



DEPARTMENT OF THE NAVY
COMMANDER NAVAL AIR FORCES
BOX 357051
SAN DIEGO CALIFORNIA 92135-7051

5830
Ser N00/152
19 Apr 22

FINAL ENDORSEMENT on CAPT (b) (3) (A), (b) (6), USN ltr 5830 of 4 Feb 22

From: Commander, Naval Air Forces
To: File

Subj: COMMAND INVESTIGATION INTO THE FACTS AND CIRCUMSTANCES
SURROUNDING THE 31 AUGUST 2021 AVIATION MISHAP THAT OCCURRED
ONBOARD USS ABRAHAM LINCOLN (CVN-72)

Encl: (118) CDR (b) (3) (A), (b) (6), USN, ltr 5340 of 11 Apr 22

1. This command investigation [hereinafter “command investigation”] was convened to inquire into the facts and circumstances surrounding the incident on 31 August 2021 that resulted in the loss the MH-60S aircraft (BUNO 167899), call sign LOOSEFOOT 616 (LT 616) and five Sailors who tragically perished in the mishap. Enclosure (118) is the supplemental investigation [hereinafter “supplemental investigation”] convened to inquire into the material condition and performance of the Aviation Life Support Systems (ALSS) associated with the subject mishap.

2. I join Commander, THIRD Fleet and the investigating officer in extending my deepest condolences to the families and loved ones of LT Bradley Foster, LT Paul Fridley, AWS1 James Buriak, HM1 Sarah Burns, and HM2 Bailey Tucker.

3. I commend the crew of USS ABRAHAM LINCOLN for their expeditious response to this tragedy and the immediate rescue of AWS3 (b) (6), (b) (7) (C), (b) (3) (A). I would like to extend my deepest gratitude to the USS CINCINNATI and the Helicopter Maritime Strike (HSM) and Helicopter Sea Combat (HSC) squadrons who contributed to the search for our fallen Sailors.

4. After review of both the command and supplemental investigations, I hereby approve the findings of facts, opinions, and recommendations of the investigating officers as endorsed by Commander, U.S. THIRD Fleet with the below modifications.

5. The following modifications are hereby made to the command investigation:

a. Enclosures (10) and (20) of the command investigation provide conflicting accounts of the location of the pilots in the aircraft. However, enclosure (2) of the supplemental investigation clarifies this discrepancy. Therefore, Finding of Fact 45 of the command investigation is hereby rewritten to state “LT Foster was seated in the left pilot seat. LT Fridley was seated in the right pilot seat.”

6. The following corrective actions have been taken to address each likely cause of this mishap:

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a. On 14 September 2021, an H-60 Interim Rapid Action Change (IRAC), and an Engineering Advisory Report (EAR) were released to highlight proper use of the Spindle Pry Bar during maintenance and reemphasized possible damage when improperly used.

b. On 7 December 2021, an H-60 Interim Support Equipment Change (ISEC) was released directing the modification of the Main Rotor Head Spindle Pry Bar by adding a “hard stop” to ensure the spindle pry bar cannot be installed with the damper hose attached. 78% of all U.S. Navy Spindle Pry Bars have been inducted and completed to date.

c. On 24 January 2022, Naval Air Systems Command (NAVAIR) released an Urgent H-60 NATOPS Change providing amplifying information on Ground Resonance (Chapter 11 and Chapter 12), Damper Failures (Chapter 12), and updating Unusual Vibrations in Flight and Ground Resonance/Unusual Vibrations on Deck Emergency Procedures (Chapter 12). The change to the Emergency Procedure immediately addresses Recommendation 2 of the command investigation by emphasizing the need to move the Power Control Levers (PCLs) to the off position, and by having the Pilot Not At the Controls put their hands on PCLs prior to landing.

d. On 3 March 2022, an H-60 Airframe Bulletin (AFB) was released ordering the inspection and replacement of all main rotor damper hoses no later than 60 flight hours from that date. HSC-8 has been issued 24 Damper Lines for their six assigned aircraft. NAVAIR is currently conducting analysis to determine a standard periodicity for replacement versus “fly-to-fail” procedures currently used.

e. NAVAIR Aircrew Systems Program Office (PMA 202) review of Life Preserver (LPU) 36/37 design is ongoing to prevent unintended migration of inflation tube knurled locking ring.

f. NAVAIR Aircrew Systems Program Office (PMA 202) review of inspection periodicity is ongoing for knurled locking rings and CO₂ cartridge alignment.

7. I have directed the following actions for all H-60 commands and NAVAIR:

a. Aircrew shall continue to regularly train to these types of emergencies and incorporate lessons learned from this incident into all future aircrew briefings.

b. Aviation commands shall brief this mishap, the command and supplemental investigations, lessons learned, and revisit procedures related to ground resonance, damper failures, and unusual vibrations both in the air and on deck. Commands shall brief the importance of proper preflight of SEA bottles, proper attachment procedures for Emergency Release Assemblies, and develop standardized methods for installing and utilizing passenger and aircrew seats, including gunner seats.

8. I have directed my staff to forward this investigation to NAVAIR and to address the following:

a. Examine the design and feasibility of incorporating failure indications of the main rotor head damper system into the cockpit.

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b. Examine the material design of the main rotor damper hoses to allow for material condition inspection to prevent in-flight failure.

c. Examine the depth at which a properly functioning LPU fails to provide effective flotation with a fully burdened life vest

d. Conduct random functional checks on 10% of squadron Ready For Issue (RFI) in-service LPUs to determine if the LPU functionality is an issue endemic to the Fleet.

e. Amend the requirements of the Naval Aviation Survival Training Program to require both auto inflation and manual inflation of at least one lobe for aircrew that utilize the LPU-73A/P and LPU-34B/P.

9. I have determined that no punitive or administrative action is warranted.

10. This investigation and enclosures will be maintained in the Force Judge Advocate office for Naval Air Forces, which may be reached at (b) (6), (b) (7)(C)



K. R. WHITESELL

Copy to:

CPF

C3F

NAVAIR

NAVSAFCOM

OJAG (Code 14)

CCSG-9

CVN 74

HSCWINGPAC

HSC-8



DEPARTMENT OF THE NAVY
COMMANDER U.S. THIRD FLEET
53690 TOMAHAWK DR STE 338
SAN DIEGO, CALIFORNIA 92147-5004

IN REPLY REFER TO:

5830
Ser N00/038
15 Feb 22

FIRST ENDORSEMENT on CAPT (b) (3) (A), (b) (6), USN ltr 5830 of 4 Feb 22

From: Commander, U.S. THIRD Fleet
To: Commander, Naval Air Forces

Subj: COMMAND INVESTIGATION INTO THE FACTS AND CIRCUMSTANCES
SURROUNDING THE 31 AUGUST 2021 AVIATION MISHAP THAT OCCURRED
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1. Endorsed and forwarded in accordance with reference (a), concurring with the findings of fact, opinions, and recommendations.
2. First and foremost, I extend my deepest condolences to the families and friends of LT Bradley Foster, LT Paul Fridley, AWS2 James Buriak, HM2 Sarah Burns, and HM3 Bailey Tucker. Their tragic deaths remind us of the dangerous duties our aircrew perform on a daily basis in the service of our nation, and our duty to continually improve our equipment and procedures to reduce risk.
3. In furtherance of this duty and as noted in the investigation, the Navy took immediate steps to reduce the risk of another tragedy. The Navy directed both a modification to spindle pry bar assemblies and found replacements of all damper hoses throughout the Fleet as warranted. Implementation of the recommendations in the Engineering Investigation and their incorporation into the Aviation Mishap Report is required to continue the tireless work to provide for the safety of our aircrew. These modifications, Fleet-wide replacements, and review of equipment and procedures reflect both the urgency and unrelenting desire to ensure the safety of our fellow Sailors.
4. My point of contact in this matter is CDR (b) (6), (b) (3) (A) JAGC, USN who may be reached via email at: (b) (6), (b) (3) (A) or COMM: (b) (6), (b) (3) (A)

S. T. KOEHLER

5830
4 Feb 22

From: CAPT (b) (6), (b) (3) (A), USN
To: Commander, U.S. THIRD Fleet

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Ref: (a) JAGINST 5800.7G, Manual for the Judge Advocate General
(b) A1-H60SA-NFM-000 MH-60S, Naval Air Training Operating Procedures
Standardization Manual
(c) CNAF M-3710.7, NATOPS General Flight and Operating Instructions Manual
(d) HSC-8 INST 3710.3Y, HELSEACOMBATRON EIGHT Standard Operating
Procedures
(e) COMHELSEACOMBATWINGIANDINST 3710.5F/
COMHELSEACOMBATWINGPACINST 3710.F, Joint Type Wing Standard
Operating Procedures
(f) NAVAIR 00-80T-105 CV NATOPS Manual
(g) COMNAVAIRFORINST 4790.2D, The Naval Aviation Maintenance Program
(h) A1-H60SA-MRC-350 Maintenance Requirement Card
(i) A1-H60CD-60S-000 MH-60S IETMS

