, local departments and agencies formed a task force to protect Government property, recover remains, investigate and clean-up the sites. These complex and exhaustive efforts were performed under demanding conditions. I am

extremely proud and deeply touched by the dedication, efforts and professionalism demonstrated by those who searched for and recovered our fallen.

7. Additionally, I want to highlight the efforts and generosity of many of the wonderful people in and around Itta Bena, Mississippi. They were there from the beginning to offer and provide food, shelter and any other need. All the efforts and friendships will be remembered and kept, respectively.

8. Just as with most inspections and investigations, the critical analysis and synthesis generates better operating practices. This learning process has identified areas to improve efficiencies and effectiveness while never losing focus of an acceptable safety margin. We owe that to our Marines and Sailors to enable them to conduct the needed training and ultimately mission accomplishment. All leaders of 4th Marine Aircraft Wing will be thoroughly briefed on this investigation and directed to use their experience within their skillsets to improve the aforementioned, specifically in recommendations 13 and 14.

9. I directed 4th MAW Aviation Logistics Division (ALD) to conduct a follow-up visit to their March 2018 visit and report the status on all directed specific remedial action with the respect to the missed 56-day inspection. In addition, the Commanding Officer of MAG-49 and VMGR-452 shall take specific actions with respect to ALD findings and instituting recommendations 8 and 9.

10. I respectfully recommend this investigation at a minimum, be delivered as follows:

a. To the Commander, Marine Special Operations Command for endorsement and appropriate action in accordance with the investigating officer's recommendation 16.

b. To the Deputy Commandant for Aviation for appropriate action and coordination with Commander, Naval Air Systems in accordance with the investigating officer's recommendations 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15 and 17.

c. To the Director, Commandant of the Marine Corps Safety Division, for appropriate action in accordance with the investigating officer's recommendations 12, 14 and 15.

d. To the Commander, Naval Air Systems Command for appropriate action in accordance with the investigating officer's recommendations 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and 17.

e. To the Commanding General, 2d Marine Logistics Group for appropriate action in accordance with the investigating officer's recommendation 16.

B. S. JAMES

UNITED STATES MARINE CORPS
FOURTH MARINE AIRCRAFT WING
UNITED STATES MARINE CORPS FORCES RESERVE
2000 OPELOUSAS AVE.
NEW ORLEANS LA 70114

IN REPLY REFER TO:
5830
JLB
30 Aug 18

From: Lieutenant Colonel (b)(6) /7557 USMCR
To: Commanding General, Fourth Marine Aircraft Wing

Subj: COMMAND INVESTIGATION INTO THE CLASS A AVIATION MISHAP WITHIN MARINE AERIAL REFUELER TRANSPORT SQUADRON 452 ON 10 JULY 2017

Ref:
(a) JAGINST 5800.7F, (JAGMAN)
(b) NAVAIR 01-75GAH-1, KC-130T NATOPS Flight Manual
(c) OPNAVINST 3710.7V, NATOPS Program
(d) MCO P3500.14, Aviation T&R Program
(e) NAVMC 3500.52D, KC-130T T&R Manual
(f) NAVAIR 01-75GAA-6, Periodic Maintenance Information Manual, Navy Models C-130T, KC-130T, KC-130T-30 Hercules Aircraft
(g) NAVAIR 03-20C-4 Change 11 DTD 15 July 2016 Technical Manual, Intermediate and Depot Maintenance with Illustrated Parts Breakdown, Aluminum Alloy Propeller Blades, Part Numbers A7111D-2, A7111E-2, A7121B-2
(h) NAVAIR 03-20C-4 Change 6 DTD 15 Aug 2011 Technical Manual, Intermediate and Depot Maintenance with Illustrated Parts Breakdown, Aluminum Alloy Propeller Blades, Part Numbers A7111D-2, A7111E-2 , A7121B-2
(i) NAVAIR 03-20CBBJ-2, Technical Manual, Intermediate and Depot Maintenance with Illustrated Parts Breakdown, Variable Pitch Aircraft Propeller
(j) COMNAVAIRFORINST 4790.2C, Interim Change 2, Naval Aviation Maintenance Program
(k) NAVAIR 01-75GAA-6-3, Technical Manual Isochronal (ISO)/Special/Conditional Maintenance, Model C-130T, KC-130T, KC-130T-30 Hercules Aircraft
(l) AFMAN 24-204, Transportation-Preparing HAZMAT for Military Air Shipments

Encl:
(1) Appointing Order and Extension Letters
(2) VMGR-452 Signed Schedule - 10 July 2017
(3) MCTFS BIRs and Naval RED with CASREP
(4) Training Jacket Excerpt
(5) Aircrew MOS Designation Letters
(6) Aircrew Flight Hours Excel Sheet Printout
(7) MAC Folder Contents
(8) Autopsy Reports

(9) Aircrew Risk Assessment Worksheets
(10) Interview Transcript Major (b)(6)
(11) Interview Transcript Major (b)(6)
(12) NALCOMIS Safe-for-Flight Print Screen
(13) Lockheed Martin Technical Report
(14) Interview Transcript Sergeant (b)(6)
(15) Interview Transcript Lance Corporal (b)(6)
(16) Interview Transcript (b)(6)
(17) Weather Data [CD]
(18) Navigation Log for MAC (Flight Winds Aloft)
(19) Federal Aviation Administration (FAA) Tapes - 10 July 2017
(20) 84 Radar Evaluation Squadron (RADES) Flight Data
(21) CP6811083MER1 Structures Materials Engineering Report (MER)
(22) CP6819585MER1 Propeller 2 Blade 4 (P2B4) MER
(23) 911 Calls for Plane Crash [CD]
(24) Statement and Emails from Mr. (b)(6)
(25) MOA between U.S. Navy and U.S. Air Force
(26) Production Acceptance Certification Standards
(27) V55215-17-0044 Propeller 2 EI
(28) Propeller Blade Repair at Warner Robins Aviation Logistics Complex (WR-ALC) Process Audit - 25-26 August 2017
(29) JAGMAN WR-ALC Interview Summary
(30) Propeller Blade Cracking PowerPoint (USAF)
(31) Propeller Blade 101 PowerPoint (UTC Aerospace)
(32) WR-ALC Blade Overhaul Process
(33) NAVAIR 03-20C-4 2011 and 2016 Technical Manuals
(34) NAVAIR 01-1A-16-1 Technical Manual
(35) USAF Quality Assurance (QA) Chapters
(36) Redstripe Letter from Commander NAVAIR
(37) 26 February 2018 WR Visit Presentation Sheets and Statement of Findings
(38) 2009 Depot Maintenance Interservice Support Agreement (DMISA) Sheets
(39) Summary of NAVSUP Teleconference
(40) 1998 USAF Liaison Manager Position Description
(41) V55215-17-0043 Propeller 1 EI
(42) NALCOMIS Propeller History Excerpts
(43) V55215-17-0045 Propeller 3 EI
(44) V55215-17-0046 Propeller 4 EI
(45) NAVAIR 01-75GAA-6-3 56-Day Conditional Inspection Cards
(46) 700-hour ISO A Engine Inspection Maintenance Requirement Cards (MRCs)
(47) NAVAIR 01-75GAA-6-3 840-Day Special Inspection Cards
(48) NALCOMIS Aircraft Flight Reports
(49) 700-Hour ISO A Engine Inspection In-Process Sheets
(50) ISO A Inspection Sequence Control Cards (SCCs)
(51) VMGR-452 Site Visit Statement of Findings

(52) Sergeant (b)(6) Interview Transcript
(53) Staff Sergeant (b)(6) Interview Transcript
(54) MSHARP BUNO 165000 Flight Hours Print Screen
(55) Aircraft Discrepancy Book Summary Report
(56) Aircraft Flight Report 13 June - 10 July 2017
(57) 18 August 2016 Inspection Results
(58) 14 December 2017 Inspection Results
(59) Interview Transcript Gunnery Sergeant (b)(6)
(60) Joint Inspection (JI) Procedures for Military Airlift
(61) Joint Inspection (JI) Inspection form DD2133 (signed)
(62) MAC Load Plan, 20170708 18:20 UTC
(63) MAC Cargo Hazardous Declarations (Hazdecs)
(64) AFMAN 24-204 Excerpts
(65) Unrecovered Hotel Company Crash Gear List
(66) Field Manual (FM) 4-30.13 Ammunition Handbook Excerpts
(67) Ammo Pallet Restraint Powerpoint Slides
(68) MCRP 4-11.3G Embarkation Handbook Excerpt
(69) Interview Transcript Corporal (b)(6)
(70) MRZR Photos
(71) Interview Transcript Sergeant (b)(6)
(72) Interview Transcript Sergeant (b)(6)
(73) Written Statement Lance Corporal (b)(6)
(74) MAC Embark Mission Timesheet
(75) 437th Airlift Wing (AW) Mission Statement and Investigation Report
(76) (b) (6) Letters

Table of Contents

Table of Individuals

Rank	Full Name	EDIPI	MOS	BOS	Billet
Marine Aerial Refueler Transport Squadron 452 (VMGR-452)					
Mishap Aircrew/Passenger					
Major	Caine M. Goyette	(b) (6)	7557	USMC	Pilot
Captain	Sean E. Elliott	(b) (6)	7557	USMC	Co-Pilot
Staff Sergeant	Joshua Snowden	(b) (6)	6276	USMCR	Flight Engineer
Sergeant	Owen J. Lennon		6276	USMCR	Flight Engineer
Gunnery Sergeant	Mark A. Hopkins		7372	USMCR	Tactical System Operator
Gunnery Sergeant	Brendan C. Johnson		6276	USMCR	Crewmaster
Sergeant	Julian M. Kevianne		6276	USMCR	Crewmaster
Lance Corporal	Daniel I. Baldassare		6276	USMCR	Crewmaster
Corporal	Collin J. Schaaff		6531	USMC	VMGR-452 Passenger
2d MRB MARSOC Mishap Passengers					
Staff Sergeant	William J. Kundrat	(b) (6)	0372	USMC	2d MRB Passenger
Staff Sergeant	Robert H. Cox		0372	USMC	2d MRB Passenger
Staff Sergeant	Talon R. Leach		0372	USMC	2d MRB Passenger
Sergeant	Chad E. Jenson		0372	USMC	2d MRB Passenger
Sergeant	Joseph J. Murray		0372	USMC	2d MRB Passenger
Sergeant	Dietrich A. Schmieman		0372	USMC	2d MRB Passenger

Petty Officer First Class	Ryan Lohrey	(b) (6)	SARC	USN	2d MRB Passenger
VMGR-452 Personnel					
Lieutenant Colonel	(b) (6)		7557	USMCR	Commanding Officer
Major			7557	USMC	Non-Mishap Pilot
Major			7557	USMC	Non-Mishap Co-Pilot
Staff Sergeant			6216	USMC	Senior CDQAR and Powerline Chief
Sergeant			6216	USMC	Powerline Mechanic
Sergeant			6216	USMC	CDQAR and Powerline Mechanic
H Co 2d MRB MARSOC					
Gunnery Sergeant	(b)(6)		0491	USMC	Logistics Chief
Sergeant			0431	USMC	Embarkation Chief
Corporal			2311	USMC	Ammunition Technician
Combat Logistics Company 21					
Sergeant	(b)(6)		2311	USMC	Ammunition Technician
Lance Corporal			3112	USMC	Joint Inspector
USMC Command Personnel					
General	Robert B. Neller	(b)(6)	8003	USMC	Commandant of the Marine Corps
Lieutenant General	Rex C. McMillian		8003	USMCR	Commander Marine Forces Reserve
Brigadier General	Bradley S. James		8003	USMCR	4th MAW CG
JAGMAN Investigation Team					
Lieutenant Colonel	(b)(6)		7557	USMCR	VMR Belle Chasse Investigating Officer
Lieutenant Colonel			7525	USMCR	MFR Staff Judge Advocate Mishap SME
Lieutenant Colonel			4402	USMC	3rd MAW Staff Judge Advocate Mishap SME
Major			7557	USMC	VMGR-234 KC-130 Maintenance SME
Major			7557	USMCR	VMGR-234 KC-130 NATOPS SME

Captain	(b)(6)	0430	USMC	MARSOC Mobility Officer Embarkation SME
Captain		6002	USMC	4th MAW ALD Data Architect
Command SJAs				
Colonel	(b)(6)	4402	USMC	MFR Staff Judge Advocate
Colonel		4402	USMCR	4th MAW Staff Judge Advocate

Table of Figures

Preliminary Statement

1. Per enclosure (1) and in accordance with reference (a), the Commanding General, Fourth Marine Aircraft Wing (4th MAW) appointed the Investigating Officer, Lieutenant Colonel (b)(6), to conduct this command investigation to inquire into the facts and circumstances surrounding the Class A Aviation mishap of the KC-130T aircraft Bureau Number (BUNO) 165000 from Marine Aerial Refueler Transport Squadron 452 (VMGR-452) on 10 July 2017 in the vicinity of Itta Bena, Mississippi. All personal data was obtained through administrative means. All reasonably available evidence was collected, each directive of the appointment order has been met and all governing regulations contained within the references were followed. Original items of evidence have been released to the Commanding Officer of VMGR-452, Lieutenant Colonel (b)(6). Legal guidance was

provided by Colonel (b)(6), 4th MAW Staff Judge Advocate (SJA) and Colonel (b)(6) Marine Forces Reserve (MARFORRES), SJA. All times in this report are local Central Daylight Time (CDT) unless otherwise annotated.

2. The Investigating Officer (IO) and his team arrived on-site in Itta Bena, MS on 12 July 2017 and immediately began to photograph, collect evidence from the crash site and interview witnesses in the general vicinity.

3. The CG of 4th MAW, Brigadier General Bradley S. James, USMCR, was on-site in Itta Bena, Mississippi from 11 July to 14 July 2017 and again on 2 August 2017. The Commander of Marine Forces Reserve (MARFORRES), Lieutenant General Rex C. McMillian, USMCR, was on-site on 20 July 2017 and again on 2 August 2017. The Commandant of the Marine Corps (CMC), General Robert B. Neller, USMC, was on-site on 20 July 2017.

4. There were six extension requests during this investigation. The delays encountered included, but were not limited to: autopsy reports, engineering investigations, and vastness of the crash site and associated debris field. As an additional delay, historical data necessary for the investigation was required, but was not contained in the Auto Log Set (ALS) and could not be accessed as the database was locked in accordance with standard aviation mishap procedures. This data is contained in the Naval Aviation Logistics Command Management Information System (NALCOMIS) Optimized Organizational Maintenance Activity (OOMA) Configuration Management (CM). In order to obtain the necessary information, the OOMA entry for the Mishap Aircraft (MAC) had to be unlocked.

5. The aircraft and crew involved in the mishap and one passenger were from VMGR-452. The squadron is located at Stewart Air National Guard Base (ANGB), Newburgh, New York and falls under the command of Marine Aircraft Group 49 (MAG-49), 4th MAW. All other passengers on the MAC flight were from 2d Marine Raider Battalion (2d MRB), Marine Raider Regiment, Marine Special Operations Command (MARSOC), which is located at Marine Corps Base (MCB) Camp Lejeune, Jacksonville, North Carolina.

6. Line of duty determinations for all deceased service members were made on 20 October 2017. These determinations were made and disseminated to the next of kin before completion of this report.

7. Interviews were conducted in Greenwood, Mississippi; Stewart ANGB, Newburgh, New York; MCAS Cherry Point, North Carolina; MCB Camp Lejeune, North Carolina; Salt Lake City, Utah, and Robins AFB, Warner Robins, Georgia, in person or by telephone. No difficulties were encountered while interviewing witnesses.

8. The Lockheed KC-130T Hercules is a high wing, all metal, long range, land based monoplane with multiple missions that include providing inflight refueling or rapid transportation of personnel or cargo for delivery by parachute or landing. The aircraft is used as a tactical transport asset and can be converted readily for ambulance or aerial delivery missions.

9. The MAC first entered service with the United States Government on 14 January 1993, with an original procurement cost of $38,000,000.00. The MAC was destroyed in this mishap.

10. The terms proficiency, currency and naval air training and operating procedures standardization (NATOPS) qualified refer to the standards set forth in references (b), (c), (d) and (e).

11. To provide a holistic view of all parties involved in the depot-level propeller overhaul process the JAGMAN Investigation Team is publishing remedial measures initiated by those parties since the mishap. This will assist in portraying the change in attitude and focus by those parties responsible for producing and overhauling propellers from 2011 to 2018.

Narrative Summary

At 1549 central daylight time on 10 July 2017, a KC-130T, flown by a crew of eight United States Marines from VMGR-452, suffered a fatal mishap en route to Naval Air Facility El Centro, California. Eight passengers were on board: seven from 2d Raider Battalion, Marine Corps Special Operations Command, and one from VMGR-452. The aircraft crashed into a soybean field in the vicinity of Itta Bena, Mississippi. All fifteen Marines along with one United States Navy Sailor were tragically killed. The aircraft was destroyed.

The investigation determined the cause of the mishap to be an in-flight departure of the number four blade from the number two propeller. This propeller blade (P2B4) liberated while the aircraft was flying at a cruise altitude of 20,000 feet. The liberation of P2B4 initiated the catastrophic sequence of events resulting in the midair breakup of the aircraft and its uncontrollable descent and ultimate destruction.

Post-mishap analysis of P2B4 revealed that a circumferential fatigue crack in the blade caused the fracture and liberation. This fatigue crack propagated from a radial crack which originated from intergranular cracking (IGC) and corrosion pitting. The analysis also revealed the presence of anodize coating within the band of corrosion pitting and intergranular cracking on the blade near the origin of the crack. This finding proves that the band of corrosion pitting and intergranular cracking was present and not removed during the last overhaul of P2B4 at Warner Robins Air Logistics Complex (WR-ALC) in the fall of 2011. The investigation concluded that the failure to

remediate the corrosion pitting and intergranular cracking was due to deficiencies in the propeller blade overhaul process at WR-ALC which existed in 2011 and continued up until the shutdown of the WR-ALC propeller blade overhaul process in the fall of 2017.