Encl: (1) COMTHIRDFLT ltr 5830 Ser N00/196 of 7 Sep 21
(2) HSC-8 Flight Schedule of 31 Aug 21
(3) Carrier Strike Group NINE Line of Duty Determination for HSC-8 Crewmen of
17 Sep 21
(4) Carrier Strike Group NINE Line of Duty Determination for AWS3 (b) (6), (b) (3) (A), (b) (7)(C) of
17 Sep 21
(5) Carrier Strike Group THREE Line of Duty Determination for ABEAN (b) (6), (b) (3) (A), (b) (7)(C) of
1 Oct 21
(6) Carrier Strike Group THREE Line of Duty Determination for LT (b) (6), (b) (3) (A), (b) (7)(C) of
1 Oct 21
(7) USS ABRAHAM LINCOLN Flight Deck Videos from 31 Aug 21
(8) COMTHIRDFLT Fleet Battle Watch Captain Email of 15 Sep 21
(9) Summary of Interview of LCDR (b) (6), (b) (3) (A) (HSC-8)
(10) Summary of Interview of LT (b) (6), (b) (3) (A) (HSC-8)
(11) Summary of Interview of ASW1 (b) (6), (b) (3) (A) (HSC-8)
(12) Summary of Interview of AWS3 (b) (6), (b) (3) (A) (HSC-8)
(13) Summary of Interview of AMCS (b) (6), (b) (3) (A) (HSC-8)
(14) Summary of Interview of AM1 (b) (6), (b) (3) (A) (HSC-8)
(15) Voluntary Statement of CDR (b) (6), (b) (3) (A) (ABE)
(16) Voluntary Statement of LT (b) (6), (b) (3) (A) (HSC-8) and related email of 20 Sep 21
(17) USS ABRAHAM LINCOLN Approved Air Plan of 31 Aug 21

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- (18) Member Data Summaries for LT Foster, Bradley; LT Fridley, Paul; AWS2 Buriak, James; HM2 Burns, Sarah; AWS3 (b) (6), (b) (3) (A), (b) (7)(C) and HM3 Tucker, Bailey
- (19) HELSEACOMBATRONEIGHT NOTICE 3500, Letter of Instruction for USS ABRAHAM LINCOLN (CVN 72) Carrier Qualification Detachment 26 August – 2 September 2021 (18 Aug 21)
- (20) Summary of Interview of AWS3 (b) (6), (b) (3) (A), (b) (7)(C) (HSC-23)
- (21) Summary of Interview of AM1 (b) (6), (b) (3) (A) (HSC-8)
- (22) Summary of Interview of AM2 (b) (6), (b) (3) (A) (HSC-8)
- (23) Photo showing damage to CNATRA Aircraft (b) (3) (A) on 31 Aug 21
- (24) Photo showing damage to CNATRA Aircraft (b) (3) (A) on 31 Aug 21
- (25) Photo showing damage to CNATRA Aircraft (b) (3) (A) on 31 Aug 21
- (26) Photo showing damage to ABE flight deck safety nets on 31 Aug 21
- (27) Photo showing of damage to ABE O-10 Signal Locker on 31 Aug 21
- (28) Email of CDR (b) (6), (b) (3) (A) (ABE) of 13 Sep 21
- (29) DD Form 250, Material Inspection and Receiving Report (BUNO 167899) of 31 Dec 11
- (30) Email of LCDR (b) (6), (b) (3) (A) (HSC-8) of 04 Oct 21
- (31) Email of Mr. (b) (6), (b) (3) (A) (CNATRA) of 21 Sep 21
- (32) COMTHIRDFLT Public Affairs Release of 04 Sep 21
- (33) COMTHIRDFLT Battle Watch Captain Email of 03 Sep 21
- (34) USS ABRAHAM LINCOLN Officer of the Deck Log for 31 Aug 21
- (35) Voluntary Statement of LTJG (b) (6), (b) (3) (A) (ABE)
- (36) USS ABRAHAM LINCOLN Rescue Report, Serial Number 21-01
- (37) USCG Search and Rescue Report of USN Helo Crash
- (38) Photo showing of MEDEVAC of AWS3 (b) (6), (b) (3) (A), (b) (7)(C) of 31 Aug 21
- (39) Voluntary Statement of Mr. (b) (6), (b) (3) (A) (COMNAVAIRPAC)
- (40) Naval Air Training and Operation Procedures Standardization Reports for LT Foster, Bradley (HSC-8)
- (41) Logbooks for LT Foster, Bradley of Feb 21- Aug 21
- (42) Naval Air Training and Operation Procedures Standardization Reports for LT Fridley, Paul (HSC-8)
- (43) Logbooks for LT Fridley, Paul of Feb 21- Aug 21
- (44) Quality Assurance Officer Designation Ltr for LT Fridley, Paul of 30 Oct 20
- (45) Naval Air Training and Operation Procedures Standardization Reports for AWS2 Buriak, James (HSC-8)
- (46) Logbooks for AWS2 Buriak, James of Feb 21- Aug 21
- (47) HSC-8 Qualifications Reports for AWS2 Buriak, James; HM2 Burns, Sarah; and HM3 Tucker, Bailey
- (48) Naval Air Training and Operation Procedures Standardization Reports for HM2 Burns, Sarah
- (49) Logbooks for HM2 Burns, Sarah of Feb 21- Aug 21
- (50) Naval Air Training and Operation Procedures Standardization Reports for AWS3 (b) (6), (b) (3) (A), (b) (7)(C) (HSC-23)

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- (51) Logbooks for AWS3 (b) (6), (b) (3) (A), (b) (7)(C) of Jan 21- Aug 21
- (52) Naval Air Training and Operation Procedures Standardization Reports for HM3Tucker, Bailey (HSC-8)
- (53) Logbooks for HM3 Tucker, Bailey Mar 21 – Aug 21
- (54) LT 616 Operational Risk Management Form of 31 Aug 21
- (55) Aviation Discrepancy Book (BUNO 167899)
- (56) Qualification of Safe for Flight for ATC (b) (6), (b) (3) (A) (HSC-8)
- (57) HSC-8 Underway Naval Flight Records (NAVFLIRS) and associated emails for Aug 21
- (58) HSC-8 Underway Naval Flight Log LT 616 for 31 Aug 21
- (59) HSC-8 Qualifications Report for AWS3 (b) (6), (b) (3) (A), (b) (7)(C) (HSC-23)
- (60) HSC-8 SAR Syllabus Report for LT Foster, Bradley; and LT Fridley, Paul
- (61) Aviation Life Support Systems Logs for LT Foster, Bradley
- (62) Aviation Life Support Systems Logs for LT Fridley, Paul
- (63) Aviation Life Support Systems Logs for AWS2 Buriak, James
- (64) Aviation Life Support Systems Logs for HM2 Burns, Sarah
- (65) Aviation Life Support Systems Logs for AWS3 (b) (6), (b) (3) (A) (worn by AWS3 (b) (6), (b) (3) (A), (b) (7)(C) and related email of 05 Oct 21
- (66) Aviation Life Support Systems Logs for AWS3 (b) (6), (b) (3) (A) and AWS3 (b) (6), (b) (3) (A) (worn by HM3 Tucker, Bailey) and related email of 04 Oct 21
- (67) Photo Showing AWS3 (b) (6), (b) (3) (A), (b) (7)(C)'s TRI-SAR vest on 31 Aug 21
- (68) Designation Letter for AM1 (b) (6), (b) (3) (A) (HSC-8)
- (69) Advanced Skills Management System Qualifications for AN (b) (6), (b) (3) (A) (HSC-8)
- (70) Email of LCDR (b) (6), (b) (3) (A) (HSC-8) of 14 Sep 21
- (71) HSC-8 Carrier Qualifications Detachment Manning List
- (72) Emails of CDR (b) (6), (b) (3) (A) (ABE) of 22 Sep 21
- (73) ABE Tower Personnel Qualifications
- (74) Email of LT (b) (6), (b) (3) (A) (ABE) of 27 Sep 21
- (75) Email of LT (b) (6), (b) (3) (A) (ABE) of 24 Sep 21
- (76) Carrier Air Traffic Control Center (CATCC) Qualifications
- (77) USS ABRAHAM LINCOLN Meteorology & Oceanography Officer (METOC) Weather Summary and Observations of 31 Aug 21
- (78) Photo Showing Representative Gunner's Seat Configuration of LT 616 on 31 Aug 21
- (79) Photo Showing Representative Aft Crew Cabin Configuration of LT 616 on 31 Aug 21
- (80) Photo Depiction of Standard Gunner's Belt
- (81) USS ABRAHAM LINCOLN Flight Deck "Ouija Board" Snapshot from 31 Aug 21
- (82) USS ABRAHAM LINCOLN Tower Transcription of 31 Aug 21 Aircraft Mishap dtd 10 Sep 21
- (83) Summary of Naval Air Systems Command (NAVAIR) Fleet Support Team (FST) Interview
- (84) USS ABRAHAM LINCOLN Navigation Position Report of 31 Aug 21
- (85) Photo Showing Smoke Flare on 31 Aug 21
- (86) Photo of AWS3 (b) (6), (b) (3) (A), (b) (7)(C)'s SAR Radio on 31 Aug 21