The investigation also examined whether any operational or intermediate level maintenance inspections or maintenance actions exist which could have detected the underlying causal conditions prior to the mishap. The investigation concluded that while these inspections exist, it cannot be quantifiably determined that these inspections would have detected the causal condition. The investigation arrived at this conclusion due to the fact that the growth or propagation rate of an IGC radial crack cannot be predicted. Though no evidence exists to determine when the radial crack had grown to a detectable area, beyond the bushing, there exists a distinct possibility that it could have been detected if the radial crack had grown past the bushing and the off wing eddy current inspection was performed.

Findings of Fact

A. Aircraft Manifest (KC-130T)

1. Mishap Aircraft Aircrew

1. The aircrew of the KC-130T, from VMGR-452, that crashed on 10 July 2017 in the vicinity of Itta Bena, Mississippi, consisted of:

Major Goyette - Mishap Pilot
Captain Elliott - Mishap Co-Pilot
Staff Sergeant Snowden - Mishap Flight Engineer
Sergeant Lennon - Mishap Flight Engineer
Gunnery Sergeant Hopkins - Mishap Tactical Systems Operator
Gunnery Sergeant Johnson - Mishap Crewmaster
Sergeant Kevianne - Mishap Crewmaster
Lance Corporal Baldassare - Mishap Crewmaster [Encls (2), (3)]

2. Major Goyette was designated a Naval Aviator on 2 July 2004. [Encls (3-5)]

3. Major Goyette's most recent NATOPS Transport Plane Commander qualification in the KC-130T model aircraft was on 28 September 2016. [Encls (4), (5)]

4. Major Goyette completed his annual flight physical on 7 June 2017. [Encl (4)]

5. Major Goyette had a current medical "up-chit" with an expiration date of 31 May 2018 certifying his clearance for aviation duty. [Encl (4)]

6. Major Goyette's physiology training was current and valid until 31 August 2020. [Encl (4)]

7. Major Goyette's standard instrument rating was current and valid through 31 December 2017. [Encl (4)]

8. Major Goyette completed Crew Resource Management (CRM) ground training on 7 January 2017. [Encl (4)]

9. There were no discrepancies with Major Goyette's NATOPS training requirements or currency. [Encl (4)]

10. Major Goyette had 47.8 flight hours in the 30 days prior to the mishap, and 86.3 flight hours in the 90 days prior to the mishap. [Encl (6)]

11. Major Goyette had flown 2,614.4 hours in military aircraft. [Encl (6)]

12. Captain Elliott was designated a Naval Aviator on 3 August 2012. [Encl (3)]

13. Captain Elliott was NATOPS qualified in KC-130T model aircraft on 30 June 2017. [Encls (4), (5)]

14. Captain Elliott completed his annual flight physical on 11 April 2017. [Encl (4)]

15. Captain Elliott had a current medical "up-chit" with an expiration date of 31 March 2018 certifying his clearance for aviation duty. [Encl (4)]

16. Captain Elliott's physiology training was current and valid until 31 December 2018. [Encl (4)]

17. Captain Elliott's standard instrument rating was current and valid through 30 June 2018. [Encl (4)]

18. Captain Elliott completed CRM ground training on 30 June 2017. [Encl (4)]

19. There were no discrepancies with Captain Elliott's NATOPS training requirements or currency. [Encl (4)]

20. Captain Elliott had 22.9 flight hours in the 30 days prior to the mishap and 33.1 flight hours in the 90 days prior to the mishap. [Encl (6)]

21. Captain Elliott had flown 822.0 hours in military aircraft. [Encl (6)]

22. Staff Sergeant Snowden was designated a Flight Engineer 1 on 15 November 2014. [Encl (5)]

23. Staff Sergeant Snowden was designated a Night Systems Instructor (NSI) on 25 January 2017. [Encl (5)]

24. Staff Sergeant Snowden was NATOPS qualified in the KC-130T model aircraft on 2 November 2016. [Encl (4)]

25. Staff Sergeant Snowden completed his annual flight physical on 24 June 2017. [Encl (4)]

26. Staff Sergeant Snowden had a current medical "up-chit" with an expiration date of 31 July 2017 certifying his clearance for aviation duty. [Encl (4)]

27. Staff Sergeant Snowden's physiology training was current and valid until 28 February 2021. [Encl (4)]

28. Staff Sergeant Snowden completed CRM ground training on 10 January 2017. [Encl (4)]

29. There were no discrepancies with Staff Sergeant Snowden's NATOPS training requirements or currency. [Encl (4)]

30. Staff Sergeant Snowden had 43.4 flight hours in the 30 days prior to the mishap and 127.2 flight hours in the 90 days prior to the mishap. [Encl (6)]

31. Staff Sergeant Snowden had 2,627.7 hours of Special Crew Time (SCT) in military aircraft. [Encl (6)]

32. Sergeant Lennon was designated a Flight Engineer 2 on 3 April 2015. [Encl (5)]

33. Sergeant Lennon was NATOPS qualified in the KC-130T model aircraft on 3 April 2017. [Encl (4)]

34. Sergeant Lennon completed his annual flight physical on 5 August 2016. [Encl (4)]

35. Sergeant Lennon had a current medical "up-chit" with an expiration date of 31 August 2017 certifying his clearance for aviation duty. [Encl (4)]

36. Sergeant Lennon's physiology training was current and valid until 28 February 2019. [Encl (4)]

37. Sergeant Lennon completed CRM ground training on 3 April 2017. [Encl (4)]

38. There were no discrepancies with Sergeant Lennon's NATOPS training requirements or currency. [Encl (4)].

39. Sergeant Lennon had 31.5 flight hours in the 30 days prior to the mishap, and 132.4 flight hours in the 90 days prior to the mishap. [Encl (6)]

40. Sergeant Lennon had 2,055.8 hours of SCT in military aircraft. [Encl (6)]

41. Gunnery Sergeant Hopkins was designated a Tactical Systems Operator on 27 June 2003. [Encl (5)]

42. Gunnery Sergeant Hopkins was NATOPS qualified in the KC-130T model aircraft on 28 June 2017. [Encl (4)]

43. Gunnery Sergeant Hopkins completed his annual flight physical on 12 April 2017. [Encl (4)]

44. Gunnery Sergeant Hopkins had a current medical "up-chit" with an expiration date of 30 April 2018 certifying his clearance for aviation duty. [Encl (4)]

45. Gunnery Sergeant Hopkins's physiology training was current and valid until 30 September 2019. [Encl (4)]

46. Gunnery Sergeant Hopkins completed CRM ground training on 7 January 2017. [Encl (4)]

47. There were no discrepancies with Gunnery Sergeant Hopkins' NATOPS training requirements or currency. [Encl (4)]

48. Gunnery Sergeant Hopkins had 16.6 flight hours in the 30 days prior to the mishap, and 39.3 flight hours in the 90 days prior to the mishap. [Encl (6)]

49. Gunnery Sergeant Hopkins had 3,475.0 hours of SCT in military aircraft. [Encl (6)]

50. Gunnery Sergeant Johnson was designated a Crewmaster 3 on 28 October 2013. [Encl (5)]

51. Gunnery Sergeant Johnson was designated the NATOPS Evaluator (NE) for the KC-130T platform on 16 May 2014. [Encl (5)]

52. Gunnery Sergeant Johnson was designated an NSI on 17 April 2000. [Encl (5)]

53. Gunnery Sergeant Johnson was designated a Weapons Tactics Aircrew Instructor (WTACI) on 17 April 2000. [Encl (5)]

54. Gunnery Sergeant Johnson was NATOPS qualified in the KC-130T model aircraft on 5 June 2017. [Encl (4)]

55. Gunnery Sergeant Johnson completed his annual flight physical on 23 August 2016. [Encl (4)]

56. Gunnery Sergeant Johnson had a current medical "up-chit" with an expiration date of 31 August 2017 certifying his clearance for aviation duty. [Encl (4)]

57. Gunnery Sergeant Johnson's physiology training was current and valid until 30 August 2019. [Encl (4)]

58. Gunnery Sergeant Johnson completed CRM ground training on 7 January 2017. [Encl (4)]

59. There were no discrepancies with Gunnery Sergeant Johnson's NATOPS training requirements or currency. [Encl (4)]

60. Gunnery Sergeant Johnson had 0.0 flight hours in the 30 days prior to the mishap, and 64.2 flight hours in the 90 days prior to the mishap. [Encl (6)]

61. Gunnery Sergeant Johnson had 6,047.6 hours of SCT in military aircraft. [Encl (6)]

62. Sergeant Kevianne was designated a Crewmaster 2 on 11 October 2014. [Encl (5)]

63. Sergeant Kevianne was NATOPS qualified in the KC-130T model aircraft on 12 June 2016, which was valid through 30 June 2017. [Encl (4)]

64. Sergeant Kevianne's NATOPS qualification had expired, per his NATOPS jacket and Marine Sierra Hotel Aviation Readiness Program (MSHARP). However, a qualified and current Crewmaster NATOPS Instructor was scheduled to complete his NATOPS evaluation during this mission. [Encls (2), (4)]

65. Sergeant Kevianne completed his annual flight physical on 5 April 2017. [Encl (4)]

66. Sergeant Kevianne had a current medical "up-chit" with an expiration date of 30 April 2018 certifying his clearance for aviation duty. [Encl (4)]

67. Sergeant Kevianne's physiology training was current and valid until 31 July 2018. [Encl (4)]

68. Sergeant Kevianne completed CRM ground training on 10 January 2016. [Encl (4)]

69. Other than his expired NATOPS qualification, no other discrepancies were found with Sergeant Kevianne's NATOPS training requirements or currency. [Encl (4)]

70. Sergeant Kevianne had 0.0 flight hours in the 30 days prior to the mishap and 5.4 flight hours in the 90 days prior to the mishap. [Encl (6)]

71. Sergeant Kevianne had 1,565.8 hours of SCT in military aircraft. [Encl (6)]

72. Lance Corporal Baldassare graduated from the KC-130 Fleet Replacement Detachment (FRD) KC-130J Crewmaster Initial Accession Maintenance Course on 21 December 2016. [Encl (3)]

73. As a trainee, Lance Corporal Baldassare had mission codes scheduled during the Naval Air Facility (NAF) El Centro training evolution to advance him towards his NATOPS qualification in the KC-130T model aircraft. [Encl (4)]

74. Lance Corporal Baldassare completed his annual flight physical on 2 June 2017. [Encl (4)]

75. Lance Corporal Baldassare had a current medical "up-chit" with an expiration date of 30 June 2018 certifying his clearance for aviation duty. [Encl (4)]

76. Lance Corporal Baldassare's physiology training was current and valid until 30 March 2020. [Encl (4)]

77. Lance Corporal Baldassare completed CRM ground training on 28 February 2017. [Encl (4)]

78. There were no discrepancies with Lance Corporal Baldassare's NATOPS training requirements or currency. [Encl (4)]

79. Lance Corporal Baldassare had 47.6 flight hours in the 30 days prior to the mishap and 115.5 flight hours in the 90 days prior to the mishap. [Encl (6)]

80. Lance Corporal Baldassare had 115.5 hours of SCT in military aircraft. [Encl (6)]

2. Mishap Aircraft Passengers

81. The following Marines were passengers on the MAC:

Corporal Schaaff
Staff Sergeant Kundrat
Staff Sergeant Cox

Sergeant Leach
Sergeant Jenson
Sergeant Murray
Sergeant Schmieman
Petty Officer First Class Lohrey [Encl (7)]

82. Corporal Schaaff was attached to VMGR-452 as an Aircraft Ordnance Technician. [Encl (3)]

83. All other passengers were members of the 2d MRB. [Encl (3)]

84. All sixteen service members, eight aircrew members and eight passengers, died. [Encl (8)]

85. No alcohol or illegal drugs were present within any of the service members aboard the MAC flight at the time of the incident. [Encl (8)]

86. The cause of death for all sixteen service members aboard the MAC was blunt force trauma and contusions. [Encl (8)]

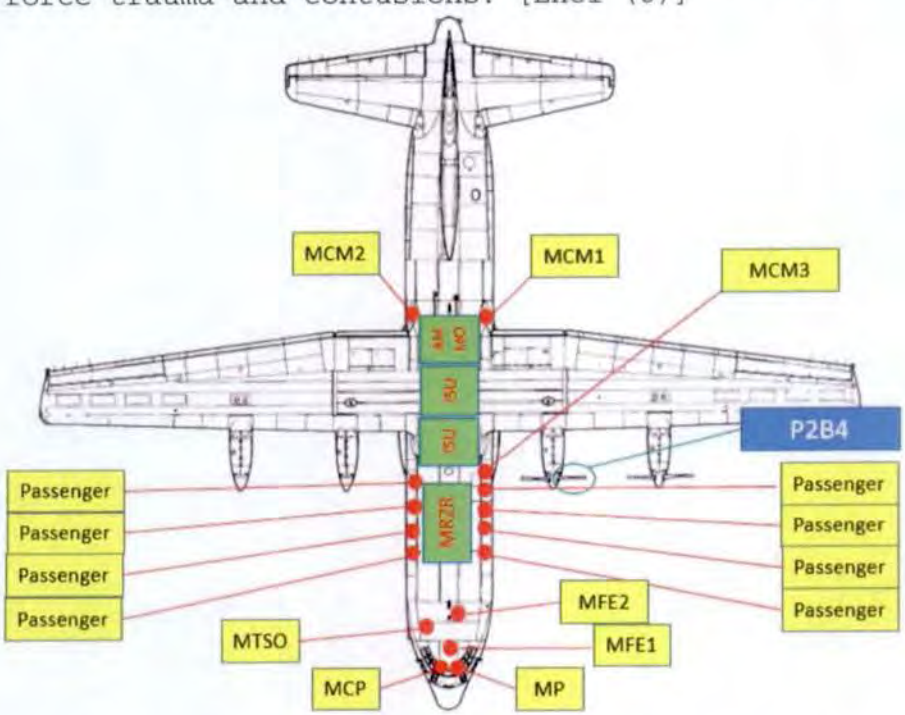

Figure 1: MAC Schematic with Probable Seating Arrangement

B. Mishap Flight

1. Departure

87. On 10 July 2017, VMGR-452 was scheduled to fly a mission where two KC-130Ts support 2d MRB by transporting Marines and equipment from Marine Corps Air Station (MCAS) Cherry Point, North Carolina to NAF El Centro, California. [Encl (2)]

88. The Squadron Commanding Officer, (CO) authorized this mission by publishing and executing the VMGR-452 flight schedule for 10 July 2017. [Encl (2)]

89. A completed VMGR-452 Risk Assessment Worksheet (RAW) indicated the aircrew were all well-rested, physically and mentally prepared to conduct the mission, and had no apparent personal problems that would affect their performance. [Encl (9)]

90. At 0830 Major (b)(6) briefed the aircrew for both aircraft together as a section, in the VMGR-452 spaces, for a formation training mission. Following the section portion of the brief, Gunnery Sergeant Johnson briefed each aircrafts' anticipated load plans to be picked up at MCAS Cherry Point, North Carolina. [Encls (2), (10), (11)]

91. The Instructor, Major (b)(6), briefed the three phases of the flight: the section flight from Newburgh, New York to MCAS Cherry Point, North Carolina, the separate individual flights from MCAS Cherry Point, North Carolina to NAF El Centro, California, and the aircraft prepositioning for training. The group then split into individual crews for each aircraft, who finished briefing separately. [Encls (10), (11)]

92. Sergeant Lennon signed the Turn-Around Inspection[1] as the MAC Plane Captain at 0927 EDT on 10 July 2017. [Encl (12)]

93. Sergeant (b)(6) signed the Safe-for-Flight Inspection at 0930 EDT on 10 July 2017. [Encl (12)]

94. Major Goyette, the Aircraft Commander, signed for the aircraft at 0932 EDT on 10 July 2017. [Encl (12)]

95. The MAC was not equipped with a flight data recorder or a cockpit voice recorder. [Encl (13)]

96. The initial section flight took off from Stewart Air National Guard Base, New York at 1000 EDT en route to MCAS Cherry Point, North Carolina. [Encls (2), (10), (11)]

2. Cherry Point

97. After landing at MCAS Cherry Point at approximately 1230 on 10 July 2017, the planes taxied to the fuel pits for refueling, then to the APOE for cargo loading. [Encls (14-16)]

[1] Turn-Around Inspection is always conducted on the first flight of the day after the Daily Inspection and before the Safe-for-Flight and before the Aircraft Commander signs for the aircraft.

98. Due to difficulties with cargo and embarkation, the two planes switched missions, call signs, and flight plans. The non-mishap aircraft departed MCAS Cherry Point slightly before the MAC departed on its second mission to NAF El Centro. [Encls (10), (11)]

99. The MAC's mission for this flight was transporting seven 2d MRB members and their equipment from MCAS Cherry Point to NAF El Centro. [Encl (7)]

100. At approximately 1407 EDT, the MAC departed MCAS Cherry Point for NAF El Centro. [Encls (7), (10), (11)]

3. Final Flight

Figure 2: MAC Actual Flight Path on 10 July 2017

101. The weather for the reporting station at Greenwood-Leflore Airport (KGWO), the station closest to the mishap location, Itta Bena, Mississippi, listed winds variable at two knots, greater than 10 statute miles visibility and skies clear at the time of the mishap. [Encl (17)]

102. Reported winds aloft in the vicinity of the incident were: at Flight Level (FL) 18,000 feet, 260 degrees at four knots; 16,000 feet, 100 degrees at two knots; 14,000 feet, 075 degrees at two knots; 12,000 feet, 082 degrees at three knots. [Encl (18)]

103. The MAC's last radio transmission was with Memphis Air Route Traffic Control Center (ARTCC) (Memphis Center) at 1546:58. [Encl (19)]

104. Memphis ARTCC's last radar contact with the MAC was at 1549:24. [Encls (19), (20)]

105. Memphis ARTCC attempted to make radio contact with the MAC nine times after the MAC's last transmission, including one call on Guard frequency.[2] [Encl (19)]

106. While the MAC was flying at 20,000 feet, P2B4 departed and sliced through the left (port) side of the fuselage, and impacted the interior of the right (starboard) side, initiating the catastrophic sequence of events of this mishap. [Encls (13), (21), (22)]

107. This impact caused the skin of the aircraft to separate along the starboard side. The energy transferred from P2B4's impact through the structure of the airframe also caused an overload condition of propeller three's drive shaft. This resulted in its associated reduction gearbox assembly (RGA) failing and the separation of propeller three from the aircraft. Propeller three then momentarily embedded into the upper right section of the fuselage. After which, it continued over the aft starboard section of the fuselage and impacted the starboard horizontal stabilizer separating a significant portion of the stabilizer from the aircraft. [Encls (13), (21), (22)]

C-130 Frontal View

Figure 3: Frontal View of C-130

[2] Guard frequencies, 121.5 and 243.0, broadcast to every aircraft who choose to monitor.