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- (87) Voluntary Statement of LT (b) (6), (b) (3) (A) (HSC-8)
- (88) Email of Fleet Support Team Lead Mr. (b) (6), (b) (3) (A) (FST) of 17 Sep 21
- (89) FST Damper System Failure PowerPoint Presentation dated 07 Sep 21
- (90) HSC-8 Maintenance Action Form of 3 Aug 21 - 4 Aug 21
- (91) Integrated Mechanical Diagnostic System Report of 30-31 Aug 21
- (92) Voluntary Statement of LT (b) (6), (b) (3) (A), USN (HSC-8)
- (93) Voluntary Statement of LT (b) (6), (b) (3) (A) USN (HSC-8)
- (94) Summary of Interview of ATC (b) (6), (b) (3) (A) (HSC-8)
- (95) Summary of Interview of LTJG (b) (6), (b) (3) (A) (HSC-8)
- (96) Summary of Interview of AD1 (b) (6), (b) (3) (A) (HSC-8)
- (97) Summary of Interview of AD1 (b) (6), (b) (3) (A) (HSC-8)
- (98) Summary of Interview of AD1 (b) (6), (b) (3) (A) (HSC-8)
- (99) Summary of Interview of AD2 (b) (6), (b) (3) (A) (HSC-8)
- (100) Summary of Interview of AD2 (b) (6), (b) (3) (A) (HSC-8)
- (101) Summary of Interview of AD3 (b) (6), (b) (3) (A) (HSC-8)
- (102) HSC-8 Commanding Officer's Safety Policy
- (103) Email of CDR (b) (6), (b) (3) (A) (HSC-8) of 30 Sep 21
- (104) H-60 Fleet Support Team Immediate Rapid Action Change of 13 Sep 21
- (105) H-60 Fleet Support Team Engineering Advisory Report of 15 Sep 21
- (106) Photo Depicting Sheared Damper Hose on MH60 Aircraft
- (107) FST Main Rotor Damper Hose MAF data dated 10 Sep 21
- (108) H-60 Fleet Support Team Leader Ltr Ser H6010-MRB/002-22
- (109) Email of Fleet Support Team Lead Mr. (b) (6), (b) (3) (A) of 24 Jan 22
- (110) COMTHIRDFLT Ltr 5830 Ser N00/014 of 19 Jan 22
- (111) 30 hour MRH Damper Inspection
- (112) ISEC NR. 2 of 7 Dec 21
- (113) Email of LT (b) (6), (b) (3) (A) (HSCWINGPAC) of 1 Feb 22
- (114) Email of LCDR (b) (6), (b) (3) (A) (ABE) of 1 Feb 22
- (115) Email of CDR (b) (6), (b) (3) (A) (COMTHIRDFLT) of 24 Jan 22
- (116) Photo Depicting Damper Hose Kinking on MH60 Aircraft
- (117) Email of LT (b) (6), (b) (3) (A) (HSCWINGPAC) of 9 Feb 22

Preliminary Statement

1. Pursuant to enclosure (1) and in accordance with reference (a), this command investigation was conducted to inquire into the facts and circumstances surrounding a Class Alpha Mishap involving the loss of MH-60S aircraft Bureau Number (BUNO) 167899 in the Pacific Ocean on 31 August 2021. The Investigating Officer, CAPT (b) (6), (b) (3) (A) USN, U.S. THIRD Fleet, extends his deepest condolences to the families and loved ones of LT Bradley Foster, LT Paul Fridley, AWS2 James Buriak, HM2 Sarah Burns, and HM3 Bailey Tucker, who tragically perished in the mishap. Their service reflects the utmost in honor, courage, and dedication to duty.

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2. In accordance with Title 10 United States Code Section 2255 and reference (a), the Investigating Officer is a graduate of the Naval Aviation Safety Course and is qualified to conduct this investigation.
3. LCDR (b) (6), (b) (3) (A), USN, U.S. THIRD Fleet, and LT (b) (6), (b) (3) (A), USN, Helicopter Sea Combat Wing Pacific, assisted the Investigating Officer and provided technical advice during the course of this investigation.
4. LCDR (b) (6), (b) (3) (A), JAGC, USN, Region Legal Service Office Southwest assisted the Investigation Team with legal advice during the course of this investigation.
5. LNI (b) (6), (b) (3) (A), USN, U.S. THIRD Fleet, assisted the Investigation Team with administrative support during the course of the investigation.
6. All required Line of Duty investigations were separately completed in accordance with reference (a) by Commander, Carrier Strike Group NINE, and Commander, Carrier Strike Group THREE.
7. The Fleet Support Team (FST) completed the Engineering Investigation (EI) on 13 January 2022. Upon receipt of the EI, the Investigating Officer reopened this investigation to incorporate the results of the EI into this report.
8. All original evidence is currently maintained by Helicopter Sea Combat Squadron 8 (HSC-8) and the Aviation Mishap Board (AMB) which was formed to conduct a safety investigation for this mishap.

Executive Summary

1. According to Naval Aviation Logistics Command Management Information Systems (NALCOMIS) Organizational Maintenance Activity (OMA), the Aircraft Discrepancy Log book (ADB) summary report, and OPNAV 4790 Aircraft inspection and Acceptance Record, on 31 August 2021, BUNO 167899, also known as Loosefoot 616 (LT 616), was fully mission capable for the mission assigned.
2. Following a 2.5 hour plane guard/search and rescue (SAR) support event on 31 August 2021, a tragic mishap occurred when LT 616 experienced uncommanded lateral and vertical vibrations upon landing on the USS ABRAHAM LINCOLN (ABE) flight deck Spot 7. As the vibrations intensified, the aircraft began a left yaw (rotation of the helicopter along the vertical axis) for approximately 50 degrees followed by a right yaw for approximately 200 degrees on the flight deck. The aircraft's rotor blades impacted ABE's flight deck and LT 616 fell over the starboard side, tail first, into the ocean.
3. Based on interviews with multiple HSC-8 personnel and corroborated by the results of the EI, there is no evidence that weather conditions or pilot error were causal or contributing factors to the mishap. LT 616 flight crew clearances, qualifications, and designations were current for the assigned mission, including compliance with all Naval Air Training and Operating Procedures Standardization

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(NATOPS), Instrument Training, Egress Training, Naval Aviation Survival Training, and Aircrew Coordination Training requirements, as well as a current DD Form 2992, also known as a Medical Up-Chit. All crewmembers' Aviation Life Support Systems (ALSS) were in compliance with periodic maintenance inspections.

4. The mishap was caused by the failure of the yellow damper hose on LT 616 in-flight, resulting in total loss of main rotor system damping and the immediate onset of severe vibrations upon touchdown. The damper hose failed in-flight due to mechanical damage (flattening) of steel braid strands. Kinking (bending) the hose crushed wire braids into each other causing flattening and nicking that resulted in fatigue failure of the steel braid strands. The engineering investigation, conducted by the FST, opined that the most likely cause of the damage was bending or kinking of the hose instead of disconnecting prior to using a spindle pry bar during rotor head maintenance. Failure of the steel braids is progressive, meaning additional damage continues to ensue with more flight time. It is not possible to conclusively determine the timing or event that caused the damage due to many variables, one of which is that spindle pry bar use is not required to be documented. Additionally, records dating back to 2011 do not document a yellow damper hose replacement and the flattening likely happened due to a one-time event at some point.

5. The Navy has taken steps to prevent hose damage due to kinking from occurring in the future. Specifically, on 14 September 2021 the FST released an Engineering Advisory Report (EAR) reiterating the importance of disconnecting the damper hose prior to spindle pry bar use. Then, on 7 December 2021 COMNAVAIRSYSCOM released an Interim Support Equipment Change (ISEC) directing modification of all spindle pry bar assemblies to prevent the ability to bend the hose to accommodate the spindle pry bar. Additionally, the FST recommended a one time replacement of all damper hoses in order to mitigate risk due to potential pre-existing damage to damper hoses.

6. Based on review of LT 616 maintenance records and interviews with multiple HSC-8 maintenance and supervisory personnel there is no evidence of any inadequate management or leadership practices at HSC-8. All inspection and maintenance procedures for LT 616 were completed and documented in accordance with requirements. Prior to the mishap, there were likely no indications of an impending damper system failure as visual inspection of the damper hose would not uncover flattening of steel braid strands.