108. As a result of these events, the MAC split into three primary sections: the cockpit, the rear fuselage, and the 19' 4" section in between (where the passengers were sitting), which explosively disintegrated into multiple pieces. [Encls (13), (21), (22)]

109. Shortly after its last call to the MAC, Memphis ARTCC asked Boutique 485 (BTQ485), a local crop-duster aircraft in the vicinity, to proceed towards the MAC's last known radar position. [Encl (19)]

110. At 1556:55, BTQ485 responded seeing blackish smoke rising from the ground in the vicinity of the MAC's last known radar contact position. [Encl (19)]

111. Shortly after the MAC impacted the ground, several local civilians and emergency responders drove to the crash site. [Encl (23)]

4. Crash Site

112. The MAC inflight break up resulted in two primary debris fields: a north debris field (NDF) and a south debris field (SDF), both of which were agricultural land sites. [Encl (13)]

113. These two debris fields were separated by over a mile in distance in an east to west orientation with the center of debris fields being located at North 33.4616, West 90.4411. [Encl (13)]

114. The NDF consisted primarily of the cockpit, six crew, eight passengers, MRZR, some cargo and personal gear, the 19'4" midsection pieces of the aircraft, right hand horizontal stabilizer and number two and number three propellers. [Encl (13)]

115. Fire damage in the NDF was concentrated in the area of the impact site of the cockpit. [Encl (13)]

116. With the exception of the right hand horizontal stabilizer and the number two and number three propellers, the vast majority of the parts of the aircraft recovered in the NDF were from the aircraft sections forward of FS (fuselage station) 477.[3] [Encl (13)]

117. Both blade two and blade four which liberated from propeller two were also recovered in the NDF. [Encl (13)]

118. The SDF consisted primarily of aircraft fuselage structure aft of the forward wing box attachment at FS 477, the aircraft's wing and its four turboprop engines, the majority of the cargo and the two remaining aircrew. [Encl (13)]

119. Fire damage was significant at the SDF. [Encl (13)]

[3] The term fuselage station is a metric, which measures precise locations on an aircraft along the longitudinal axis, increasing incrementally from the front to the rear.

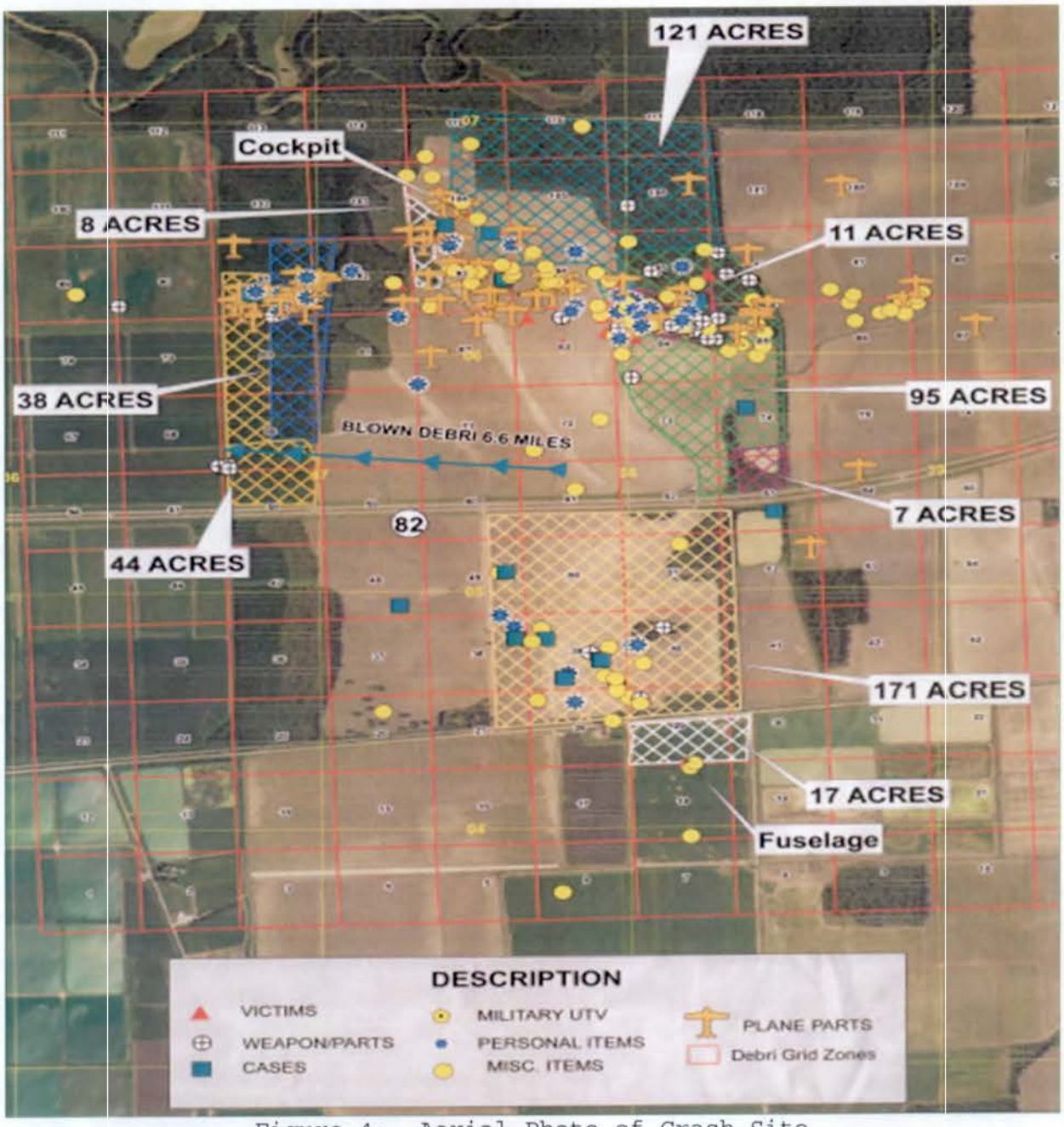

Figure 4: Aerial Photo of Crash Site

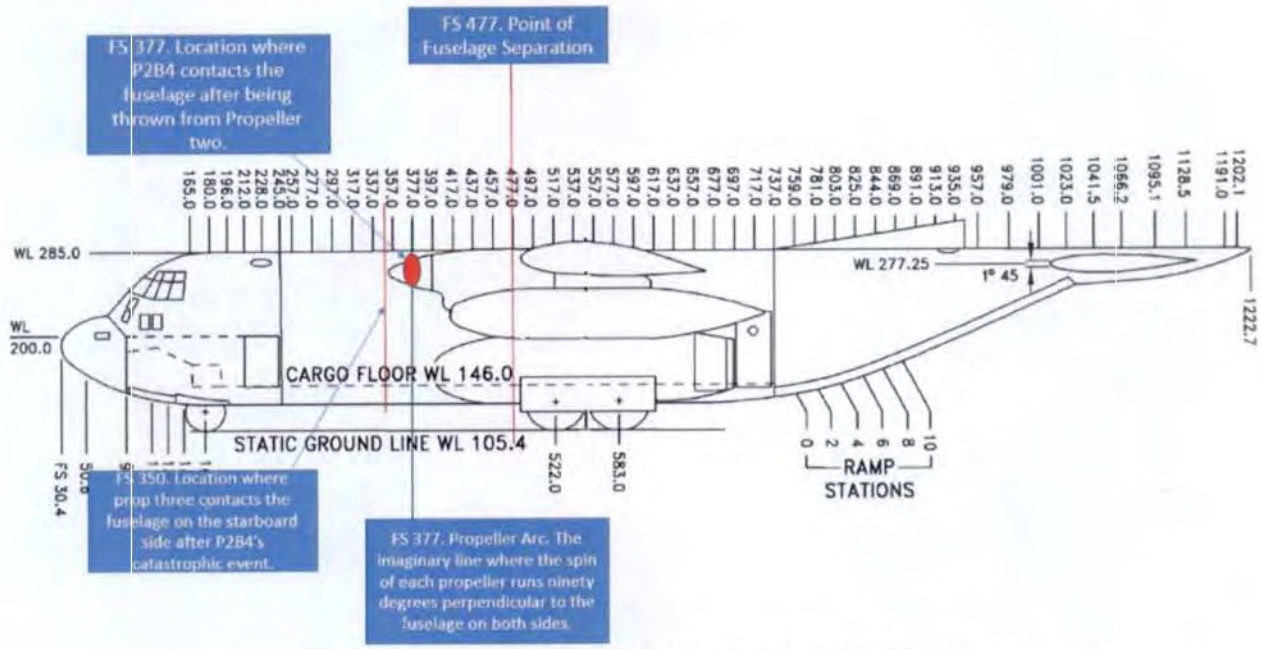

Figure 5: Side Schematic of Key Areas

C. Cause of Mishap

1. Propeller Two Blade Four (P2B4)

120. While in flight, blade four of propeller two departed the aircraft. [Encls (13), (21), (22)]

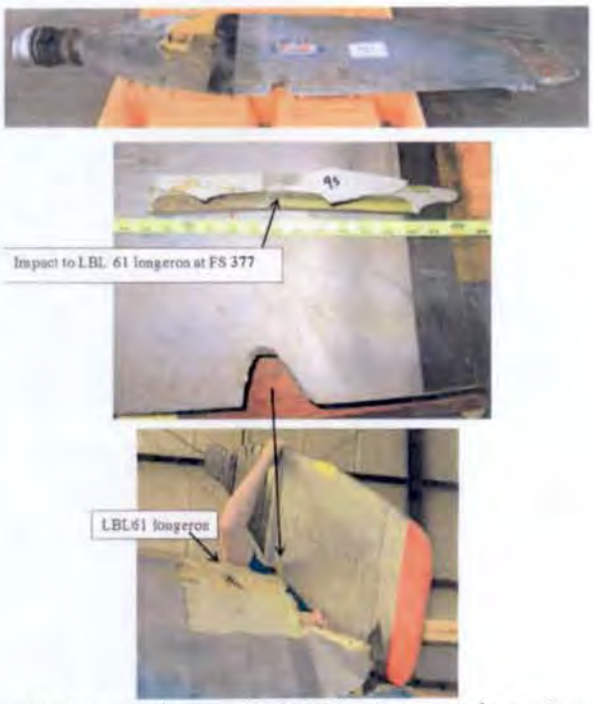

Figure 6: Reconstruction of P2B4 Impacting Port Side Panel

121. After departure, P2B4 sliced through the port side of the fuselage at FS 377 slightly aft of the propeller arc plane upon entry in a near vertical orientation. This deteriorated the left side longeron support structures as the tip cut 36 inches below left butt line (LBL) 61 and the root end of the blade impacted 19 inches above LBL 61. P2B4 then passed unobstructed through the MAC interior, and did not exit the airframe but rather impacted the interior starboard side of the cargo compartment where it remained until cargo compartment separation. [Encls (13), (21), (22)]

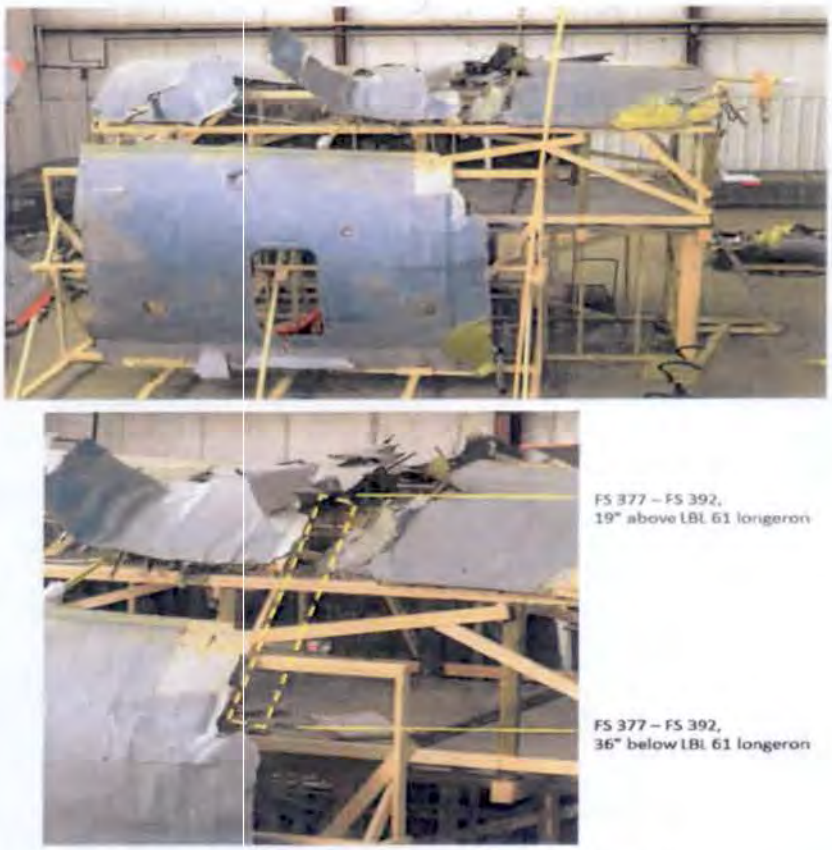

Figure 7: P2B4 Fuselage Damage

122. P2B4's intrusion resulted in an overload failure of the LBL 61 longeron on both sides of the impact point at FS 377. [Encl (21)]

123. When P2B4 passed unobstructed through the occupied space of the fuselage and impacted the starboard interior, the butt end of the blade then embedded into the robust stanchion bracket from a troop seatback support beam stowage assembly on the starboard side of the fuselage near waterline (WL) 200 between the ring segments at FS 383.67 and FS 397. [Encl (21)]

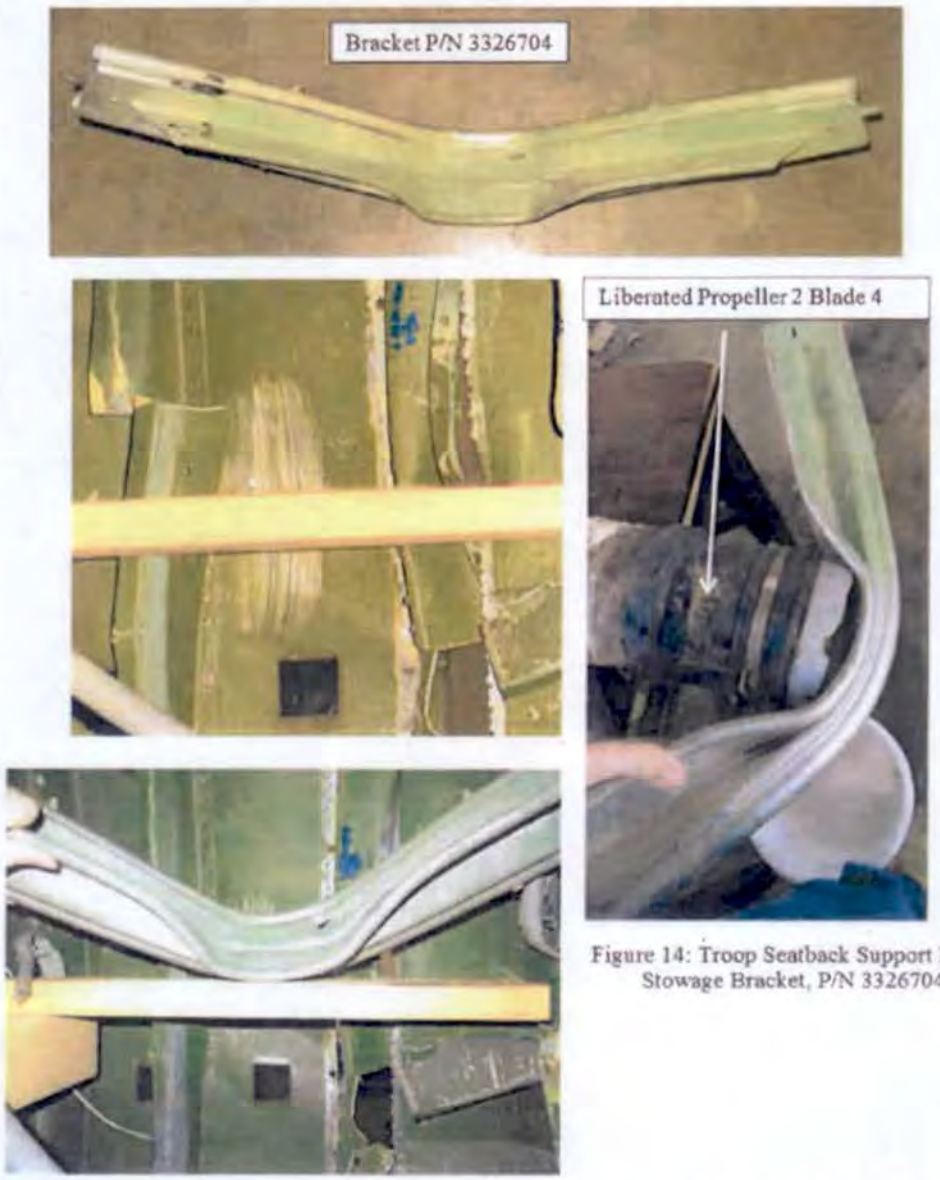

Figure 14: Troop Seatback Support Beam Stowage Bracket, P/N 3326704

Figure 8: Reconstruction of P2B4 Impact to Stanchion Bracket

124. The stanchion bracket for the troop seatback support beam stowage assembly mounted between FS 377 and FS 397 ring segments was bent into a cup-shape that closely conformed to the root end contours of the liberated blade and showed black material transfer near the forward upper edge. [Encl (21)]

125. Just aft of the point where P2B4 impacted the starboard interior support beam, the center fuselage starboard side skin separated along FS 390.33 up toward the starboard side longeron support structures. [Encls (13), (21), (22)]

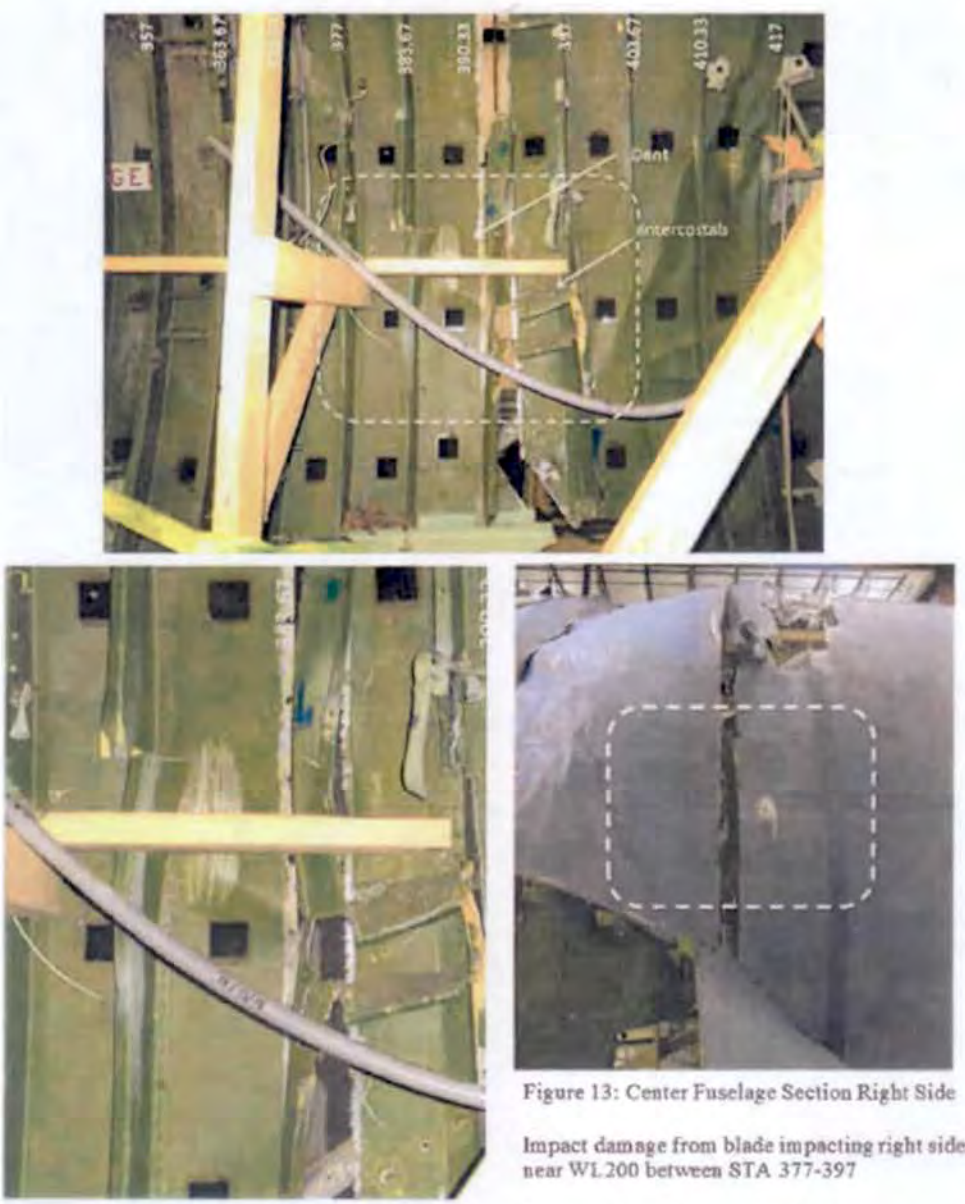

Figure 13: Center Fuselage Section Right Side

Impact damage from blade impacting right sidewall near WL 200 between STA 377-397

Figure 9: Center Fuselage Starboard Side

126. The kinetic energy from P2B4's impact transferred through the structure of the airframe causing both the aircraft to displace to the right and propeller three to separate at its RGA due to overload failure and embed into the upper starboard section of the fuselage. [Encls (13), (21), (22)]

2. Propeller Three

Figure 37: Propeller Assembly #3

Figure 10: Propeller Assembly Three

127. Propeller three struck the right side of the fuselage and the spinning blades entered at FS 350 approximately 33 inches below the upper RBL (right butt line) 61 longeron. [Encl (21)]

128. When propeller three embedded in the upper section of the fuselage, it pushed the upper structure backward, resulting in an accordion-like buckling failure of RBL 20 longeron. [Encl (21)]

129. This intrusion of propeller three caused overload failure of the RBL 61 longeron to each side of the point of impact, and the propeller continued upward to exit approximately 10 inches below RBL 20 longeron. [Encl (21)]

130. As a consequence of the outward buckling of the upper panel of the starboard fuselage and loss of both longerons, RBL 61 and RBL 20, a large upper section of panel from the propeller strike at FS 350, aft to FS 477, appeared to have immediately liberated. [Encl (21)]

131. At an undetermined point in time between propeller three's impact with the starboard side of the fuselage and the separation of the cockpit section forward of FS 245, all cockpit aircrew control inputs, to include the flight controls, power levers and condition levers, were rendered inoperative. [Encl (21)]

132. The damage created by propeller three caused the starboard side longeron supports to structurally fail. [Encls (13), (21), (22)]

133. Propeller three proceeded up and over the central fuselage section. [Encls (13), (21), (22)]

134. Propeller three impacted the starboard horizontal stabilizer and caused a significant portion of the stabilizer to separate from the aircraft. [Encls (13), (21), (22)]

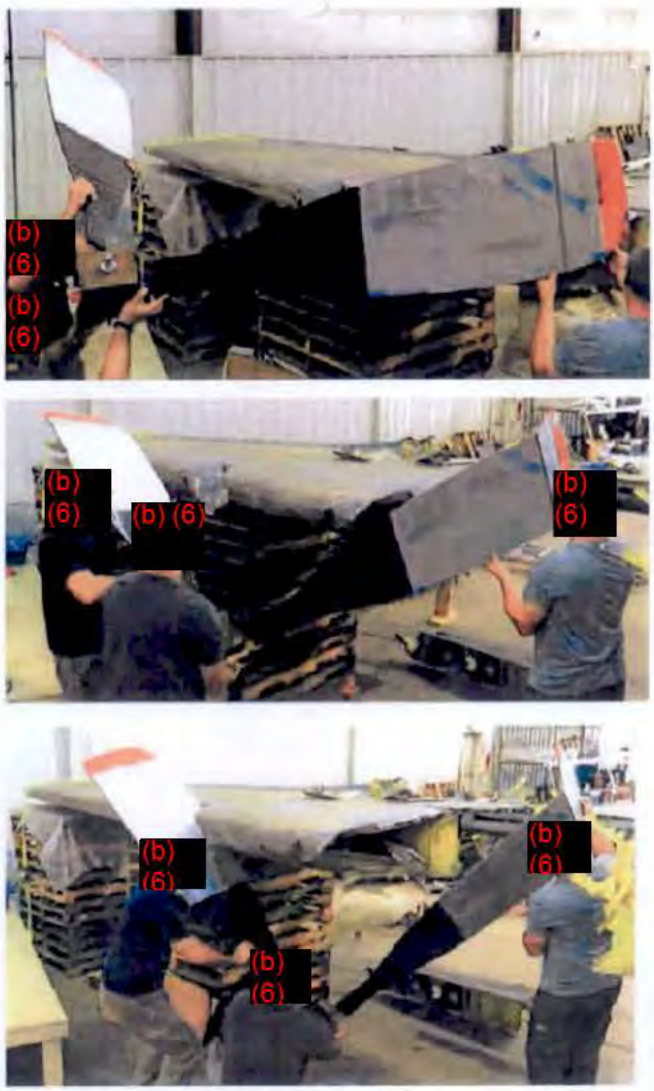

Figure 11: Reconstruction of Propeller Three Impact to Horizontal Stabilizer

135. Blade one of propeller three impacted the starboard side horizontal stabilizer at horizontal stabilizer station (HSS) 130 oriented such that the end of the airfoil tip inserted into to the leading edge, pushing rear through the stabilizer and rotating downward upon contact with the front beam assembly, slicing through the lower surface. [Encl (21)]

136. Propeller three continued to reposition through the stabilizer with the trailing edge of adjacent blade two impacting the leading

edge of the right side horizontal stabilizer near HSS 180 and halting before coming into contact with the front beam. [Encl (21)]

137. The right hand outer section of the starboard horizontal stabilizer, as well as the right hand elevator, both liberated as a direct consequence of impact from propeller three. [Encl (21)]

Figure 12: Horizontal Stabilizer

138. Naval Air Systems Command (NAVAIR) reports contain no evidence of inflight fire damage or ammunition discharge. [Encl (21)]

D. Warner Robins Air Logistics Complex (WR-ALC)

139. WR-ALC is an aircraft rework facility located in Warner-Robins, Georgia, aboard Robins AFB, where all C-130 USN/USMC aircraft propeller blades are overhauled. [Encls (24), (25)]

140. The employees at WR-ALC are federal civilian employees, who rework and overhaul the Marine Corps C-130 propellers. These employees are part of the 402d Commodities Maintenance Group, 402d Maintenance Wing. [Encl (26)]

141. In August 2011, P2B4 was inducted into WR-ALC for blade overhaul. [Encls (22), (27)]

142. The blade work documents at WR-ALC are kept for only two years after each blade has completed the overhaul process. [Encls (28), (29)]

143. WR-ALC is the last facility that overhauled propeller two and its associated blades. [Encls (22), (27)]

144. USN/USMC C-130 propellers require an overhaul every 5000 or 6000 hours, depending upon the specifications per reference (f). [Encl (22)]

1. Propeller Two Blade Four (SN N844995A)

Figure 13: P2B4

145. A post-mishap inspection showed that P2B4 had an intergranular crack (IGC) and radial crack in the vicinity of the bushing bore of the propeller. This developed from corrosion pitting and intergranular cracking that was present and not removed during the last overhaul performed by WR-ALC in September 2011. [Encls (22), (30), (31)]

146. Bushing and taper bore inspections of P2B4 revealed the following discrepancies: bushing epoxy primer was not present; permatreat was not present; and substantial clustered active corrosion was found with fluorescent penetrant inspection (FPI), and confirmed with an eddy current inspection in the bushing bore area of the blade taper bore. [Encls (22), (27)]

147. Active corrosion and the resulting IGC were found in the bushing bore area of the taper bore. [Encls (22), (27)]

148. Anodize coating was found extending into corrosion pitting and IGC. [Encls (22), (27)]

149. Anodize is a process that applies a protective coating which occurs as a step in the overhaul process. [Encl (24)]

150. This process should occur after existing corrosion pitting and intergranular cracking has been identified and removed. [Encl (24)]

151. Presence of anodize in the corrosion pits and IGC proves the corrosion was present and not removed at the last overhaul in August of 2011. [Encls (22), (27)]

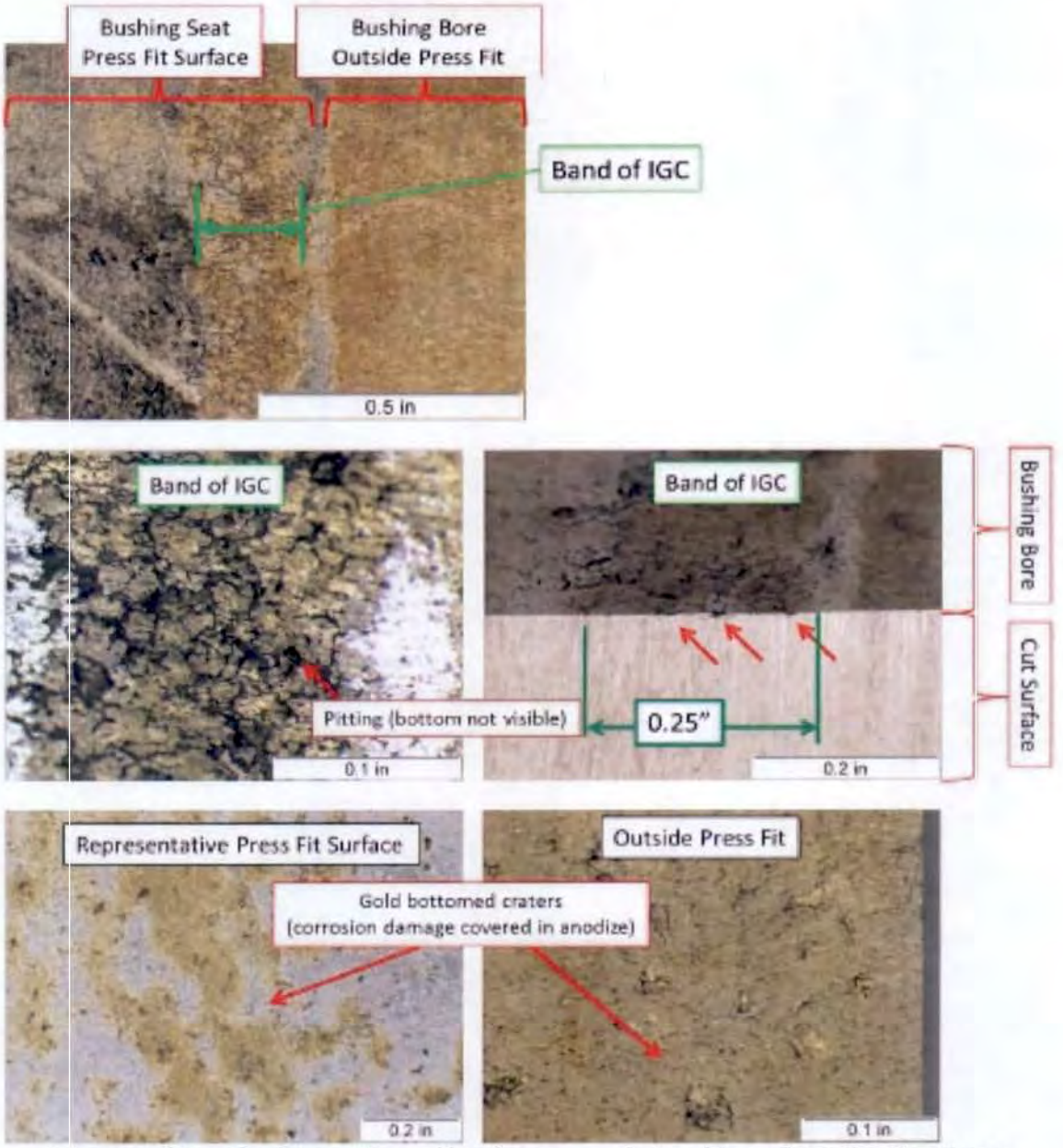

Figure 14: Bushing Bore Surfaces - Note Changing Scale Bars

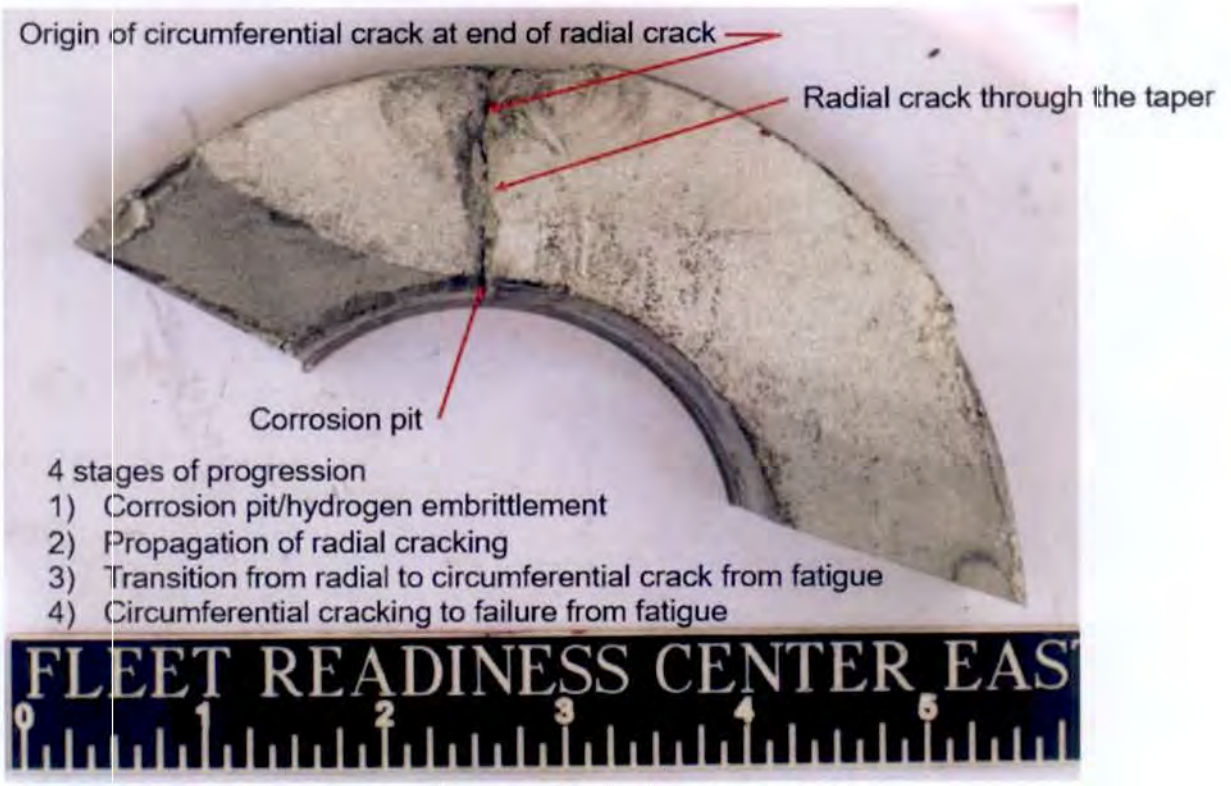

Figure 15: Radial Crack Root Cause

152. The presence of the clustered active corrosion and IGC initiated the formation of the intergranular radial crack in blade four. [Encls (22), (27)]