Findings of Fact

1. MH-60S Aircraft assigned to Helicopter Sea Combat Squadron Eight (HSC-8), BUNO 167899, also known as Loosefoot 616 (LT 616), and USS ABRAHAM LINCOLN (CVN 72) (ABE) were involved in a Class A Flight Mishap on 31 August 2021. [Enclosures (2) - (17)]

2. Onboard LT 616 at the time of the mishap were:

- a. LT Bradley Foster, USN;
- b. LT Paul Fridley, USN;

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- c. AWS2 James Buriak, USN;
- d. HM2 Sarah Burns, USN;
- e. AWS3 (b) (6), (b) (3) (A), (b) (7)(C), USN; and
- f. HM3 Bailey Tucker, USN [Enclosure (2)]

3. All crewmembers were active duty United States Navy personnel. [Enclosures (2), (18)]

4. LT Foster, LT Fridley, AWS2 Buriak, HM2 Burns, and HM3 Tucker were assigned to the HSC-8 detachment embarked on ABE for Commander, Naval Air Training Command (CNATRA) Carrier Qualifications (CQ) between 25 August 2021 and 4 September 2021. [Enclosures (2), (9), (18), (19), (71)]

5. AWS3 (b) (6), (b) (3) (A), (b) (7)(C), who is assigned to HSC-23, embarked on ABE for CNATRA CQ, was augmenting the HSC-8 CQ detachment on 31 Aug 21. [Enclosures (2), (4), (18), (20), (71)]

6. Following a 2.5 hour plane guard/search and rescue (SAR) support event on 31 August 2021, the mishap occurred when LT 616 experienced uncommanded lateral and vertical vibrations upon landing on the ABE flight deck Spot 7. As the vibrations intensified, the aircraft began a left yaw (rotation of the helicopter along the vertical axis) for approximately 50 degrees followed by a right yaw for approximately 200 degrees on the flight deck. The aircraft's rotor blades impacted ABE's flight deck, and LT 616 fell over the starboard side, tail first, into the ocean. [Enclosures (2), (7) - (16), (21), (22)]

7. The mishap resulted in complete loss of LT 616, extensive damage to CNATRA aircraft (see paragraphs 15 and 16 for details), and minor damage to the ABE flight deck and main superstructure. The cost of the loss of LT 616 was estimated at \$28,900,000.00. [Enclosures (7), (8), (23) - (31)]

8. LT Foster, LT Fridley, AWS2 Buriak, HM2 Burns, and HM3 Tucker perished in the mishap. Line of Duty Determinations for LT Foster, LT Fridley, AWS2 Buriak, HM2 Burns, and HM3 Tucker were completed on 17 September 2021. All five crew members were determined to have died in the line of duty and not due to their own misconduct. [Enclosures (3), (32), (33)]

9. AWS3 (b) (6), (b) (3) (A), (b) (7)(C) successfully egressed the aircraft after water impact. He incurred a (b) (6) (b) (6) and was medically evacuated to Scripps Mercy Hospital from Naval Station North Island on 31 Aug 21 at 1845. A Line of Duty Determination for AWS3 (b) (6), (b) (3) (A), (b) (7)(C) was completed on 17 September 2021, with AWS3 (b) (6), (b) (3) (A), (b) (7)(C)'s injuries determined to be incurred in the line of duty and not due to his own misconduct. [Enclosures (4), (8), (20), (28), (34) - (38)]

10. ABE's oncoming Arresting Gear Officer, who was on the flight deck at the time of the mishap, incurred a (b) (6) as a result of flying debris from LT 616. He was medically evacuated to Naval Air Station North Island and taken to the University of California San Diego Hillcrest Medical Campus. A Line of Duty Determination

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was completed on 1 October 2021, with injuries determined to be incurred in the line of duty and not due to his own misconduct. [Enclosures (6), (8), (28)]

11. ABE's Arresting Gear Officer, who was on deck at the time of the mishap, incurred injuries which were treated onboard ABE. A Line of Duty Determination was not required under reference (a). [Enclosures (6), (8), (28)]

12. ABE's Arresting Gear Deck Edge Operator, who was on the flight deck at the time of the mishap, incurred a (b) (6) and was medically evacuated to Naval Air Station North Island, and taken to Scripps Mercy Hospital. A Line of Duty Determination was completed on 1 October 2021 and the Arresting Gear Deck Edge Operator's injuries were determined to be incurred in the line of duty and not due to his own misconduct. [Enclosures (5), (8), (28)]

13. Two additional flight deck personnel experienced superficial scrapes and returned to work. [Enclosure (8)]

14. ABE suffered minor damage to equipment. Two flight deck safety nets located on the perimeter of aircraft elevator number three were damaged as LT 616 fell over the edge. The O10 level signal locker on the aft portion of the main superstructure also incurred damage. The majority of repairs were completed by the ship's force and were estimated at less than \$10,000 in material cost. [Enclosures (7), (15), (26) - (28), (39), (114)]

15. Two VT-7 T-45 aircraft from Training Wing One, side numbers (b) (3) (A) and (b) (3) (A) incurred damage as a result of the mishap. Aircraft (b) (3) (A) incurred a hole in the canopy transparency (glass). The current estimated costs for repairs is \$186,733. The current estimated cost does not include additional required repair parts required for Aircraft 161. [Enclosures (23), (24), (31)]

16. Training Wing Two, VT-22 T-45 aircraft, side number (b) (3) (A) incurred extensive damage estimated at \$1,485,393. [Enclosures (25), (31)]

Crew Background

17. LT Bradley A. Foster, age 29, was the Helicopter Aircraft Commander (HAC) for the mishap event and was the NATOPS instructor for HSC-8. He had approximately 900 total flight hours, with approximately 702 flight hours in H-60 model aircraft. LT Foster had 6.3 years of service in the Navy. [Enclosures (2), (3), (18), (40), (41)]

18. LT Paul R. Fridley, age 28, was the co-pilot for the mishap event. He was a qualified HAC and was the Quality Assurance Officer (QAO) for HSC-8. He had approximately 958 total flight hours with approximately 761 flight hours in H-60 model aircraft. LT Fridley had 6 years of service in the Navy. [Enclosures (2), (3), (18), (42) - (44)]

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19. AWS2 James P. Buriak, age 31, was the Utility Crewman for the mishap event. He had approximately 743 total flight hours all in H-60 model aircraft. AWS2 Buriak had 4.6 years of service in the Navy. [Enclosures (2), (3), (18), (45) - (47)]

20. HM2 Sarah F. Burns, age 31, was a Hospital Corpsman and qualified aircrewman onboard LT 616 to conduct medical training. She had approximately 146 total flight hours, all in an H-60 model aircraft. HM2 Burns had 9.4 years of service in the Navy. [Enclosures (2), (3), (18), (47) - (49)]

21. AWS3 (b) (6), (b) (3) (A), (b) (7)(C), age (b) (6), was assigned as the rescue swimmer on the mishap event. He had approximately 148 total flight hours at the time on the mishap, all in H-60 model aircraft. AWS3 (b) (6), (b) (7)(C) has 2.2 years of service in the Navy. [Enclosures (2), (3), (18), (50), (51), (59)]

22. HM3 Bailey J. Tucker, age 21, was a Hospital Corpsman and qualified aircrewman onboard LT 616 to conduct medical training. He had approximately 39 total flight hours, all in H-60 model aircraft. HM3 Tucker had 1.7 years of service in the Navy. [Enclosures (2), (3), (18), (47), (52), (53)]

23. LT 616 was within weight and balance limitations as required by reference (c) on 31 August 2021. [Enclosures (2), (54), (55)]

24. As documented on the 31 August 2021 Pre-flight Operational Risk Management form, all performance calculations on LT 616 were completed by the aircrew and were in compliance with all aircraft limitations and restrictions. [Enclosures (2), (54), (55)]

25. ATC (b) (6), (b) (3) (A) HSC-8 Detachment Aviation Electronics Technician Chief, released LT 616 Safe for Flight. He was qualified to sign Safe for Flight. [Enclosures (55), (56)]

26. According to NALCOMIS OMA and the ADB summary report, LT 616 was in compliance with all the periodic maintenance inspections and applicable technical directives. The aircraft had 4170.3 total flight hours. [Enclosures (55), (57), (58)]

Conditions Surrounding Flight

27. The LT 616 31 August 2021 flight was properly scheduled per references (b) through (e). The flight was authorized by the HSC-8 detachment Officer-In-Charge (DET OIC), LCDR (b) (6), (b) (3) (A) [Enclosures (2), (7), (9), (17)]

28. LT 616 was scheduled for four events. The mishap occurred during the third event. The aircraft had flown approximately 6.8 hours and successfully "hot seated" (the aircraft had refueled and passed from one crew to the next without shutting down the engines) twice before the mishap occurred. [Enclosures (2), (9), (17), (58)]

29. The crew of LT 616 completed a pre-mission Crew Risk Assessment form in accordance with references (d) and (e) and discussed operational risk management (ORM) issues and mitigation

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techniques during the pre-mission brief prior to the flight. The ORM sheet did not note any stress or human factors for any of the crew members. [Enclosures (20), (54)]

30. Multiple witnesses stated that none of the LT 616 crew members expressed nor exhibited any signs of human factors or stress during the witnesses' interactions with the crew members prior to the mishap flight. [Enclosures (9) – (12), (14), (16), (20)]

31. LT 616 flight crew clearances, qualifications, and designations were current for the assigned mission, including compliance with all Naval Air Training and Operating Procedures Standardization (NATOPS), Instrument Training, Egress Training, Naval Aviation Survival Training, and Aircrew Coordination Training requirements, as well as a current DD Form 2992. [Enclosures (2), (40) – (54), (59) - (60)]

32. All crewmembers' Aviation Life Support Systems (ALSS) were in compliance with periodic maintenance inspections. LT Fridley, LT Foster, AWS2 Buriak, and HM3 Tucker were outfitted in CMU-37s; HM2 Burns was outfitted in a CMU-33; and AWS3 [REDACTED] was outfitted in his TRISAR Harness. [Enclosures (20), (61) - (67)]