153. This intergranular radial crack in P2B4 had grown to a total of 2.7 inches in length along the interior taper bore of the blade, extending 1.25 inches beyond the bushing. [Encls (22), (27), (30)]

154. A radial crack on the interior of the blade beyond the bushing could be detected by an off wing eddy current internal taper bore inspection. [Encls (22), (27), (30)]

155. The radial crack had grown outward through 64 percent of the shank wall section until it was 0.45 inches from the outer diameter at the time P2B4 liberated on 10 July 2017. [Encls (22), (27), (30)]

156. This radial crack propagated towards the blade tip and led to the formation of the circumferential fatigue crack which propagated around the blade shank due to normal operating loads. This circumferential fatigue crack was undetectable by an off wing eddy current inner taper bore inspection due to the fact it was entirely behind the bushing. [Encls (22), (27), (30)]

157. The fatigue crack initiated from the outer boundary of the radial crack, propagating circumferentially for an arc length of 100 degrees prior to the catastrophic overload. [Encls (22), (27)]

158. When the circumferential fatigue crack reached critical length the remainder of the blade shank structure failed in overload causing instantaneous liberation of blade four from the propeller barrel. [Encl (27)]

159. The intergranular radial crack in blade four, which ultimately was the root cause of this catastrophic mishap, developed and matured from corrosion pitting and IGC that was not removed during the last blade overhaul in the fall of 2011. [Encls (22), (27), (30)]

160. This liberation of P2B4 is the first known occurrence of a circumferential fatigue crack initiating from a radial crack which had not grown to pass fully through to the outer diameter blade shank wall of a propeller produced by UTC Aerospace Systems (UTAS).[4] [Encls (22), (27), (30)]

161. No evidence exists depicting the relationship between the growth rate of this circumferential fatigue crack and the associated intergranular radial crack, nor is there any evidence depicting the growth rate of the radial crack, from their origination of the crack prior to 2011 to the culminating event on 10 July 2017. [Encls (22), (24), (27), (28), (30)]

162. Prior to the mishap, there was no visual indication of a crack on the outer diameter of the propeller shank. [Encl (22)]

163. The corrosion damage on P2B4 should have been detected and removed, but was not removed, at WR-ALC during the last overhaul in 2011. The lack of detection and removal of this corrosion is attributed to noncompliance with established publications and procedures within them. [Encls (22), (24), (27), (28), (30)]

2. Blade Overhaul Process

a) 2011 Blade Overhaul Process

164. The WR-ALC blade overhaul procedure for USN/USMC propeller blades in 2011 required the following: (1) blade tear down, bushing and plug removal and cleaning; (2) glass bead blast of taper bore; (3) caustic soda etch; (4) borescope inspection of taper bore; (5) FPI of taper bore, screw holes and drive pin hole; (6) taper bore back-up inspection by eddy current; (7) meandering winding magnetometry (MWM); (8) taper bore ream; (9) beveled thrust ring grinding; (10) thrust ring inspection - mag particle; (11) butt face cut; (12) cold roll retention fillet; (13) airfoil shot peen; (14) airfoil grit blast; (15) low plasticity burnishing (LPB) of taper bore; (16) chromic acid

[4] UTAS was formally known as Hamilton Sundstrand.

anodizing; (17) permatreat taper bore; (18) foam application; (19) fairing rubber goods, heater installation; (20) balancing; (21) fit check of bushing; (22) wet installation of bushing; (23) final build-up/balance check; (24) disassembly; (25) application of preservative/packaging. [Encls (24), (32)]

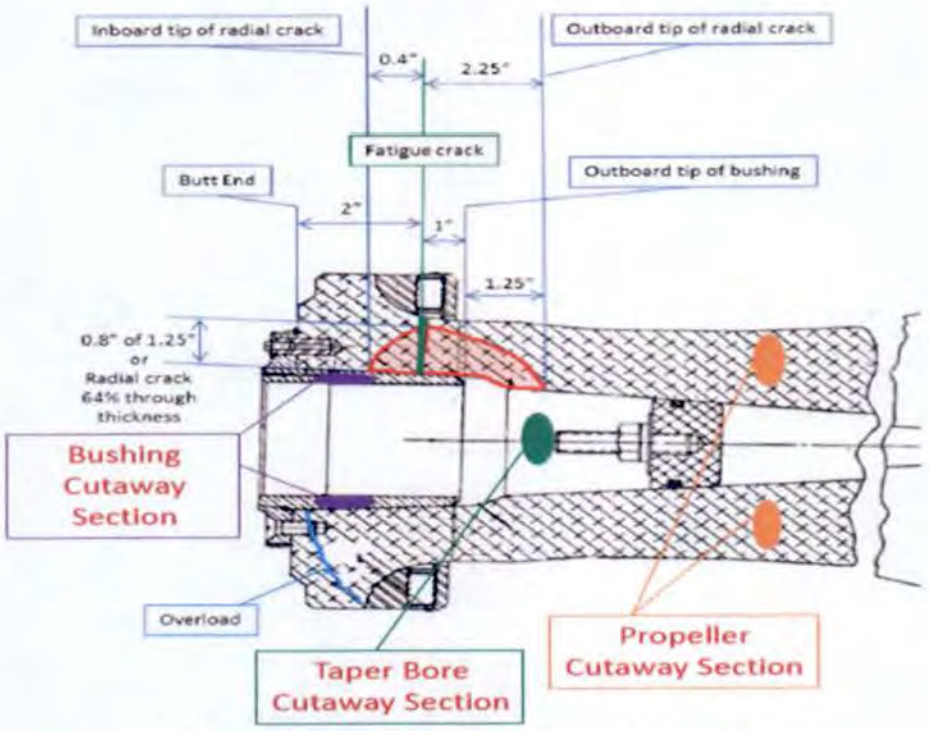

Figure 16: P2B4 Cutaway Breakdown

165. Technicians at WR-ALC have a duty to determine the presence of corrosion in the taper bore area. [Encls (24), (33)]

166. Borescope, FPI and Eddy Current inspections were the only three specific steps per the NAVAIR 03-20C-04 publication that identify corrosion on propeller blades in 2011. [Encls (22), (24), (28), (33)]

167. The borescope inspection of the taper bore is conducted to detect corrosion, cracks, and damage on the blades. This process requires the technician to view the taper bore through a device that magnifies the surface to find these defects. [Encl (33)]

168. This process requires the technician to identify the difference between the shot peening and the corrosion pitting that could be present. [Encl (33)]

169. The FPI is conducted by swabbing the surface of the blade with a chemical substance that seeps into the surface of the blade for a minimum of thirty minutes. The technician will then run a black light over the surface of the blade to determine whether it fluoresces,

which indicates corrosion and cracking. This process does not identify smaller defects. [Encls (33), (34)]

170. If corrosion is detected on the blade, all corrosion should be removed or the blade should be condemned. [Encls (22), (24), (32), (33)]

171. Two procedures exist for corrosion removal: spot treating and reaming. [Encl (33)]

172. Spot treating corrosion is completed by the technician hand blending the area with mechanical sanding while it is at the technician's location. [Encl (33)]

173. Reaming is conducted when the area is too large for spot treating and requires the taper bore to be shaved off so that the overall blade stays consistent. [Encl (33)]

174. The glass bead blasting step is used to clean the propeller of any debris or coating that could be on it before the blade goes into the borescope inspection. [Encl (33)]

175. Air Force regulations did not require the use of glass bead blasting, borescope inspection, or the eddy current inspection for Air Force blades in 2011. [Encls (24), (28)]

176. An average of five percent of blades processed by WR-ALC were Navy or Marine Corps blades over the past nine years. [Encls (22), (28)]

177. Though required by Naval regulations, eddy current inspections were not conducted at the WR-ALC in 2011. [Encls (24), (28), (33)]

178. As each blade moves through the different stages of the overhaul process, standard procedures dictate that each blade is accompanied by a work control document. The purpose of this document is to record the actions performed on that specific blade at each appropriate stage. [Encls (28), (29)]

179. All evidence of corrosion must be identified and listed on work control documents by the technician so that the corrosion can be removed by the appropriate process. [Encls (24), (29)]

180. Per USAF regulations, work control documents are destroyed after a period of two years. [Encls (28), (29)]

181. All work control documents associated with the 2011 overhaul of P2B4 no longer exist. [Encls (28), (29)]

182. Permatreat protective coating and epoxy primer coating were originally introduced as product and process improvements to protect

the taper bore from corrosion and electrically insulate the blade and bushing materials in order to mitigate and prevent corrosion pitting in Navy and Marine Corps propeller blades. [Encls (28), (35)]

183. No evidence exists that any permatreat coating was applied within taper bore or bushing bore surfaces during the overhaul process in September 2011 at WR-ALC; violating reference (f). [Encl (22)]

184. No evidence exists that any epoxy primer was applied within bushing bore surfaces during the overhaul process in September 2011 at WR-ALC; violating reference (f). [Encl (22)]

185. The current procedures in the technical publications for the overhaul of USAF blades differ from the procedures outlined in the technical publications for USN blades. [Encls (28), (32)]

186. Multiple contradictions and other errors were found in reference (g) which defines the maintenance procedures required for overhauling a USN/USMC KC-130T propeller blade. [Encl (22)]

187. The USAF blades do not receive taper bore borescope inspections and do not receive permatreat coating or epoxy primer on/in bushing areas. [Encls (28), (32)]

b) 2017 Post Mishap Investigations

188. As a result of this mishap, the Navy engineering team conducted a process audit of the WR-ALC propeller blade repair facility on 25 and 26 August 2017. [Encl (28)]

189. The purpose of this process audit was to inspect the typical blade repair overhaul process from induction to packaging for shipment. [Encl (28)]

190. The Navy engineering team found the following deficiencies: lack of procedural compliance with the technical publication requirements, preservation/storage, borescope inspection, FPI, Quality Assurance (QA) checks, and standardization of USAF/USN repair processes. [Encls (28), (35)]

191. The Navy engineering team concluded by recommending special process instructions be developed and implemented for preservation, borescope inspection, FPI, and eddy current inspection. [Encl (28)]

192. The engineering report concluded the USN technical publication requirements for propeller overhaul at WR-ALC are different from the USAF propeller overhaul technical publication requirements. [Encl (28)]

193. Since only approximately five percent of C-130 blades are a Navy/Marine Corps asset, it is uncertain whether sufficient steps are

embedded in the work flow process to ensure that Navy/Marine Corps critical requirements, such as borescope inspections and permatreat/epoxy primer coatings, are satisfied. [Encl (28)]

194. The Navy engineering team recommended that, to the greatest extent possible, a standard process should be developed for all C-130 blades processed while at a depot level repair facility. [Encl (28)]

195. On 1 September 2017, Commander, Naval Air Systems Command (NAVAIR), issued a propeller Redstripe on instructions, inspections, and compliance standards that affect propellers within the Navy and Marine Corps.[5] [Encls (28), (36)]

196. In addition to the Navy engineering team's process audit, the JAGMAN Investigation Team toured WR-ALC on 9 November 2017 as well as from 26 February to 2 March 2018. [Encls (29), (37)]

197. WR-ALC purports to employ control measures designed to ensure the different service-specific procedures are applied to the correct propeller blade by utilizing a color-coded system for their work control documents. [Encl (29)]

198. The propeller blade work control documents are structured to consist of different colors for each service (i.e. blue paper represents USN P-3 aircraft, white represents USAF C-130s, and yellow represents USN/USMC C-130s). [Encl (29)]

199. Many of the color-coded work control documents did not reflect the proper color paper for each respective service. [Encl (29)]

200. Due to the fact that there is no standardized method defining how an individual blade and its associated work control documents are maintained, tracked and physically accompany the blades throughout the overhaul process, the work control documents were consistently difficult to locate on the production line. [Encl (29)]

201. There is a noted trend of discrepancies associated with the products produced at WR-ALC during the span of years beginning sometime prior to 2011 and continuing until 2 September 2017 when the blade overhaul suspension was initiated. This pause was initiated to allow all parties involved with the propeller overhaul process at WR-ALC to make the necessary changes in an attempt to fix all known deficiencies and begin better practices. [Encls (22), (24), (28), (29), (36), (37)]

c) 2017/2018 Process Improvements from WR-ALC

[5] A Redstripe is a NAVAIR-issued airworthiness bulletin that grounds a particular type of aircraft for a specific issue. The term "Redstripe" comes from the diagonal red stripe that is placed on this message.

202. As a result of the mishap, an Independent Review Team (IRT) was convened by SES Jorge Gonzalez, Engineering Directorate, Air Force Life Cycle Management Center, Air Force Materiel Command and is composed of members from: USAF, USN, Lockheed Martin, and UTAS. [Encls (24), (30)]

203. The purpose of the IRT is to assess and improve the propeller blade overhaul process at WR-ALC. [Encls (24), (30)]

204. The IRT first met on 26 September 2017 and is currently exploring numerous and substantive improvements to the blade overhaul process. [Encls (24), (30)]

205. The primary objective is to create a uniform approach to overhaul procedures of both Air Force and Navy C-130T blades. [Encls (24), (30)]

206. The IRT has unanimously agreed to implement a series of improvements into the blade overhaul process in order to eliminate consistent production errors at WR-ALC. [Encls (24), (30)]

207. WR-ALC plans to upgrade and improve their borescope process and equipment to incorporate robotic capture and inspection of the taper bore on all blades overhauled. [Encls (24), (30)]

208. This borescope process will require a technician to verify and inspect the robotically captured images, which are designed to provide higher definition and resolution in order to assist in identifying corrosion and other defects. [Encls (24), (30)]

209. The glass bead blast of the taper bore will be conducted on all blades in order to clean the taper bore prior to capturing the image with the borescope camera. [Encls (24), (30)]

210. The eddy current inspection will be upgraded to automate, improve the sensitivity, and increase the area that the inspection can cover on the blade which will allow the technician the ability to inspect the whole blade. [Encls (24), (30)]

211. The FPI process will be upgraded to utilize robotics to completely submerge the blades into the chemical substance and increase the submersion time to four hours before the technician reviews the blade for corrosion and cracks. [Encls (24), (30)]

212. The MWM process will be performed on all blades processed at WR-ALC. [Encls (24), (30)]

213. WR-ALC plans to update their process mapping to incorporate all the various work control documents into one consolidated electronic document identifying all defects and corrective actions conducted on the blade. [Encls (24), (30)]

214. This document will follow the blade through the process and be included into the blade's historical logbook for life cycle preservation. [Encls (24), (30)]

215. The low plasticity burnishing process has been suspended in order for the IRT to confirm its effectiveness. [Encls (24), (30)]

216. The USAF plans to adopt the USN process of wet bushing install with primer instead of dry bushing installation. [Encls (24), (30)]

217. The USAF plans to adopt the USN process of using permatreat to assist with protecting a propeller blade from corrosion. [Encls (24), (30)]

218. As a result of this mishap and the subsequent investigations, the USAF plans to adopt all of the USN blade overhaul processes. [Encls (24), (30)]

d) Quality Control (QC) / Quality Assurance (QA) Process

219. Prior to the 2012 Air Force maintenance organizational restructure, the USAF depot-level maintenance publications at Headquarters Air Force and Air Force Materiel Command (AFMC) levels did not contain a QC/QA chapter. [Encl (37)]

220. Prior to 2012, every individual Air Logistics Complex created and utilized its own distinct local QC/QA procedures. [Encl (37)]

221. The 2011 QC/QA process at WR-ALC is the same process currently being used. [Encl (37)]

222. The WR-ALC QC is a process where each item is inspected and either accepted or rejected; its purpose is to physically verify that the product conforms to the appropriate technical publication requirements. [Encl (37)]

223. The first level of QC is a self-performed work inspection and certification, conducted by the same production technician who performed the maintenance action. [Encls (28), (37)]

224. The second level of QC, utilized for more critical tasks, is a second set of eyes (SSOE) inspection and certification performed by a second production technician who maintains a qualification level that is equal to or greater than that of the initial production technician performing the maintenance. [Encls (24), (28), (37)]

225. WR-ALC QA is a process that intends to provide confidence that the control systems in place create a product that adequately conforms

to the defined standards within the appropriate technical publication.[6] [Encls (24), (28), (37)]

226. The third level of inspection is provided, only on a temporary basis, to certain processes. This "Q-stamp" is a third quality check conducted by QA personnel when there has been a loss of confidence in a particular process. [Encls (24), (28), (37)]

227. The USAF employs a combination of QA and QC methodology in an attempt to ensure product and process quality through the "two-pronged" approach. [Encls (24), (28), (37)]

228. The QA process does not ensure every overhauled blade is reviewed. [Encls (24), (28), (37)]

229. The Air Force QA process at WR-ALC, which covers Navy blades, is a risk-based quality sampling approach based on the American National Standards Institute methodology and does not inspect every overhauled blade. [Encls (28), (37)]

230. The Navy uses the term "QA" to describe QC processes where items are to be observed or checked by a quality assurance inspector before the technician continues to the next step in the procedure. [Encls (28), (37)]

231. The Navy blade overhaul process in 2011 had QA checks throughout the steps; however, the steps regarding identification and removal of corrosion did not require QA checks per reference (h). [Encls (28), (37)]

232. NAVAIR formally authorized WR-ALC to utilize the USAF QA processes regarding propeller blades overhaul in 2015. [Encl (28)]

e) Depot Maintenance Interservice Support Agreement (DMISA)

233. On 15 January 2009, the DMISA (WR-ALC03 03 ANKE) for USN/USMC C-130 propeller components was renewed through a periodic review between the Naval Supply System Command Weapons Systems Support-Philadelphia (NAVSUP WSS-P) and USAF WR-ALC. This was the agreement in effect during the overhaul of P2B4 in September 2011. [Encl (38)]

234. The last three Annual Reviews occurred on 3 February 2014, 24 May 2012 and 15 January 2009. [Encls (37), (38)]

235. The purpose of the DMISA is to define requirements and obligations of all parties with respect to depot maintenance support for USN/USMC C-130 propeller components, which includes authority to initiate audits by the Principal. [Encl (38)]

[6] WR-ALC QA system is based on random sampling techniques implemented through inspections and assessments of the work force throughout various production processes, to include review of both in-process and completed maintenance actions.

236. The Principal is NAVSUP WSS-P. The Agent is WR-ALC-CMD. [Encl (38)]

237. The requirements for periodic review states the DMISA ". . .will be reviewed at least annually to determine whether it should be continued, modified or terminated." This review ". . .must be documented by both Agent and Principal utilizing the Periodic Review Certification Sheet. Modifications can be initiated by the Principal or Agent and must be signed by both parties. . ." [Encl (38)]

238. The DMISA does not specify a requirement that NAVAIR be present during periodic reviews. Also, according to existing business processes between NAVSUP and NAVAIR, there is no requirement for NAVAIR to be present during periodic review. NAVSUP will notify the NAVAIR COC, via NAVAIR 6.7, if representation is requested during the process. NAVAIR can also request to be present during the periodic review process by notifying NAVSUP-WSS-P. [Encls (29), (37-39)]

239. Per the DMISA, "The Principal will deal with the Agent in all quality matters." [Encl (38)]

240. The DMISA also stipulates that Monthly Production Reports will be submitted by the Agent to the Principal generally within 10 calendar days of the end of each month. There are 24 specific areas that are listed in this report. [Encl (38)]

241. NAVSUP-WSS-P will receive Monthly Production Reports and disseminate to NAVSUP-IWST. Per business processes between NAVSUP and NAVAIR, unless a negative trend is observed these reports will not be passed to NAVAIR. There are no records of negative trends observed through these reports from records dating back to 2010. [Encls (38), (39)]

242. The DMISA also defines the following Exhibits that are applicable to this agreement: schedule & costs- minor programs, projected requirements- minor programs, national emergency requirements, special engineering support, statement of work, technical data, QA requirements, lists of reports, Monthly Production Report, special markings, shipping instructions and preservation, and packaging instructions. [Encl (38)]

243. While these Exhibits are managed by NAVSUP-WSS-P their contents were created by NAVAIR. If changes to these Exhibits are required by the Agent, the Agent will notify the Principal. If changes are required by the Principal, it is typically at the request of NAVAIR through NAVSUP. [Encls (38), (39)]

244. The statement of work that addresses the requirements for overall of USN/USMC C-130 Propeller Assemblies, Propeller Control Assemblies and all pertinent subcomponents is listed under Exhibit Section VII-A

of the DMISA. Exhibit Section VII-A, Section 3 lists 25 specific and different propeller components to be overhauled by Part Number (P/N) and National Stock Number (NSN), the manual to be used for the overhaul and any special overhaul requirements for a particular component. This has remained unchanged since 8 September 2010. [Encl (38)]

245. The DMISA requires WR-ALC to utilize the 23 Naval Aviation Maintenance Manuals required to support all DMISA requirements. [Encl (38)]

246. Exhibit VII-A, Section 4, defines documentation requirements that WR-ALC shall provide electronically to the USN Propeller FST. [Encl (38)]

247. No evidence exists that this documentation has ever been produced or provided to the USN Propeller FST. [Encl (38)]

248. As stipulated within this DMISA with respect to quality assurance at the WR-ALC, the USN has the right to request quality audits or quality related visits based on quality history and criticality of application. All requests for an audit or visit will be coordinated with WR-ALC/OBWB (Depot Workloading Section, Workload and Analysis Branch, Business Operations Office, WR/ALC). [Encl (38)]

249. These audits or visits are further defined as Quality Audits and Quality Investigations. Quality Audits and Quality Investigations are essential tools which comprehensively evaluate factors and conditions effecting product or process quality. They identify potential problems, opportunities for improvement and stimulate root cause corrective or preventative actions. [Encl (38)]

250. The Quality Audit and Investigation objective is to provide continuous improvement of a system or process. [Encl (38)]

251. Quality audits are independent reviews conducted to compare performance aspects with predefined quality standards. Audits should be conducted on a regularly scheduled basis. [Encl (38)]

252. Quality investigations are conducted when a known or perceived problem exists. They are used for the identification, correction, and prevention of conditions that degrade the quality or reliability of products, processes, or systems. [Encl (38)]

253. Neither Principal nor Agent is able to produce any evidence that either a Quality Audit or Investigation has ever occurred, nor been requested, since the inception of the DMISA. [Encls (37), (39)]

254. NAVAIR is not a party named in the DMISA, nor do they report to NAVSUP. Per the interviews, NAVSUP only coordinates with NAVAIR in

their role as a subject matter expert (SME) with respect to DMISA obligations. [Encls (24), (38), (39)]

255. There is no evidence to support the DMISA requirement that "Procedures must be established to:

i. Maintain quality audit records,

ii. Ensure follow-ups are conducted on all documented concerns, and

iii. Provide written corrective and preventative actions on documented deficiencies within specified time frames." [Encl (24), (38), (39)]

256. The Principal may assign a liaison representative on a part-time or full-time basis at the Agent's depot administration office. The current liaison, a full-time position, has held this position since 1998. This position reports to Tactical Airlift Program Office (PMA-207), but does not report to Naval Supply System Command Weapons System Support Philadelphia (NAVSUP-WSS-P) or USN Propeller FST. [Encls (38), (40)]

f) Other Mishap Aircraft Blade Discrepancies

257. Propeller one and its associated blades were last overhauled at WR-ALC in June of 2003. [Encls (41), (42)]

258. Propeller one blades one, two, and four did not have any significant discrepancies. [Encls (41), (42)]

259. Propeller one blade three (SN N887679) lacked any anodization in the bushing contact area of the taper bore from its last overhaul at WR-ALC in June 2003. [Encls (41), (42)]

260. Propeller two and its associated blades were last overhauled at WR-ALC in September 2011. [Encls (27), (42)]

261. Propeller two blade one (SN N844403) did not show 100% permatreat coverage, had isolated active corrosion found with an FPI and confirmed with an eddy current inspection, and had active corrosion that contained anodize extending down into the corrosion pitting. [Encls (27), (42)]

262. Propeller two blade two (SN N851258A) did not have adequate bushing epoxy primer, did not show 100% permatreat coverage, and had isolated corrosion found with FPI, but not confirmed with an eddy current inspection. [Encls (27), (42)]

263. Propeller two blade three (SN N876052A) did not have adequate bushing epoxy primer, did not have any permatreat present, had isolated active corrosion found with FPI and confirmed with an eddy current inspection, and had active corrosion that contained anodize extending into corrosion pitting. [Encls (27), (42)]

264. Propeller three and its associated blades were last overhauled at WR-ALC February 2015. [Encls (42), (43)]

265. Propeller three blade one (SN N852517A) contained active corrosion that was present at its last overhaul and contained anodize extending into corrosion pitting. [Encls (42), (43)]

266. Propeller three blade two (SN 803064A) contained isolated active corrosion found with FPI, but not confirmed with an eddy current inspection, and active corrosion and anodize down into corrosion pitting that was present at the last overhaul. [Encls (42), (43)]

267. Propeller three blade three (SN N844069A) contained isolated active corrosion found with FPI, but not confirmed with an eddy current inspection, and active corrosion and anodize down into corrosion pitting that was present at the last overhaul. [Encls (42), (43)]

268. Propeller three blade four (SN N829096A) contained isolated active corrosion, found with FPI and confirmed with an eddy current inspection, and active corrosion and anodize down into corrosion pitting was found that was present at the last overhaul. [Encls (42), (43)]

269. After 1 March 2003, all blades with SNs less than N813320 were to be removed from service at overhaul. [Encl (43)]

270. Though required, propeller three blade two (SN N803064A) was not removed from service by WR-ALC at its last overhaul in 2015. [Encl (43)]

271. Propeller four and its associated blades were last overhauled at WR-ALC March 2012. [Encls (42), (44)]

272. Propeller four blade one (SN 2007060396A) did not have adequate bushing epoxy primer, did not show adequate permatreat coverage, contained isolated active corrosion found with FPI and confirmed with an eddy current inspection, and had active corrosion that was present at the last overhaul. [Encls (42), (44)]

273. Propeller four blade two (SN 2007060395A) did not have adequate bushing epoxy primer, did not show adequate permatreat coverage, contained isolated active corrosion found with FPI but not confirmed with an eddy current inspection, and had active corrosion that was present at the last overhaul. [Encls (42), (44)]

274. Propeller four blade three (SN N885535A) did not have adequate bushing epoxy primer, did not show adequate permatreat coverage, contained isolated active corrosion found with FPI but not confirmed with an eddy current inspection, and had active corrosion that was present at the last overhaul. [Encls (42), (44)]

275. Propeller four blade four (SN N876380A) did not have adequate bushing epoxy primer, did not show adequate permatreat coverage, contained isolated active corrosion found with FPI and confirmed with an eddy current inspection. Active corrosion was present at the last overhaul. [Encls (42), (44)]

EI RESULTS ON MAC PROP BLADES FROM WR-ALC				
	PROPELLER 1			
	BLADE 1	BLADE 2	BLADE 3	BLADE 4
ANODIZATION LOCATED IN CORROSION				
ACTIVE CORROSION PRESENT				
PERMATREAT				
BUSHING EPOXY PRIMER				
ANODIZATION			NO ANODIZATION IN BUSHING CONTACT AREA June 2003	

Figure 17: MAC Propeller EIs (Part 1 of 4)

	PROPELLER 2			
	BLADE 1	BLADE 2	BLADE 3	BLADE 4
ANODIZATION LOCATED IN CORROSION	BLADE 1	BLADE 2	BLADE 3	P2B4
ACTIVE CORROSION PRESENT	ANODIZE DOWN INTO CORROSION PITTING September 2011		ANODIZE DOWN INTO CORROSION PITTING September 2011	ANODIZE DOWN INTO CORROSION PITTING & IGC September 2011
PERMATREAT	ISOLATED ACTIVE CORROSION FOUND September 2011	ISOLATED ACTIVE CORROSION FOUND September 2011	ISOLATED ACTIVE CORROSION FOUND September 2011	ACTIVE CORROSION PRESENT AT LAST OVERHAUL September 2011
BUSHING EPOXY PRIMER	NOT COMPLETE September 2011	NOT COMPLETE September 2011	NOT PRESENT September 2011	NOT PRESENT September 2011
ANODIZATION		NOT ADEQUATE September 2011	NOT ADEQUATE September 2011	NOT PRESENT September 2011

Figure 17: MAC Propeller EIs (Part 2 of 4)

	PROPELLER 3			
	BLADE 1	BLADE 2	BLADE 3	BLADE 4
ANODIZATION LOCATED IN CORROSION	ANODIZE DOWN INTO CORROSION PITTING January 2015	ANODIZE DOWN INTO CORROSION PITTING January 2015	ANODIZE DOWN INTO CORROSION PITTING January 2015	ANODIZE DOWN INTO CORROSION PITTING January 2015
ACTIVE CORROSION PRESENT	ACTIVE CORROSION PRESENT AT LAST OVERHAUL January 2015	ACTIVE CORROSION PRESENT AT LAST OVERHAUL January 2015	ACTIVE CORROSION PRESENT AT LAST OVERHAUL January 2015	ACTIVE CORROSION PRESENT AT LAST OVERHAUL January 2015
PERMATREAT		*SEE FOOTNOTE 1*		
BUSHING EPOXY PRIMER		*SEE FOOTNOTE 1*		
ANODIZATION		*SEE FOOTNOTE 1*		

1 PROPELLER ASSEMBLY 3, BLADE 2 WITH SN N803064A SHOULD HAVE BEEN REMOVED FROM SERVICE BY WR-ALC AT THE LAST OVERHAUL IN 2015. THIS WAS IN VIOLATOIN OF PUBLICATIONS NA03-20-C-4.

Figure 17: MAC Propeller EIs (Part 3 of 4)

	PROPELLER 4			
	BLADE 1	BLADE 2	BLADE 3	BLADE 4
ANODIZATION LOCATED IN CORROSION				
ACTIVE CORROSION PRESENT	ISOLATED ACTIVE CORROSION FOUND March 2012	ISOLATED ACTIVE CORROSION FOUND March 2012	ISOLATED ACTIVE CORROSION FOUND March 2012	ISOLATED ACTIVE CORROSION FOUND March 2012
PERMATREAT	NOT ADEQUATE March 2012	NOT ADEQUATE March 2012	NOT ADEQUATE March 2012	NOT ADEQUATE March 2012
BUSHING EPOXY PRIMER	NOT ADEQUATE March 2012	NOT ADEQUATE March 2012	NOT ADEQUATE March 2012	NOT ADEQUATE March 2012
ANODIZATION				

Figure 17: MAC Propeller EIs (Part 4 of 4)

E. Service Level Inspection and Maintenance

1. Types of Inspection

276. The 56-day conditional inspection is designed to prevent corrosion from developing in propellers that have been idle by keeping the propeller's attachment point lubricated. [Encl (45)]

277. The 56-day conditional inspection is required when, within 56 days, the engine has not been run; the propeller has not been manually rotated at least three consecutive times while on the aircraft; or the

propeller has not been flowed on a test stand at an intermediate level maintenance activity. [Encl (45)]

278. If this maintenance action is not completed, then the remedial portion of the inspection is required. [Encl (45)]

279. If the propeller has remained idle for at least 56 days, it must receive either a Category 1 or 2 propeller inspection. [Encl (45)]

280. Category 1 propellers[7] must be inspected every 100 flight hours or 20 flights, whichever comes first, by conducting an on-wing eddy current inspection per reference (i). [Encl (45)]

281. If the Category 1 propeller has already flown 100 flight hours or 20 flights past the scheduled 56-day rotation, the aircraft will be considered non-mission capable (NMC) until an on-wing eddy current inspection is accomplished. [Encl (45)]

282. For Category 1 propellers, recurring on-wing inspections shall continue until the propeller is inducted into an intermediate-level maintenance activity for an off-wing eddy current inspection. [Encl (45)]

283. Category 2 propellers[8] must be inducted into an intermediate-level maintenance activity (IMA) for an off-wing eddy current inspection during the first aircraft Isochronal (ISO) inspection after the 56-day rotation is missed. [Encl (45)]

284. If for any reason the propeller is not inducted, the propeller shall be considered a Category 1 propeller until an off-wing eddy current inspection is performed by intermediate level maintenance activity. [Encl (45)]

285. An on-wing eddy current inspection utilizes a magnetized metal probe to detect potential cracks and other defects on the exterior surface of the propeller blade by moving the tip of the probe across the surface. [Encls (33), (34)]

286. An on-wing eddy current inspection is conducted while the blade is still attached to the propeller and conducted by intermediate maintenance level qualified personnel that support the operational squadron. [Encls (33), (34)]

287. An off-wing eddy current inspection utilizes a magnetized metal probe to detect potential cracks on the interior surface of the propeller taper bore by moving the tip of the probe across that surface starting just above the edge of the bushing. [Encls (33), (34)]

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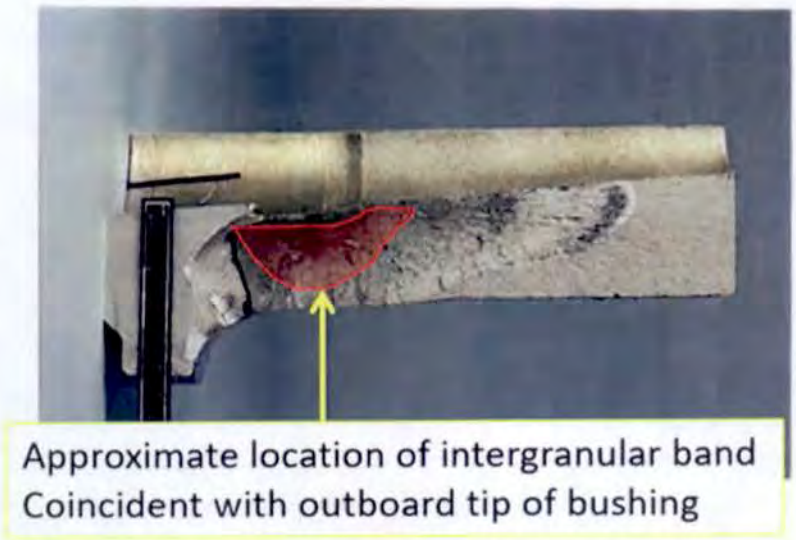
[7]All propeller blades with a serial number less than or equal to 813320.
[8]All propeller blades with a serial number greater than 813320.