33. The third event was scheduled as a 2.5 hour plane guard/SAR training event. The scheduled takeoff time on 31 August 2021 was 1400. The scheduled landing time was 1630. [Enclosures (2), (17)]

34. The mishap occurred upon LT 616 landing on helicopter precision landing spot 7. Per reference (f), page 8-13, paragraph 8.6, spot 7 can be used for concurrent fixed wing/helicopter operations (Carrier Qualifications (CQ)). The DET OIC stated that it was common for the HSC-8 CQ detachment to use spot 7 during CQ evolutions and spots 3 - 6 during shutdown. [Enclosures (7), (9) – (12), (14) – (16), (20), (34)]

35. Helicopter landing precision spot 7 is one of two helicopter precision landing spots in which a helicopter will slide left for recovery. All other helicopter landing spots require a right slide in approach. [Reference (f), page 8-13, paragraph 8-6]

36. Several HSC-8 personnel were on the flight deck for recovery of LT 616 at the time of the mishap, including the qualified Quality Assurance Safety Representative; Flight Deck Coordinator; qualified Plane Captain and Lineman; Chocks and Chain runners; and Troubleshooting Team members. [Enclosures (68) - (71)]

37. Other HSC-8 personnel on the flight deck at the time of the mishap were the two pilots and two aircrewman assigned to event four in LT 616. [Enclosures (2), (10) – (12), (16) (71)]

38. ABE flight deck personnel in the vicinity of spot 7 during the mishap included the off-going Arresting Gear Officer; oncoming Arresting Gear Officer; Arresting Gear Deck Edge Operator; "Air

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Bos'n,"; "Fuels Bos'n."; and other flight deck Sailors. These personnel were assisting with concurrent CNATRA CQ flight operations. [Enclosures (15), (17), (28)]

39. ABE Tower personnel at the time of the mishap included the Air Boss; Mini Boss; Tower Supervisor; Tower Operator; Forward Spotter; Aft Spotter; and Arresting Gear personnel. All ABE Tower personnel, as well as all helicopter control personnel in the Carrier Air Traffic Control Center at the time of the mishap, were current in qualifications. [Enclosures (28), (72) - (76)]

40. ABE Strike Group Oceanography Team (SGOT) observed the weather around the time of the mishap (1635L) as 20.5° celsius; sea surface temperature 20° celsius, combined sea height 2 feet, swell of 2 feet with a period of 9 seconds from 310° True; altimeter setting 29.75; surface winds 290° true at 10 knots; ceiling overcast at 1200 feet; visibility 10 nautical miles; no thunderstorms; light turbulence starting at 5000 feet above ground level; no icing or precipitation. [Enclosure (77)]

41. Weather forecast by ABE SGOT called for surface winds 270° true at 10 knots, ceilings broken at 1500 feet, with unrestricted visibility. No sea state was reported. [Enclosure (77)]

42. Weather was in accordance with weather requirements defined by reference (c) through (f). Weather was reported as Visual Meteorological Conditions (VMC) (ceilings greater than 1000 feet, visibility greater than 3 nautical miles). [Enclosure (77)]

43. At the time of LT 616 recovery, ABE was heading 301° true at 18 knots. [Enclosures (34), (77)]

44. Witnesses present at the time of the mishap reported ceilings were about 1100 feet above ground level, visibility was 10 nautical miles, and the wind was light over the flight deck. They also stated the flight deck was stable and nothing regarding the weather or the sea state was out of the ordinary. [Enclosures (10) - (12), (16), (20)]

45. Based on witness accounts, at the time of the mishap, LT Foster was seated in the right pilot seat. LT Fridley was seated in the left pilot seat. [Enclosures (10), (20)]

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51. The flight deck was laid out as shown in Enclosure (81).

Chronological Summary of Mishap Events (all times are in T (PDT)):

52. The flight was routine prior to the mishap. Upon takeoff at approximately 1400, the aircrewman and hospital corpsman completed 2 - 3 medical training scenarios in the cabin, followed by one Search and Rescue (SAR) training scenario with the entire crew. Communication was good throughout the flight and there were no noted Crew Resource Management (CRM) issues. [Enclosure (20)]

53. 1626: Tower confirmed LT 616 is “snuggled up” (operating within 1 nm of ABE) on the starboard side ABE. Once confirmed, tower passed flight deck winds “down the angle” at 25 knots, and gave clearance to land on LSE’s (landing signalman enlisted) signal at spot 7. [Enclosures (15), (82)]

54. 1629: LT 616 conducted a normal slide in approach to spot seven. The aircraft established an approximate 10-foot hover and then commenced landing. [Enclosures (7), (10), (11), (16), (20)].

55. According to witnesses, LT 616’s slide appeared controlled and there were no observed unusual movements or vibrations. [Enclosures (7), (9) – (12), (14), (16), (20), (83)]

56. LT 616 began a controlled descent to touchdown. [Enclosures (7), (9) – (12), (16), (20), (83)]

57. Touchdown felt light and controlled in the aircraft. AWS3 [REDACTED] felt no lateral movements, hard landing, or rapid descent rates upon touchdown. AWS3 [REDACTED] believed the landing was well cushioned. [Enclosure (20)]

58. Immediately upon touchdown, LT 616 began experiencing divergent and uncommanded lateral and vertical vibrations. A vertical vibration, visible especially in the tail wheel, was the first indication that something was wrong. [Enclosures (7), (9) – (12), (14), (16), (20), (83)]

59. Inside the aircraft, the vibrations became violent and the noise level increased significantly upon touchdown. AWS3 [REDACTED] stated he heard loud knocking sounds and could not hear any Internal Communication System (ICS) or external radio calls being made throughout the mishap event. [Enclosure (20)]

60. As the aircraft began to shake, flight deck personnel started moving backwards and sheltering behind crates, boxes, and the tower. Additionally, multiple people shouted to “get down” and “get back”. [Enclosures (7), (10) – (12), (16), (83)]

61. Vibrations amplified and the aircraft began to yaw left. [Enclosures (7), (20), (83)]

62. The aircraft’s tail wheel impacted ABE’s starboard side gutter and the aircraft’s nose started a right yaw. Vibrations continued to amplify. [Enclosures (7), (11), (16), (83)]

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63. AWS3 [REDACTED] saw both pilots reaching up to the Power Control Levers (PCLs) in an attempt to secure them. Both the NAVAIR Fleet Support Team (FST) and AWS3 [REDACTED] stated they did not think the pilots were successful in pulling the PCLs off. [Enclosures (20), (83)]

64. 1630: LT 616 rotor blades impacted the flight deck after it completed approximately 50 degrees of left rotation followed by 200 degrees of right rotation. ABE Air Boss reported that he saw one blade fly toward three T-45s parked aft of Aircraft Elevator 3 and two blades detach and travel across the Landing Area (LA) and over T-45s parked on Aircraft Elevator 4. He did not see where the fourth blade went. [Enclosures (5) - (7), (10), (15), (20), (81)]

65. 1630: LT 616 rolled to the left and fell off the starboard side of ABE's flight deck, tail first. Location of water impact was 31°35.7'N, 118°04.3'W. [Enclosures (3), (4), (7), (10) – (12), (84)].

66. One witness who was on the flight deck at the time of the mishap stated that he ran to the deck edge after LT 616 went overboard, but was unable to see anything on the surface. [Enclosure (11)]

67. AWS3 [REDACTED] reported that both pilots were still restrained in 5-point harnesses prior to the aircraft falling over the flight deck. He remembered that HM2 Burns was still in a gunner's belt located by the left cabin door, while HM3 Tucker and AWS2 Buriak were also still restrained in gunner's belts by the right gunner's window and right cabin door respectively. [Enclosure (20)]

68. 1630: ABE Mini Boss triggered the Crash/Warning alarms, and the Tower called away a crash on flight deck spot 7. Air Boss and Mini Boss both called away Mass Casualty based on observations of the flying rotor blades. All T-45s in the landing pattern were directed to divert to Naval Air Station North Island. The Officer of the Deck began the "Aircraft Crash on Flight Deck Emergency" checklist. [Enclosures (10), (15), (34), (35), (82)]

69. Shrapnel from the detached rotor blades impacted personnel located in the Arresting Gear Officer pit located approximately 200 feet aft of the island at the aft end of the shelf and the area behind a T-45 parked aft of Spot 7. Two other sailors, location at the time of the mishap unknown, received superficial scrapes from the debris. [Enclosures (5), (6), (15)]

70. 1630: ABE declared man overboard, maneuvered for rescue, and commenced the man overboard checklist. [Enclosures (15), (34), (35), (37)]

71. AWS3 [REDACTED] does not believe he lost consciousness at any time during the mishap. Following water impact, he escaped from the left gunner's window and swam to the surface as soon as he was able to get free from the helicopter. He estimates that he had to swim approximately 25 feet to reach the surface and recalled that the helicopter was oriented so that he was facing the surface as he egressed via the window. [Enclosure (20)]

72. 1630: ABE reported sight of AWS3 [REDACTED]. The ship dropped a flare IVO 31°35.7N, 118°04.3'W. [Enclosures (15), (34), (35), (85)]

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73. AWS3 [REDACTED] inflated his Life Preserver Unit (LPU) and expended two MK-124 flares to alert ABE of his position. He attempted to use his radio but was unsuccessful in establishing communications with ABE. [Enclosures (20), (36), (85), (86)]

74. 1645: ABE lowered its starboard Rigid Hull Inflatable Boat (RHIB) in the water to commence rescue of AWS3 [REDACTED] [Enclosures (34) – (36)]

75. 1653: AWS3 [REDACTED] was recovered from the water via RHIB. [Enclosures (20), (34) - (36)]

76. 1710: AWS3 [REDACTED] was brought onboard and taken to ABE's Medical Department to assess his injuries. [Enclosures (20), (34) – (36)]

77. Other search and rescue efforts began immediately with the launch of ABE's alert SAR helicopter Loosefoot [REDACTED] (MH-60S), and assistance from local units; Landslide [REDACTED] (MH-60S), Landslide [REDACTED] (MH-60S), and USS CINCINNATI (LCS 20). [Enclosures (3), (4), (8), (34) - (37)]

78. A prolonged search and rescue effort took place over three days, including 34 search and rescue flights, over 170 hours of flight time, five search helicopters, and constant surface vessel search coverage. [Enclosures (3), (4), (36), (37)]

79. Based on the USCG SAROPS report, the probability of success, meaning the cumulative probability to date of the aircrew being located, was 99% and the survival time for the crew in the water was estimated at 47 hours. This led Commander, U.S. THIRD fleet (COMTHIRDFLT) to suspend search and rescue operations after three days of continuous searching and declare the missing crew members deceased at 2100T on 03 September 2021. [Enclosures (3), (4), (32), (33)]

80. On 03 September 2021, COMTHIRDFLT ordered the commencement of salvage and recovery operations. On 17 September 2021 LT 616 was located using a towed sonar system on the HOS Dominator. On 8 October 2021 HOS Bayou recovered LT 616 and the missing crew. [Enclosures (3), (4), (32) – (34), (37), (115)]

NAVAIR Fleet Support Team (FST) Analysis and Engineering Investigation (EI) Conclusions

81. The FST subject matter experts identified unconstrained lead/lag movement of the rotor blades as shown in the flight deck video as a likely cause of the ground resonance event. Their conclusion is consistent with multiple eyewitness accounts by those on the ABE flight deck who described the vibrations as appearing similar to an out of balance washing machine. [Enclosures (7), (10), (11), (20), (83), (87), (88)]

82. Based on evidence from the video footage showing the mishap from multiple angles, the FST concluded that LT 616 experienced a ground resonance event upon landing. The FST stated that they had seen left yaw accompany vibrations resulting from other ground resonance events. [Enclosures (7), (83), (108)]

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83. Ground resonance is a phenomenon of multi-bladed helicopters and is due to the center of gravity of the rotating blades traversing off center. For the condition to occur, there must be some abnormal lead/lag blade condition that would dynamically unbalance the rotor and a reaction between the helicopter and the ground that could aggravate and further unbalance the system. [Reference (b), paragraph 11.1.3]

84. Ground resonance amplifies over time with power continuously applied to the rotor system, leading to increased vibrations, both in frequency and magnitude. [Enclosure (83); Reference (b) paragraph 11.1.3]

85. Ground resonance can be caused by a blade being badly out of track, a peculiar set of landing conditions, a malfunctioning damper, or hard landing coupled with lateral drift. [Reference (b), paragraph 11.1.3.]

86. In this case, the FST determined the yellow damper hose failed in-flight, resulting in total loss of main rotor system damping and immediate onset of severe vibrations upon touch down. [Enclosures (7), (83), (88), (108)]

87. The FST concluded that all other damage observed to the rotor head, to include departure of main rotor blades, spindles, and dampers is considered secondary, resulting from excessive lead-lag motion of main rotor blades upon touch down with main rotor damper system no longer functioning as designed. [Enclosure (108)]

88. Mechanical damage (flattening) of steel braid strands was observed in the yellow damper hose consistent with bending or kinking the hose. A spindle pry bar is used to manipulate the main rotor spindle and/or swashplate during rotor head maintenance and requires moving or removing the hose to use the tool. [Enclosure (108)-(109)]

89. Damage from bending or kinking the hose crushes wire braids into each other causing wire nicking, which creates stress concentrations in the wire braids that will eventually result in fatigue failure of the steel braid strands with normal flight operations. Fatigue failure of the steel braid strands is progressive. In other words, it takes flight time for the failure to occur. The FST determined that the flattened regions of the wires did not appear to be "heavily worked/worn and likely occurred from a singular crushing event." [Enclosures (108)-(109)]

90. According to the FST, a single kinking can damage the wire braids such that they will fail in fatigue over time, leading to failure of the damper hose. The time lapse between kinking and damper hose failure is highly dependent on numerous factors and is very difficult to determine. Some factors include spindle pry bar use is not required to be documented, records dating back to 2011 do not document a yellow damper hose replacement, and the flattening likely happened due to a one-time event. [Enclosures (108)-(109)]

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91. The inspection criteria for a 30 hour inspection does not include an inspection of damper hose braiding as the braiding is located under a chafing guard. The FST has explored multiple inspection methods to detect mechanical damage to damper hoses, including visual, borescope, pressure testing, and x-ray. Ultimately, after exploring these options, the FST determined there is no adequate inspection criteria available. [Enclosure (108), (111)]

92. Failure of a damper will cause a dynamically unbalanced rotor system often felt as low frequency lateral and vertical vibration. Failure can occur gradually or suddenly. [Reference (b) paragraph 12.4.1.2.]

93. The emergency procedure for any unusual vibrations on deck is to remove power from the rotor system (Collective-Lower, PCL-OFF, Rotor brake – apply as required.). [Reference (b), paragraph 12.4.1.5]

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94. LT 616 was delivered to the Navy in December 2011. Based on a search of all maintenance records dating back to December 2011, there is no record of a yellow damper hose replacement, though records exist for other damper hose replacements. Damper hoses are not replaced based on flight time. Instead, damper hoses are only replaced upon failure or the discovery of a discrepancy. [Enclosure (117)]

95. The last Intermediate Phase Inspection, Phase C, occurred on 28 June 2021 in accordance with reference (g). Phase C inspections primarily inspect the Tail Rotor and Landing Struts. During the inspection there was no maintenance required or performed on the damper system. [Enclosure (55)]

96. The last 30 Hour special inspection required by reference (g) was completed 30 August 2021. Reference (h) states that the 30 Hour special inspection requires a damper inspection to check for damage or degradation to the spherical bearings, proper alignment, and integrity of inboard and outboard damper bolts. The inspection does not look for flattening of braids as flattening is not identifiable upon visual inspection. No discrepancies were noted in either the ADB or during interviews with those personnel that completed the inspection. The inspection was completed in accordance with references (g) and (h). [Enclosures (14), (21), (22), (55), (111), (113)]

97. Daily and turnaround inspections were conducted on 30 August 2021 at 2202T in accordance with reference (g). The only discrepancies noted were a broken bonding jumper and the Number 1 Engine oil level low, neither of which are associated components of the damper system per reference (b). Both the broken bonding jumper and Number 1 Engine oil level low were documented in accordance with reference (f) and corrected in accordance with reference (i). [Enclosure (55)]

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98. According to NALCOMIS, OMA, the ADB summary report, and OPNAV 4790 Aircraft inspection and Acceptance Record, on 31 August 2021 LT 616 was fully mission capable for mission assigned. [Enclosure (55)]

99. On 03 August 2021, LT 616 had a damaged red damper hose. As a result of the damage, the red damper hose (one of 4 damper hoses in the rotor head system, which are labeled red, black, blue, and yellow per reference (b)) was replaced and properly documented. Maintenance was performed and the aircraft was signed off safe for flight on 04 August 2021 in accordance with references (g) and (i). The IMDS data from the event showed no vibration exceedences in flight. [Enclosures (55), (87), (90)]

100. On 04 August 2021, LT 616 had a damaged blue blade damper hose. As a result, the blue damper hose was replaced. Maintenance was performed and the aircraft was signed off safe for flight in accordance with references (g) and (i). The IMDS data from the event showed no vibration exceedences in flight. [Enclosures (55), (87), (90)]

101. IMDS data showed no indications of unusual vibrations on 31 August 2021 in the two events prior to the mishap flight. [Enclosure (2), (91)]

102. LT (b) (6), (b) (3) (A) and LT (b) (6), (b) (3) (A), the Aircraft Commanders for the two scheduled flight events conducted prior to the mishap, stated they experienced no unusual vibrations during their flights in LT 616 on 31 August 2021. [Enclosures (92), (93)]

103. During preflight on 31 August 2021, the pitch lock pin on the blue blade was slightly extended. According to reference (b), pitch locks on all blades should be retracted prior to flight. Pitch locks are used to fix the pitch of the rotor blades during the blade fold sequence. LT (b) (6), (b) (3) (A) stated maintainers were able to retract the test set blade fold system box in accordance with maintenance procedures and the issue was resolved. [Enclosure (92)]