288. An off-wing eddy current inspection is conducted while the blade is detached from the propeller and performed by intermediate maintenance level qualified personnel that support the operational squadron. [Encls (33), (34)]



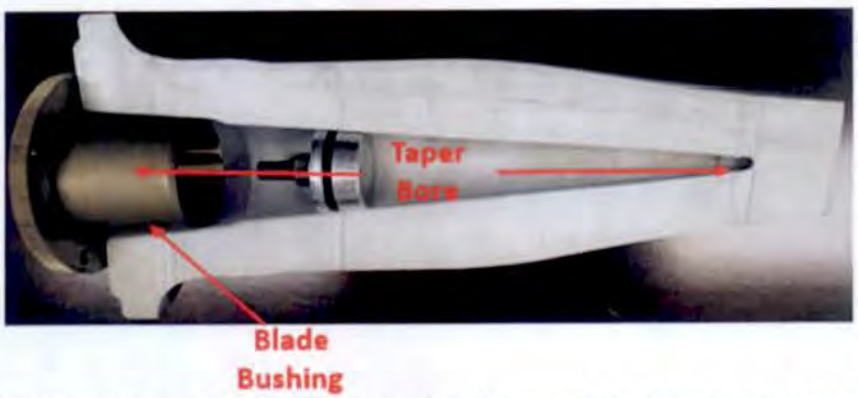


Figure 18: Taper Bore Side View with Blade Bushing

289. An eddy current inspection can only detect cracks which are within 0.017 inches of the surface of this particular propeller blade material. [Encls (33), (34)]

290. When the probe detects a crack or other defect, it is depicted on the machine's display. [Encls (33), (34)]

291. An off-wing eddy current inspection is the only authorized inspection at the intermediate level which could have detected the radial crack on P2B4 if the crack had extended beyond the bushing. [Encls (24), (33), (34)]

292. Missing the 56-day manual rotation while an aircraft remains idle is the only time an off-wing eddy current inspection is required outside of depot level maintenance. [Encls (24), (33), (34)]

293. The 700-hour engine inspection fails to meet 56-day conditional inspection requirements associated with propeller idle time. [Encl (46)]

294. The ISO B 840-day inspection is primarily focused on airframe structural inspections and fails to meet 56-day conditional inspection requirements associated with propeller idle time. [Encl (47)]

2. Maintenance of Mishap Aircraft

295. Propeller two, including P2B4, had flown 1316.2 hours since the last overhaul in September 2011. [Encl (42)]

296. Propeller two was prepared and made Ready-for-Issue (RFI) on 12 December 2011 by Fleet Readiness Center West (FRC-W), Fort Worth, Texas. [Encl (42)]

297. Propeller two was rotated on 2 February 2012, but was not rotated again until 3 April 2012, logging 61 days since its last rotation triggering the requirement for 56-day conditional inspection. [Encls (42), (45)]

298. No evidence exists to support that a 56-day conditional inspection was conducted or the corresponding off wing eddy current inspection was performed. [Encls (42), (45)]

299. On 1 March 2017, the MAC flew its last flight before entering scheduled maintenance. [Encl (48)]

300. On 21 March 2017, the MAC initiated a routine, pre-planned, scheduled maintenance ISO B 840-day inspection, which included an ISO A 420-Day Inspection, and a 700-hour engine inspection. [Encl (49), (50)]

301. On 26 April 2017, the MAC propellers had been idle for 56 days which triggered the 56-day conditional inspection requirement for propellers one, two, and four, but the 56-day conditional inspection was not performed. [Encls (42), (45)]

302. Propellers one, two, and four each meet the criteria of a Category 2 propeller per reference (i). [Encls (42), (45)]

303. The number three propeller did not require a 56-Day Conditional Inspection because it was installed on 18 May 2017, which meant it did not accrue the same 56-Day idle time as the other three propellers. [Encl (42)]

304. At the time the 56-day conditional inspection was missed the MAC was conducting an ISO inspection. Therefore, propellers one, two, and four should have been removed from the aircraft and turned into an IMA to receive off-wing eddy current inner taper bore inspections. [Encls (42), (45)]

305. A powerline technician (MOS 6216) conducts the procedures used to execute the 700 hour engine inspection, E1 - 4.1 engine borescope inspection, whose work is validated and verified by a Collateral Duty Quality Assurance Representative (CDQAR). [Encl (49), (50)]

306. Staff Sergeant (b)(6), the senior CDQAR and Powerline Chief from the VMGR-452 Powerline Division, during this ISO, claims that the 700 hour engine inspection alone would satisfy the requirement for the 56-day conditional inspection via E1-4.1 by completing at least three turns of the propeller. [Encl (51)]

307. When asked how many times the propeller blades must rotate in order to ensure all engine turbine blades have been inspected, Staff Sergeant (b)(6) stated, "until I feel comfortable" all turbine blades have been inspected. [Encl (51)]

308. At VMGR-452, when conducting the borescope inspection portion of the 700 hour engine inspection, there exists no objective measurement that quantifies the number of times a respective propeller is turned. This eliminates the ability to validate the requirements of the 56-day conditional inspection. [Encls (49-52)]

309. VMGR-452 Maintenance has no maintenance documentation to support either of the scenarios that: the 56-day conditional inspection was not required or the 56-day conditional inspection was complied with from 1 March 2017 to 26 April 2017. [Encls (42), (45)]

310. From 1 March 2017 to 26 April 2017 a 56-day conditional inspection was not performed. [Encls (42), (45)]

311. The MAC performed a post-maintenance engine run on 19 May 2017 ending 79 days of idleness. [Encl (48)]

312. Propellers one, two, and four remained on the MAC, and there is no evidence showing an off-wing eddy current inner taper bore inspection was performed on the MAC between the dates of 26 April 2017 and 24 May 2017. [Encls (42), (45)]

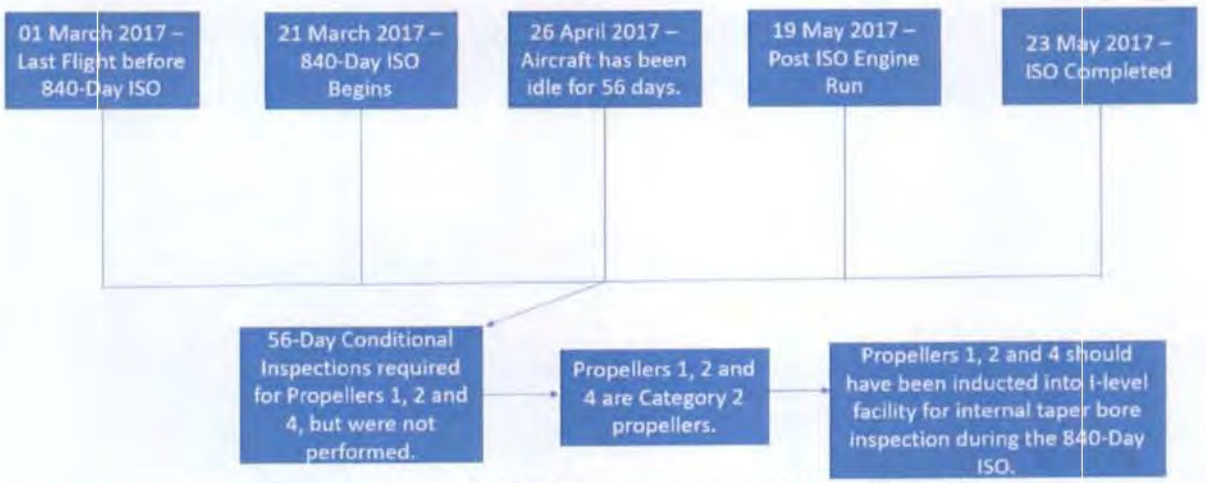


Figure 19: MAC Maintenance Inspection Timeline

313. The MAC's next flight was on 24 May 2017. [Encl (48)]

314. The MAC flew 73.3 hours from 24 May 2017 to 6 July 2017. [Encl (48), (55)]

315. The MAC had 8,084.3 total flight hours before its final flight. [Encl (48), (55)]

316. The 6 July 2018 flight was the MAC's most recent flight before 10 July 2017. [Encls (48), (55), (56)]

317. Since the propagation rate of a radial crack is unknown, it cannot be definitively ascertained if the radial crack would or would not have grown past the bushing and thus been detected utilizing an off wing internal taper bore eddy current inspection. [Encls (22), (24), (30)]

318. There is no evidence of P2B4 ever receiving an off-wing eddy current inspection after the depot level maintenance conducted by WR-ALC in 2011. [Encls (42), (50), (55)]

319. On 18 August 2016, VMGR-452 Maintenance underwent the Wing Maintenance Program Assessment (MPA) performed by the 4th MAW Aviation Logistics Maintenance Team (ALMAT). During this inspection, VMGR-452 Maintenance received an overall grade of "NON MISSION CAPABLE" (NMC), in accordance with reference (j). [Encl (57)]

320. This overall grade is comprised of receiving grades of "ON TRACK" in thirty areas, "OFF TRACK" in six areas and "NEEDS MORE ATTENTION" in four additional areas. [Encl (57)]

321. The six "OFF TRACK" areas were: maintenance control,[9] tool control, support equipment planned maintenance system (SEPMS), central technical publications librarian (CTPL), technical directives, and weight and balance. [Encl (57)]

322. The grade of "OFF-TRACK" in the maintenance control area is for inadequate maintenance documentation, missing documentation of in-process inspections and unauthorized maintenance being conducted without maintenance control's knowledge or authorization. [Encl (57)]

323. From December 2016 to July 2017, VMGR-452 Maintenance Control did not have a formal process in place to track the amount of time each propeller remained idle in order to comply with the propeller idle time 56-day manual rotation per reference (k). [Encls (49-51)]

324. Sergeant (b)(6), CDQAR, completed the corrective action portion of the "IN-PROCESS" sheet produced on 11 April 2017 in the OOMA maintenance database by consolidating his historical in-process comments. While this met the minimal documentation requirements of the 700-hour engine inspection, it provided no quantitative documentation to support compliance with the preconditions of the 56-day conditional inspection. [Encls (49-52)]

325. On 14 December 2017, VMGR-452 Maintenance underwent the next Wing MPA performed by the 4th MAW ALMAT. During this inspection VMGR-452 Maintenance received an overall grade of "MISSION CAPABLE" (MC). This overall grade is comprised of receiving grades of "ON TRACK" in 34 areas; "OFF TRACK" in two areas, Foreign Object Damage (FOD) and Aviation Life Support Systems (ALSS); and "NEEDS MORE ATTENTION" in four additional areas. [Encl (58)]

326. From 27 to 30 March 2018, the Commanding Officer, VMGR-452, directed an Operational Pause where two Marines from 4th MAW Aviation Logistics Department (ALD), as well as two Marines from MALS-49, conducted maintenance training and inspected records. [Encl (51)]

F. Other Issues

1. Embarkation at Cherry Point

327. Gunnery Sergeant (b)(6) is the Logistics Chief for Hotel Company, 2d MRB. [Encl (3)]

328. Sergeant (b)(6) is the Embarkation Chief for Hotel Company, 2d MRB. [Encl (3)]

329. Corporal (b)(6) is the Ammunition Technician for Hotel Company, 2d MRB. [Encl (3)]

[9] Maintenance control is one of the three core programs that exists within a squadron's maintenance department.

330. Gunnery Sergeant (b)(6) is the Staff Non-Commissioned Officer in Charge (SNCOIC) for both Sergeant (b)(6) and Corporal (b)(6). [Encl (59)]

331. Gunnery Sergeant (b)(6) Hazard class materials (HAZMAT) certification expired in December of 2010 and was not current in July 2017. [Encl (59)]

332. Sergeant (b)(6) is the Ammunition Technician for the Cherry Point APOE. [Encl (3)]

333. Lance Corporal (b)(6) is the Distribution Management Specialist, who was performing duties as a cargo joint inspector for CLC-21, APOE from 7-10 July 2017. [Encls (3), (15)]

334. Lance Corporal (b)(6) was assigned by CLC-21 as the only joint inspector to conduct the joint inspection (JI) on all cargo for the MAC flight. [Encl (15)]

335. A JI is a cargo air worthiness inspection conducted prior to loading cargo on military aircraft or military contracted aircraft. [Encls (60), (61)]

336. The cargo onboard the MAC consisted of the following items: two internal slingable unit 90-inch (ISU-90) containers, one Polaris Defense all-terrain utility vehicle (MRZR), and one 463L pallet of ammunition. [Encls (61), (62)]

337. The cargo load was organized inside the aircraft from front to rear in the following order: one MRZR, an ISU-90 with SN 77293, an ISU-90 with SN 76603 and one ammunition pallet. [Encl (62)]

338. No classified material was on the aircraft. [Encls (61-63)]

339. ISU-90 SN 77293 contained the following: 968 lithium-ion batteries, 22 cans of spray paint, 1 compressed oxygen cylinder, personal baggage and military kits, and weighed 2800 pounds. [Encls (61-63)]

340. The oxygen cylinder is Class 2.2 HAZMAT but was not identified on the load plan as HAZMAT. [Encl (62)]

341. The spray paint is Class 8 HAZMAT but was not identified on the load plan as HAZMAT. [Encls (62), (63)]

342. The ISU-90 SN 77293 was incorrectly designated as "J3D" on the load plan and should have been designated as "D3D" as it contained hazardous substances. [Encl (62)]

343. HAZMAT must be accessible to the aircrew during flight per reference (l). [Encl (64)]

344. ISU-90 SN 77293 contained hazard Classes 9, 2.2, and 8; and was blocked on both sides by other cargo not providing the crew the ability to access the hazardous cargo in flight. [Encl (62)]

345. ISU-90 SN 76603 contained serialized personal weapons, optics, communications equipment, and weighed 6420 pounds. [Encl (62)]

346. All weapons loaded as cargo onto the MAC were found after the mishap in the surrounding debris fields with the exception of one Glock-19 handgun with Serial Number ABFN570 and National Stock Number (NSN) 1005-01-571-9875. [Encl (65)]

347. MRZR SN 928912 was in operational condition and contained the following HAZMAT: UN1203 gasoline (less than one half tank) and UN2800 wet-filled batteries. The MRZR weighed 1980 pounds. [Encls (62), (63)]

348. The ammunition pallet consisted of the following classes: 1.4S (small arms), 1.2G (incendiary ammunition), 1.3G (signal flare), 1.1E (cartridge w/ secondary detonating charge), and 1.4G (smoke signal). [Encls (62-64)]

349. The ammunition pallet consisted of four warehouse pallets placed onto a 463L pallet which had crated munitions banded across the top, with dimensions of 108 inches in length by 88 inches in width and by 48 inches in height. [Encls (62-64)]

350. The ammunition is Class 1 HAZMAT but was not identified on the load plan as HAZMAT. [Encls (62), (63)]

351. Pursuant to AFMAN 24-204 and independent USAF HAZMAT experts, ammunition class 1.1E is not compatible with classes 1.3G & 1.4G.[10] (All military aircraft must comply with the AFMAN 24-240 regardless of service association.) [Encls (64), (66)]

352. Pursuant to AFMAN 24-204 and independent USAF HAZMAT experts, HAZMAT class 8 is not compatible with ammunition classes 1.1, 1.2 and 1.3. [Encls (64), (66)]

353. The ammunition pallet weighed 4275 pounds with a net explosive weight (NEW) of the ammunition as 3843.07 pounds. [Encl (62)]

354. The load plan used for the MAC flight had markings identifying it as a "Chapter 3" move in the header section of the document. [Encl (62)]

[10] The AFMAN 24-204 utilizes a matrix, or chart, to define compatibility restrictions between different classes of HAZMAT and ammunition.

355. 2d MRB should have but did not request a procedural exemption for ammunition compatibility limitations, otherwise known as a "Chapter 3 request". [Encl (62)]

356. The 2d MRB embark section did not mark the boxes of ammunition, which are not full, "LITE" and color them orange per the Ammunition Handbook. [Encls (16), (66)]

357. Some of the ammunitions crates and cans were missing the Performance Oriented Packaging (POP) markings as required by the Ammunition Handbook. [Encls (16), (66)]

358. The steel banding used to unitize the ammunition and affix it to warehouse pallets initially only utilized one crimp per band instead of two crimps per band as required. [Encls (16), (66)]

359. The ammo pallet for the MAC on 10 July 2017 had 5,250 pounds of effective restraint in the forward direction. [Encls (67), (68)]

360. This ammo pallet required 12,825 pounds of effective restraint in the forward direction per the Embarkation Handbook. [Encls (67), (68)]

361. Gunnery Sergeant (b)(6) was not present to provide supervision at the APOE during the inspection process from 6-9 July 2017. [Encl (59)]

362. Gunnery Sergeant (b)(6) was only present at the APOE on 10 July 2017. [Encl (59)]

363. In accordance with local procedures, embarkation operations for the MAC load commenced on Friday 7 July 2017 with the inspections of the general cargo load and culminated on Monday 10 July 2017 with the addition of the ordnance component just prior to the MAC's departure. [Encls (14), (59)]

364. Gunnery Sergeant (b)(6) initiated the creation of the MAC load plan, Date Time Group (DTG) 20170708 18:20 UTC, and then delegated its completion to Sergeant (b)(6). [Encls (14), (59), (62)]

365. Sergeant (b)(6) completed the load plan originated by Gunnery Sergeant (b)(6) utilizing the Integrated Computerized Deployment System (ICODES). [Encls (14), (62)]

366. All initial embarkation documents were sent to Gunnery Sergeant (b)(6) for his approval for the 10 July cargo movement for the MAC and the non-MAC from MCAS Cherry Point. [Encl (14)]

367. Gunnery Sergeant (b)(6) did not discover any discrepancies during his review of the final load plan before the load was moved to

MCAS Cherry Point for embarkation onto the MAC. [Encls (14), (59), (62)]

368. Sergeant (b)(6) signed the MAC load plan, Date Time Group (DTG) 20170708 18:20 UTC, on 9 July for everything but the ammunition which was signed on 10 July 2017. [Encl (62)]

369. The MAC load plan for the 10 July 2017 flight from MCAS Cherry Point to NAF El Centro was the first load plan Sergeant (b)(6) had prepared and certified since receiving his qualification in March 2017. [Encl (14)]

370. On Friday, 7 July 2017, Corporal (b)(6) signed for the ammunition at the Ammunition Supply Point (ASP) at MCB Camp Lejeune. [Encl (69)]

371. At 1652 on 7 July 2017, Lance Corporal (b)(6) conducted a JI on the general cargo, which did not include the ammunition, for the MAC. [Encl (61)]

372. At 1530 on 8 July 2017, Lance Corporal (b)(6) indicated on the DD-2133[11] that the MRZR and the two ISU-90's had passed the JI but no other documentation exists to substantiate this inspection was conducted on 8 July.[12] [Encls (15), (61)]

373. There were multiple inconsistencies with the JI documentation, DD-2133, to include issues with securing the battery and mis-identification of the pintle hooks on the MRZR.[13] [14] [15] [16] [Encls (61), (70)]

374. At 1130 on 9 July 2017, Corporal (b)(6) and Sergeant (b)(6) drove a 7-ton truck from the MCB Camp Lejeune ASP to MCAS Cherry Point delivering ammunition to an area they believed to be the Combat Aircraft Loading Area (CALA). [Encls (14), (69)]