104. The only discrepancy LT (b) (6), (b) (3) (A) noted on 31 August 2021 was an Embedded GPS/INS system fail advisory, which was previously documented, and an Active Vibration Control System (AVCS) degraded advisory. The AVCS advisory disappeared after the system was reset as required for landing checks. [Enclosure (93)]

105. There were no unusual vibrations during the course of the 31 August flight until the ground resonance event on landing. [Enclosure (20)]

106. LT (b) (6), (b) (3) (A), LT (b) (6), (b) (3) (A), AWS1 (b) (6), (b) (3) (A), and AWS3 (b) (6), (b) (3) (A) flew LT 616 multiple times during the CQ detachment and did not experience any unusual vibrations on deck or in flight. [Enclosures (10) – (12), (16)]

107. HSC-8 detachment Maintenance personnel interviewed, to include the Detachment Aviation Electronics Technician Chief; the Detachment Lead Chief Petty Officer; Detachment Quality

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Assurance Representatives; and Detachment structural mechanic, were not aware of any unusual vibrations during the detachment either documented or mentioned by any aircrew. [Enclosures (13), (14), (21), (22), (94), (95)]

HSC-8 Maintenance Practices

108. The HSC-8 Commanding Officer's Safety Policy states, "[a] safety mindset should be incorporated in everything we do." Multiple maintainers, as well as the Maintenance Material Control Officer (MMCO), reported that HSC-8 has a good maintenance safety culture. HSC-8 Commanding Officer (CO), emphasizes safety during Helicopter Aircraft Commander boards, Plane Captain boards, and during group discussions. Since HSC-8 returned from deployment in May 2021, the HSC-8 CO's risk tolerance has been "Low," and this has been communicated to the command on a number of occasions, including prior to the CQ detachment. HSC-8 CO noted that prior to the mishap, he even cancelled an El Centro Detachment to increase available time for maintenance training in preparation for Maintenance Program Assist. [Enclosures (14), (19), (21) - (22), (94) - (103)]

109. The culture between HSC-8 aircrew (to include aircrewman and pilots) and maintainers was described as cooperative. HSC-8 Maintenance personnel stated that if an aircrew brought up a problem with the aircraft, the Maintenance department was ready and willing to perform the appropriate troubleshooting procedures. According to the HSC-8 CO, pilots and aircrewmen regularly screen ADBs in maintenance control to facilitate relationships and immediately receive answers to questions regarding the aircraft. [Enclosures (14), (20) - (22), (94) - (101), (103)]

110. The HSC-8 Quality Assurance process was described as effective, and there was no perception of sacrificing safety for speed in maintenance practices. The Quality Assurance Team stated that they have an open door policy to allow any member of HSC-8 to report unsafe practices. When maintenance is conducted, the Quality Assurance team stated they watch and observe and report any discrepancies. [Enclosures (21), (95)]

111. HSC-8 CO stated that supervision and oversight of the HSC-8 Maintenance department begins with strict adherence to the CNAF 4790.2 series of publications, and the squadron relies on Enlisted Maintenance Personnel Qualification Standard 4790.4A, which defines training timelines and additional responsibilities for those in the Maintenance department. HSC-8 CO stated that officer and chief oversight exists both in the hangar bay and on the flight line (supervision at the point of friction) and HSC-8 also conducts weekly maintenance training (Eightball University) as part of the squadron's ashore battle rhythm. [Enclosure (103)]

MH60S Damper System Failures

112. While compiling damper system failure history, the FST identified damper hoses and joint bearing/bolts as the leading failure items in the damper system associated with ground resonance, followed by internal failure, accumulator failures and failures of unknown causes. These findings

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prompted the H-60 Helicopter Program Office (PMA 299), a division of NAVAIR, to release an IRAC as well as an EAR on 14 September 2021. [Enclosures (83), (88) – (89)]

113. THE IRAC and EAR released on 14 September 2021 highlighted the proper use of the spindle pry bar and reemphasized possible damage when improperly used. These changes apply to MH-60S and MH-60R variant. [Enclosures (88), (104), (105)]

114. The 14 September 21 EAR states that if the damper hose is not disconnected prior to spindle pry bar use the hose must be kinked in order to use the tool. Damage resulting from the kink may not be evident from visual inspection. The EAR further states that kinking of the damper may lead to damper hose failures. [Enclosures (104) - (106), (116)]

115. The requirement to remove the damper hose prior to the use of the spindle pry bar existed prior to the EAR per reference (i). However, the IRAC and EAR added quality assurance verification that the damper hose is removed and tied down prior to pry bar use. Additionally, the EAR added a warning stating that if the damper hose is not disconnected, the hose may be damaged and can cause catastrophic damper system failure. [Enclosures (104) - (105)]

116. Following further investigation and findings by the FST, COMNAVAIRSYSCOM released ISEC NR. 6302 on 7 December 2021. The ISEC directed modification of all spindle pry bar assemblies to prevent misuse by kinking damper hoses. Additionally, the FST found that a one time replacement of all damper hoses is warranted in order to mitigate risk due to potential pre-existing damage to damper hoses. [Enclosures (108), (112)]

117. When interviewed, multiple HSC-8 Aviation Machinist's mates (ADs) stated they have never seen the improper use of the spindle pry bar at HSC-8. [Enclosures (96) - (101)]

Opinions

1. LT 616's flight crew was fully qualified, in accordance with current instructions to perform the duties they were assigned on the HSC-8 flight schedule on 31 August 2021. [Findings of Fact 2-5, 17-22, 30-34]
2. HSC-8 flight deck and maintenance crew were fully qualified in accordance with current instructions to perform the duties they were assigned on 31 August 2021. [Findings of Fact 25, 36, 37]
3. ABE Tower and Carrier Air Traffic Control Center personnel were fully qualified in accordance with current instructions to perform the duties they were assigned on 31 August 2021. ABE Tower personnel responded appropriately to LT 616 mishap. [Findings of Fact 39, 53, 68, 70, 74]
4. LT 616 aircrew was in compliance with all crew rest and currency requirements. No stress factors were identified, and human error is not suspected as a casual factor for this mishap. [Findings of Fact 27, 32, 33, 34]

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5. There is no evidence that fatigue, use of medication, or alcohol use were involved in the mishap. [Findings of Fact 27, 30, 31]

6. The utilization of helicopter landing precision spot 7 was a routine operation for the HSC-8 detachment and the unique slide in approach, characteristic of the spot, did not contribute to the mishap. [Findings of Fact 6, 34-35, 51]

7. The weather during the mishap flight was within weather tolerances and did not contribute to the cause of the mishap. It is unlikely that winds over the deck or shipboard movement influenced the ground resonance event. [Findings of Fact 40-44, 52-65]

8. Based on eyewitness accounts and IMDS data, no unusual vibrations occurred in flight on 31 August 2021 prior to the mishap. [Findings of Fact 28, 101-102, 105-106]

9. The unconstrained lead/lag shown in the video is characteristic of a damper failure, and would not be seen in a ground resonance event caused by an out of track blade, peculiar landing conditions, or a hard landing coupled with lateral drift. [Findings of Fact 81-85]

10. The yellow damper hose failure on 31 August 2021 most likely resulted from kinking the hose. However, numerous factors make it difficult to confirm the cause or when it would have occurred, including that spindle pry bar use is not explicitly documented, records dating back to 2011 do not document that the yellow hose was ever replaced, and the flattening likely happened due to a one time event. [Findings of Fact 88-92, 94]

11. The slide-in approach and touchdown to landing were controlled, well cushioned and without lateral drift. There is no evidence that improper landing procedures, or a hard landing were causal to the damper system failure. [Findings of Fact 54-58]

12. The initial left yaw of the aircraft was characteristic of ground resonance. The right yaw that occurred after the tail wheel impacted the gutter was probably the result of pilot right pedal input to attempt to stop the left rotation of LT 616. [Findings of Fact 61, 62, 64, 65, 82]

13. The pilots were attempting to follow the NATOPS emergency procedure by pulling the PCLs for "Unusual Vibrations on Deck", but were unable to do so based on the violent shaking of the aircraft and the centrifugal forces resulting from the yawing motion of LT 616. The PCLs were most likely not secured prior to the aircraft rolling off the flight deck. [Findings of Fact 63, 93]

14. The aircraft likely stabilized in the water with the left gunner's window facing toward the surface. LT 616 likely sunk immediately upon water entry. AWS3 ^{(b) (3) (A), (b) (6), (b) (7)(C)} position in the left gunner's window holding the two gunners handles on either side at the time of impact is probably what allowed

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him to remain conscious and successfully egress from the LT 616 upon water entry. [Findings of Fact 9, 47, 65, 66, 71-75]

15. Search and Rescue operations and procedures were appropriately executed. [Findings of fact 65-66, 70, 72-79]

16. LT 616 was in compliance with all governing maintenance related rules, regulations, and procedures, and ready for flight prior to the mishap event. [Findings of Fact 23-31, 94-107]