375. This ammunition, however, was mistakenly delivered to the Ordnance Staging Area (OSA) vice the CALA. [Encl (16)]

376. Between 1300 and 1500 on 9 July 2017, the ammunition was loaded and restrained onto the 463L pallet with six 5,000-pound cargo straps for air embarkation, and Lance Corporal (b)(6) conducted a JI

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[11] DD-2133 is a Joint Inspection Form used by the inspector to certify that a particular load is airworthy.
[12] The certified DD-2133 showed that Lance Corporal (b)(6) had validated the MRZR battery terminals were secured in a manner that would prevent arcing during flight.
[13] Pictures of the MRZR show that the terminals were not secure in a manner that would prevent arcing inflight.
[14] The certified DD-2133 showed that Lance Corporal (b)(6) had validated that the pintle hook on the MRZR was in working condition.
[15] Pintle hooks are attached to the front or rear of a vehicle and they allow a cable to be attached which enables the vehicle to either pull another object, or be pulled. They are used for quick attachment and detachment capabilities during specialized towing requirements.
[16] The MRZR loaded onto the MAC on 10 July 2017 did not have a pintle hook.

certifying the ammunition pallet airworthy for shipment. [Encls (14), (69), (71)]

377. There was no bravo flag flying at the OSA or the CALA at MCAS Cherry Point from 9 July 2017 until the morning of 10 July 2017 to alert personnel of live ammunition in the OSA. [Encl (16)]

378. At 0705 on 10 July 2017, Mr. (b)(6), Explosive Safety Officer (ESO) for MCAS Cherry Point, conducted a routine safety inspection of the OSA and found multiple discrepancies with the ammunition pallet. [Encl (16)]

379. Sergeant (b)(6) amended the Hazardous Declarations (Hazdecs) while Gunnery Sergeant (b)(6) and Corporal (b)(6) corrected the discrepancies noted by Mr. (b)(6) on the 463L pallet. [Encls (14), (69)]

380. At 1100 on 10 July 2017, Lance Corporal (b)(6) inspected the ammunition pallet for a second time, and reaffirmed that the pallet was airworthy following the correction of the discrepancies. [Encls (15), (59), (61)]

381. At 1200 on 10 July 2017, Mr. (b)(6) inspected the ammunition pallet a second time and noted that the original discrepancies had been corrected. [Encls (16), (59)]

382. All issues discovered by Mr. (b)(6) were remediated except some of the POP markings which would have required disassembling the pallets, repainting some of the items, waiting for them to dry, and re-palletizing the items before re-inspecting and loading the pallet. [Encls (16), (59)]

383. The CLC-21 chain of command provided no oversight to aid Lance Corporal (b)(6) during the inspection, and no QA check was performed by senior APOE personnel upon the completion of the inspection. [Encls (14), (15), (61), (72)]

384. Lance Corporal (b)(6) used pencil to complete the original DD-2133. For this reason, it is unknown when and where the document was created, adjusted, or signed for execution. [Encl (61)]

385. After the general cargo was loaded onto the MAC at the APOE, the MAC taxied to the CALA to load the ammunition pallet. [Encls (14), (15), (72-74)]

386. At 1350 on 10 July 2017, the MAC had completed loading ammunition at the CALA. [Encl (74)]

387. Sergeant (b)(6) could not identify the proper source documentation in order to determine HAZMAT compatibility, specific to the MAC cargo, and used the packaging paragraphs to determine

compatibility when he should have used the Segregation Tables contained within reference (1). [Encl (14)]

388. Lance Corporal (b)(6) used the CFR-49 to determine compatibility when the correct reference for military air shipment of HAZMAT is the AFMAN 24-204. [Encl (15)]

389. Lance Corporal (b)(6) stated she didn't think the AFMAN had information about ammunition. [Encl (15)]

390. Lance Corporal (b)(6) was using an outdated version of the CFR-49 when inspecting the cargo designated to be loaded onto the MAC. [Encl (15)]

391. Sergeant (b)(6) used the Hazard Classification of US Military Explosives and Munitions ("Yellow Canary") to determine compatibility rather than reference (1), the appropriate reference. [Encl (71)]

392. Sergeant (b)(6) stated that the AFMAN has no actual compatibility chart for flying ammo. [Encl (71)]

393. On 21 September 2017, the 437th Airlift Wing, the Joint Inspector training unit, conducted a site visit to assess and train the Marine Corps Air Station (MCAS) Cherry Point's aerial port of embarkation/debarkation (APOE) and as a result, identified shortfalls in manning and the conduct of inspections for cargo airworthiness. [Encl (75)]

2. Claims

394. The Tort Claims Branch, Claims & Tort Litigation Division (Code 15) possesses contact information for potential claimants and other necessary information to process claims resulting from the MAC crash. [Encl (76)]

395. As of 16 August 2018, three claims have been filed with Code 15 alleging damages to real property and damages for loss of crops. The first requests payment in the amount of $210,000; the second requests payment in the amount of $177,500; the third requests payment in the amount of $119,651.98. [Encl (76)]

396. There is no evidence of personal injury to anyone living or working in the geographic area of the crash. [Encl (76)]

Opinions

1. All but one of the aircrew met all ground and flight syllabus requirements. That individual was scheduled for his annual NATOPS evaluation during this mission with a qualified and current instructor. All aircrew were medically and physiologically qualified, aeronautically adapted, well-rested and physically and mentally

prepared to conduct the mission. They had no apparent personal problems that would affect their performance. [FOF (1-80), (85)]

2. Aircrew conduct, on the day of the mishap, to include flight preparation, briefing, and execution was professional and in accordance with standard operating procedures. [FOF (89-94)]

3. The cause of mishap was the inflight liberation of P2B4. Its liberation and penetration of the fuselage began a catastrophic sequence of events which ultimately resulted in the midair breakup. [FOF (106-108), (121-140)]

4. Since P2B4 did not exit the aircraft, its energy was transferred into the aircraft structure and resulted in two simultaneous effects: the overload failure of propeller three's drive shaft resulting in the failure of the RGA, and the displacement of the aircraft to the right. This displacement to the right can be visualized as the foundation of a shed being pushed to the right while the walls and roof collapse and crumble to the left from the extreme forces applied to the right side base of the shed. [FOF (106-108), (121-127)]

5. The unknown magnitude of the physical force applied to the overall structure of the aircraft from the impacts of P2B4 likely resulted in structural instability and allowed for energy transference to affect the propeller shaft of propeller three. This resulted in an overload condition on the number three RGA. This condition allowed for propeller three and the front half of the number three RGA to separate and, due to centrifugal force and fuselage displacement, impact the starboard side of the fuselage. [FOF (120-138)]

6. The initial impact of P2B4 caused significant damage to the LBL support structures. Propeller three caused significant damage to the RBL support structures. This combination severed the flight control cables, to include power and condition lever cables, rendering the aircraft uncontrollable. [FOF (120-138)]

7. The overwhelming physiological forces experienced by the aircrew and severe physical forces applied to the structural integrity of the aircraft as the instantaneous, catastrophic sequence of events unfolded, resulted in the aircrew and passengers suffering the following conditions at altitude: shock, disorientation, inadvertent physical responses, rapid onset of below freezing conditions and near impossible crew communication. [FOF (84-86), (106-108), (120-138)]

8. During this catastrophic sequence of events, there were sudden and rapid movements that induced a rapid G onset that aggravated and accelerated the above physiological forces. [FOF (106-111)]

9. Due to the rapid onset of the catastrophic sequence of events and instantaneous structural failures, it is unlikely that the aircrew had

time to apply sufficient input to change the final outcome. [FOF (106-108), (132)]

10. While in the initial phases of the aggravated attitude, the aircraft structure forward of the wings began to separate, resulting in the cockpit section forward of FS 245 separating and creating the trail of debris tracking on an approximate course of 270 degrees, designated as the NDF. [FOF (112-117)]

11. The absence of the cockpit, forward of FS 245, resulted in the forward section of the central fuselage creating a violent non-aerodynamic drag moment, which exceeded engineering tolerances and greatly accelerated fuselage break up forward of the wing box structure (FS 477). [FOF (131)]

12. The fuselage section from the wing box structure aft, continued to fly in a general southwest direction with enough dynamic stability that allowed the fuselage to reenter a downward attitude until final impact at the south debris field (SDF). [FOF (112-118)]

13. Efforts of the first responders and local concerned citizens who immediately responded to the crash site and assisted in the search and recovery efforts were noteworthy and commendable. [FOF (109-111)]

14. The propeller overhaul process and publications for USN blades at WR-ALC in 2011, while not optimal, still required technicians to identify and remove existing corrosion. WR-ALC failed to remove existing and detectable corrosion pitting and IGC on P2B4 in 2011, which ultimately resulted in its inflight liberation. This blade liberation was the root cause of the mishap. [FOF (106-108), (145-151), (163), (165), (171), (177-179), (185), (187), (193)]

15. Due to the absence of QC/QA requirements for the identification and removal of corrosion within prescribed NAVAIR publications, it allowed for technical oversight gaps by technicians. The absence of QC/QA requirements to validate the removal and repair of corrosion infected areas created an unacceptable level of risk and degree of fault for the parties involved. [FOF (166), (171), (175-179), (185), (187), (194), (219-232)]

16. Negligent practices, poor procedural compliance, lack of adherence to publications, an ineffective QC/QA program at WR-ALC, and insufficient oversight by the USN, resulted in deficient blades being released to the fleet for use on Navy and Marine Corps aircraft from before 2011 up until the recent blade overhaul suspension at WR-ALC occurring on 2 September 2017. [FOF (145-151), (163-166), (171), (175-179), (183-187), (193), (194), (218), (221), (226-232), (248-275)]

17. Twelve of sixteen blades on the MAC were determined to have corrosion that existed at the time of their last overhaul at WR-ALC, proving that over the course of the number of years referred to above,

that WR-ALC failed to detect, remove and repair corrosion infected blades they purported to have overhauled. [FOF (257-275)]

18. Thirteen of sixteen blades on the MAC had other discrepancies proving that, over the same span of years referred to above, WR-ALC was deficient in the effective application of the following steps: anodization, epoxy primer and permatreat. [FOF (257-275)]

19. Lack of joint standardized technical manuals addressing the blade overhaul process increases the probability of errors within the process. [FOF (175), (177), (180), (181), (183-187), (190-194), (197-204), (213), (214), (218)]

20. The physical movement of a blade progressing through the blade overhaul process at WR-ALC is unorganized and inefficient resulting in excessive movement of the blade. [FOF (178-181), (190), (194), (197-204), (213), (214), (218)]

21. Since WR-ALC does not comply with their own color-coding system in order to help differentiate the service-specific blade overhaul process requirements, the system is unreliable and increases the probability of error within the process. [FOF (178-181), (190), (194), (197-204), (213), (214), (218)]

22. Work control documents relating to each propeller blade going through the blade overhaul process should be retained within the blade's official maintenance record for the life cycle of the blade. [FOF (178-181), (190), (194), (197-204), (213), (214), (218)]

23. Due to the lack of effective documentation and the presence of anodize infused in the corrosion pitting and IGC present in 2011, it is unlikely that any QC/QA process or a SSOE inspection was conducted on P2B4 at its last overhaul. [FOF (149-154), (163), (178-181), (219-221), (229-232)]

24. The two responsible parties named in the DMISA are NAVSUP-WSS-P and WR-ALC. However, based on the evidence discovered throughout this investigation these parties do not possess the capabilities or skills necessary to adequately perform their DMISA obligations. The current organization and structure of the DMISA fails to effectively define the obligations of the USN Propeller FST and the USAF C-130 SPO for technical matters and responsibilities that are required to effectively coordinate, execute and enforce this agreement. [FOF (236-256)]

25. Had the QA provisions of the DMISA been properly managed and implemented by the Navy via conducting systematic and routine quality audits, numerous deficiencies within the blade overhaul process should have been identified which could have prevented the accident. [FOF (149-154), (164), (178-181), (219-221), (229-232), (235), (248-256)]

26. The Navy liaison representative assigned to WR-ALC is defined as a technical position but has been executed primarily as an administrative function which does not fulfill the requirements and responsibilities of the job description required to assist the Navy in fulfilling the QC/QA and oversight functions associated with the blade overhaul process. [FOF (256)]

27. VMGR-452 Maintenance Department failed to establish a formal process or procedure to track and perform the 56-day Conditional Inspection's manual blade rotation requirements. Due to the nature of this particular inspection there are no automatic triggers in OOMA which notify the maintenance department when this inspection is due. Regardless of an inspection type, Maintenance Control continues to be responsible for tracking this inspection regardless of what maintenance action is being conducted on an aircraft. [FOF (301-316)]

28. VMGR-452's inaccurate understanding of maintenance documentation requirements and tracking methods for procedural compliance related to completing maintenance actions in accordance with naval aviation maintenance publications and procedures resulted in their Maintenance Department inaccurately believing that the 700 hour engine inspection and ISO B 840 day inspection met the requirements of the 56-day Conditional Inspection manual rotation. [FOF (293), (294), (300), (305-312)]

29. Since an on-wing eddy current inspection can only detect to a depth of 0.017 inches in depth, and the radial crack was 0.45 inches below the outer surface of the propeller when P2B4 liberated, an on-wing eddy current inspection performed on P2B4 would not have detected the crack. [FOF (155), (285-291)]

30. Even if the unit had conducted the required off-wing eddy current inner taper bore inspection in April 2017, it cannot be concluded with any reasonable degree of certainty that the radial crack would or would not have been detected as the growth rate for a radial crack is unknowable. It can thus be surmised that though it cannot be definitely proven if the radial crack had developed past the bushing, it can also not be definitively proven that the radial crack had not grown past the bushing prior to mishap and could have been detected. [FOF (287-291), (317)]

31. None of the deficiencies identified in the embarkation process, were causal factors to the mishap. [FOF (340-345), (350-361), (368-375), (383-393)]

32. The lack of supervision over those involved in the embarkation process allowed multiple discrepancies to materialize requiring corrective action which created an unknown and unnecessary level of risk to Marine Corps aircrew and passengers. [FOF (334), (335), (356-363), (365-370), (372-378), (384), (385), (388-393)]

Recommendations

1. The USN and USAF create one set of standardized joint publications defining all requirements for the propeller blade overhaul process to be executed by every depot level maintenance facility. This includes the standardization of QC/QA audits and investigations for all processes and procedures dealing with detection and removal of corrosion.

2. QC/QA at any depot level maintenance facility should cover every procedure within the blade overhaul process. This should include the development of exclusive and deliberate supervisory oversight requirements ensuring corrosion is detected and removed.

3. That WR-ALC retain an electronic data base of all work control documents and records relating to each propeller blade that gets overhauled at WR-ALC within the blades' official maintenance record and keep these records indefinitely.

4. The USN and USAF update and improve the DMISA by specifically defining each party's obligations and responsibilities. This includes conducting regularly scheduled quality audits. These audits should be documented and retained to show historical trends and remediation of discrepancies discovered.

5. USN Propeller FST should to participate in the annual DMISA periodic review of each party's obligations to ensure accurate updates, requirements, publication specifications and procedural compliance exist to ensure QC/QA and execution of the production processes are satisfied.

6. That the Navy Liaison job description be redefined to require: technical expertise as a subject matter expert (SME), integration into the QC/QA process at the depot level maintenance facility, reporting directly to USN Propeller FST and ensuring that the depot level maintenance facility remains in compliance with all USN propeller overhaul policies, procedures and publications.

7. USN and USMC blades should receive an off-wing eddy current inner taper bore inspection on a regular basis. Specifically, NAVAIR should require these inspections be performed whenever a propeller goes into a scheduled ISO evolution or the propeller is removed from the aircraft for any reason.

8. That the cycle time between propeller overhauls be re-assessed and reduced to a safe operational level below the current flight hour requirement of 5,000.

9. With respect to the 56-Day Conditional Inspection, maintenance procedures need to be changed to either:

i. Create a 56-Day Special Inspection to rotate the applicable propeller assemblies three times, instead of the current 56-Day Conditional Inspection, or Incorporate the propeller rotation as part of the 35-Day Inspection, and

ii. Alter the written requirements of cards 216 and 216.1 to include requiring a work order or MAF be initiated for the propeller turns regardless of how many days the plane has been idle.

10. That Commander, Naval Air Forces (CNAF) designate and appoint an Aviation Maintenance Administration and Management Training (AMAMT) team comprised of subject matter experts (SMEs) who periodically inspect all facilities which overhaul USN/USMC propeller blades, on at least an annual basis.

11. The Navy and Marine Corps install crash survivable flight data recorders and cockpit voice recorders in the remaining aircraft that do not have these modifications

12. In order to improve future aircraft mishap investigations, the mishap aircraft data should be loaded from OOMA onto a standalone server after the OOMA database is locked by Space and Naval Warfare Systems Command (SPAWAR). This server should be accessible to the investigation teams.

13. That all Naval aviation aircrew flying aircraft which carry cargo be required to receive formal training on aviation cargo transportation, embarkation and HAZMAT compatibility on an annual basis.

14. That an initiative be established for the appropriate VMGR-452 maintenance leadership and personnel focusing on comprehensive and effective procedural compliance of naval aviation maintenance publications and maintenance documentation.

15. That Headquarters Marine Corps (HQMC) conduct a review of the experience, training and supervision of the embarkation process with respect to aviation cargo based on historical HAZREPs associated with embarkation and other safety related data.

16. Forward a copy of this investigation, regarding the embarkation process, to Commander, Marine Corps Forces, Special Operations Command and Commanding General, 2d Marine Logistics Group.

17. Although outside the department of the Navy, recommend the USAF investigate key personnel and all others for historical and current noncompliance of NAVAIR publications and procedures at Warner Robins Aviation Logistics Complex. Shortcomings exist in the areas of proper

supervision, verification and understanding of critical safety of flight repair processes. The culture at WR-ALC from 2011 to 2017 resulted in gross negligence of depot level maintenance personnel and practices that are the direct causal factor for this mishap.

(b)(6)