17. All maintenance conducted as a result of the 3-4 August damper hose failures was completed in accordance with governing maintenance directives. HSC-8 pilots and maintenance personnel took necessary and appropriate actions in response to the prior damper hose failures. Over the past five years, at least 460 damper hoses have been replaced in a fleet of 498 Navy H-60 aircraft. References (g) and (i) state damper hoses are not high time components, meaning they are not changed after a certain number of flight hours. They are only replaced if they show signs of wear or break. Without indications of wear, vibration exceedances recorded in IMDS, or complete failures of the damper hoses, there was no reason or requirement to replace the two functional hoses (black and yellow). [Findings of Fact 80, 88, 94, 96, 100-101]

18. No inspections prior to the 31 August 2021 flight revealed any deficiencies or abnormalities with the damper system. The only discrepancies noted during the Daily and Turnaround inspections conducted on 30 August 2021—a broken bonding jumper and the Number 1 Engine oil level low—were not causal to the mishap. The 30 hour inspection required an inspection of the damper system, and no discrepancies were noted in the ADB or by the maintainers who performed the inspection. This inspection was performed in accordance with all governing publications and directives, and based on interviews with the maintainers who performed the inspection, there is no evidence that any visible discrepancies were missed. [Findings of Fact 96, 99-100]

19. Mechanical damage (flattening) of steel braid strands on a damper hose would not be evident during any external inspections. Any maintainers who performed external inspections to prepare LT 616 for flight on 31 August 2021, to include the maintainers performing the daily/turnaround inspections, and the CPO who released the aircraft safe for flight, would not have known the hose was fatigued, or close to failure. [Findings of Fact 90, 95-98, 104, 107, 114]

20. HSC-8 Maintenance culture is one of safety above speed. When asked, multiple HSC-8 Aviation Machinist Mates stated when motor head maintenance was performed the damper hose was disconnected prior to spindle pry bar use. There is no evidence that it was common for maintainers to skip steps in maintenance procedures, improperly complete maintenance procedures, or improperly complete maintenance action forms. HSC-8's Quality Assurance team has appropriate processes in place to ensure safe maintenance practices and allow for reporting by any member of HSC-8 if any unsafe maintenance practices were observed. When combined with other factors, there is no way to

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determine when the yellow damper hose damage occurred on this aircraft. [Findings of Fact 81, 86-88, 90-92, 108-111]

21. There is no evidence of any supervisory negligence or inadequate management or leadership practices. The HSC-8 Commanding Officer and Maintenance department appeared to exercise appropriate oversight of squadron maintenance practices and properly foster a culture of Maintenance safety. [Findings of Fact 108-111]

Recommendations

1. Recommend NAVAIR and CNAF review the results of the Fleet Support Team's Engineering Investigation and direct corrective actions across the H-60 fleet, as necessary and appropriate, to improve safety and prevent a similar mishap from occurring.

2. Helicopter PCL location in the upper center console is not ideally located for quick securing of the engine in an emergency. Recommend NAVAIR direct a review of emergency procedures and equipment to determine whether it is possible to enable a quicker and easier PCL response during a ground resonance event.

(b) (3) (A), (b) (6)

CAPT, USN
Investigating Officer

5340
11 Apr 2022

From: CDR (b) (6) USN
To: Commander, Naval Air Forces Pacific

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CIRCUMSTANCES SURROUNDING THE 31 AUGUST 2021 AVIATION
MISHAP THAT OCCURRED ONBOARD USS ABRAHAM LINCOLN (CVN-72)

Ref: (a) JAGINST 5800.7G, Chapter II
(b) CAPT (b) (6), USN ltr 5830 of 4 Feb 22 w/ endors.

Encl: (1) CNAP ltr 5830 SerN00 of 29 Mar 22
(2) MIST Infield Report dtd 12 Oct 21
(3) LPU 37 A/P Initial EI Report dtd 27 Jan 22
(4) LPU 37 A/P Amendment 1 to Initial EI Report dtd 31 Jan 22
(5) LPU 37 A/P Final EI Report dtd 17 Mar 22

Preliminary Statement

1. Purpose and Scope. In accordance with Reference (a), this report contains the results of the supplemental command investigation convened pursuant to Enclosure (1) to inquire into the material condition and performance of the Aviation Life Support Systems (ALSS) associated with the subject mishap and to ascertain whether any of the new information now available should change any of the conclusions or recommendations of Reference (b).

2. Executive Summary.

a. Following a 2.5 hour plane guard/search and rescue (SAR) support event on 31 August 2021, a tragic mishap occurred when Loosefoot 616 (LF616) experienced uncommanded lateral and vertical vibrations upon landing on the USS ABRAHAM LINCOLN (ABE) flight deck. As the vibrations intensified, the aircraft began a left yaw for approximately 50 degrees followed by a right yaw for approximately 200 degrees on the flight deck. The aircraft's rotor blades impacted ABE's flight deck and LF616 fell over the starboard side into the ocean.

b. On 12 October 2021 the Naval Air Systems Command (NAVAIR) Mishap Investigation Support Team (MIST) generated an In-field Investigation Report (IIR). [Enclosure 2]. The NAVAIR MIST provided a copy of the IIR to the Aviation Mishap Board (AMB) for their investigation. A copy of the IIR was not provided to the person conducting the Command Investigation (CI) since it is a separate investigation with different responsibilities.

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c. The AMB requested an Engineering Investigation (EI) be completed to investigate why the LPU-37A/P (Life Preserver Unit) worn by Pilot1 was found with both beaded handles detached, right handle pulled, right side CO2 cylinder discharged, and right side inflation bladder partially deployed. [Enclosure 3]

d. The AMB also requested a second EI to review the status of the remaining Low Profile Flotation Collars (LPFC) that were worn by the mishap crew. An additional EI was requested to evaluate and document the LPU-37A/P life preserver assembly worn by Pilot1 for potential anomalies that may have prevented the LPU from functioning properly. [Enclosures 4, 5]

Findings of Fact

1. Of the six Survival Egress Air (SEA) bottles utilized by the crew only two of six the bottles were turned on. The SEA bottles not being turned on indicate that the preflight inspections were not done in accordance with NAVAIR 00-80T-123, the Aircrew Systems NATOPS. [Enclosure 2]

2. All of the mishap LPUs were analyzed. It should be noted that the ambient pressure at the recovery depth can compromise the integrity of the foil of the CO2 cartridges located in the LPU, causing the LPU to inflate without intentional action. Because of this, examination of the beaded handles and actuation levers were of critical importance. An inflated LPU with unsecured beaded handles and an unseated actuation lever can be said to have been intentionally actuated. The LPUs belonging to CC1 and Pilot1 were intentionally actuated. [Enclosure 2]

3. The LPU worn by Pilot1 had a serviceable left side inflation assembly and air bladder. The LPU worn by Pilot1 also had a serviceable right side inflation assembly. The right bladder was found to have a leak from the right side oral inflation valve. The oral inflation valve was in a "depressed/open state" which facilitated air escaping. When and why the valve became stuck open in relation to the mishap event cannot be determined. [Enclosure 3]

4. Improper CO2 cartridge installation cannot be ruled out as a contributing factor to the incomplete bladder inflation for Pilot1's LPU. [Enclosure 5]

5. Pilot2's LPU was found to have inconsistencies relative to specifications, maintenance requirements, and expected conditions. During lab functional testing, the left inflation assembly did not hold pressure due to an unseated CO2 cylinder piercing pin rod pressure seal. The timeline or cause of the failed pressure seal cannot be definitively determined due to extended exposure to the salt water environment and post-mishap handling and storage conditions. The lab functional testing also revealed a one-inch split/puncture through the inflation shell on the right bladder preventing the right inflation assembly from holding pressure following full inflation, the LPU was recovered fully packed with no damage to the outer casing. [Enclosure 5]

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Opinions

1. This mishap casts doubt on the functionality and reliability of LPU-37A/P and LPU-34B/P ALSS equipment. [Findings of Fact 2-5]
2. The ALSS gear was recovered after being exposed to salt water at a depth of 5000'. Exposure to the salt water and pressure make it difficult, if not impossible to determine the timeline of LPU actuations. It is plausible that the LPU was actuated at a depth where the subsequently provided inflation was insufficient to overcome the ambient water pressure. [Findings of Fact 1]

Recommendations

1. This supplemental Command Investigation concurs with the original recommendations of Reference (b).
2. In addition to the recommendations made by the original Command Investigation it is recommended that:
 - a. An EI be conducted to determine at what depth a properly functioning LPU fails to provide effective flotation with a fully burdened life vest.
 - b. The results of the original CI and supplemental CI be briefed to all pertinent commands addressing the importance of properly preflighting SEA bottles, proper attachment procedures for Emergency Release Assemblies, and the importance of correctly installing and utilizing crashworthy seats.
 - c. A random functional check be conducted on 22 Ready For Issue (RFI) in-service LPUs from different squadrons to determine if LPU functionality is an issue endemic to the fleet.
 - d. Amend the requirements Naval Aviation Survival Training Program to require both auto inflation and manual inflation of at least one of lobe for aircrew that utilize the LPU-37A/P and LPU-34B/P.

(b) (6)

CDR, USN
Investigating Officer

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