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Final Action Memo on the Administrative Investigation

Final Decision Letter on the MISHAP (Safety) Investigation

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MEMORANDUM

From: Admiral Thad W. Allen
Commandant, U.S. Coast Guard

To: Distribution

Subj: FINAL ACTION ON THE ADMINISTRATIVE INVESTIGATION INTO THE CRASH OF CG 6505 THAT OCCURRED ON 04 SEPTEMBER 2008

1. **Overview:**

On the evening of Thursday, 04 September 2008, Coast Guard Air Station Barbers Point helicopter CG 6505 was conducting routine small boat hoist training with Coast Guard Station Honolulu Motor Life Boat (MLB) 47317 south of Oahu after sunset. A mishap occurred during the fifth hoist evolution at approximately 2011 Hawaii-Aleutian Standard Time (HST). This initiated a chain of events that ultimately resulted in the crash of CG 6505 into the Pacific Ocean at approximately 2015(HST), approximately 5 nautical miles (NM) south-southwest of Honolulu International Airport (HNL). As a result of the crash, all four crewmembers were killed and the aircraft was lost.

This Final Action document sets forth material facts, as determined by the Administrative Investigation, which led to and evolved into this incident, states my conclusions, and orders certain actions to further mitigate risks in an effort to prevent similar incidents and tragic loss of life. Neither the exact nature nor the full extent of damage to the aircraft was precisely determined by the Administrative Investigation. A separate Aviation Safety Mishap Investigation provides further engineering analysis and causal factors for this mishap.

2. **Findings of Fact and Opinion:**

The following narrative provides the key findings that inform my conclusions and actions:

Coast Guard Air Station Barbers Point helicopter CG 6505 was conducting hoist training with Coast Guard Station Honolulu MLB 47317 south of Oahu after sunset on the evening of 04 September 2008. The environmental conditions included a surf advisory of 6-8 feet, winds from the East/Northeast (070 degrees) and reported seas of 1-2 feet. During the recovery phase of the hoist following a delivery of the rescue basket with a trail line to the "dead in the water" (DIW) MLB 47317, excessive slack in the hoist cable from the CG 6505 collected aboard the MLB 47317. The excessive slack was caused by the combined motion of the aircraft's altitude changing dynamically in a hover; the pilot's flight control inputs in response to standard conning commands provided by the flight mechanic; the hoist cable that was paid out and being tended by the flight mechanic in response to the change in distance between the helicopter and boat; and the heaving motion of the stern of the MLB 47317 as it moved in response to ocean swells. The stern of the boat fell and a loop of the hoist cable became fouled on the engine room dewatering standpipe, mounted on the forward bulkhead of the aft buoyancy chamber of the MLB 47317.

These combined actions resulted in a hard snag on the standpipe, and with no slippage, the hoist cable parted under extreme tension at approximately 2011 (HST).

The cable parting induced an unusual attitude recovery at a low altitude and damaged the rotor system. The aircraft then transitioned to forward flight, gaining altitude and commencing a slow climb on a track to the NNW in the direction of the south coast of Oahu, Hawaii. The aircraft climbed to an altitude of 558 feet and accelerated in forward flight to an indicated airspeed of 25-50 knots. Just over 3 minutes after the initial mishap, after traveling a distance of approximately 2.1 nautical miles, the aircraft experienced a catastrophic loss of airworthiness. It rapidly fell into the ocean from an altitude in excess of 450 feet, in position 21-13'-37"N, 157-57-34" W, 5 miles south-southwest of HNL in a water depth of approximately 1300 feet.

As evidenced by the abnormal oscillations in audio recordings and instrument readings and the almost immediate MAYDAY calls referencing vibrations, the CG 6505 experienced significant abnormal vibrations from the time the hoist cable parted and for the duration of the flight until the aircraft impacted the water. The most likely reason that the aircraft suffered an abrupt compromise in airworthiness was the sudden loss of main rotor speed that resulted from the damage to the aircraft's rotor system and the resulting out of balance condition. A more comprehensive analysis of the damage and causal factors is provided in the Aviation Safety Mishap Investigation.

Coast Guard Sector Honolulu and Coast Guard District 14 Honolulu Command Centers rapidly notified Coast Guard, Honolulu Fire Department and other first responders, who proceeded to the scene of the crash. Approximately one hour after the incident, LCDR Andrew Wischmeier (the pilot in command), AMT2 Joshua Nichols (the flight mechanic) and AST1 David Skimin (the rescue swimmer), were recovered in the fuselage or its general vicinity by the Honolulu Fire Department (HFD); none displayed vital signs. All three were transported to The Queen's Medical Center, in Honolulu, where they were pronounced dead by the attending emergency room physician at approximately 2215 (HST).

An extensive air and surface search for CDR Thomas Nelson (the co-pilot and the assigned Executive Officer at Air Station Barbers Point) was conducted over the next 72 hours without success. CDR Nelson was declared missing on 07 September 2008. On 21 October 2008, CDR Nelson's flight suit, the co-pilot seat, his LPU-27/P Search and Rescue (SAR) Warrior vest, and personal effects were recovered at the deep water salvage site. DNA analysis of human remains found in CDR Nelson's helmet, which was recovered the night of the incident, allowed positive identification. CDR Nelson was declared deceased by the Coast Guard Judge Advocate General on 14 November 2008.

On 24 November 2008, CDR Nelson was posthumously appointed to the grade of Captain by the Secretary of Homeland Security, for the President, with appointment effective 02 October 2008, the date upon which his promotion to Captain was confirmed by the U.S. Senate. For purposes of the investigation, Captain Nelson is referred to as Commander Nelson, his pay grade at the time of the mishap flight. On 04 September 2009, AMT2 Nichols was posthumously promoted to AMT1 by the Commandant of the Coast Guard based on his promotion list eligibility status at

the time of the mishap. For purposes of the investigation, AMT1 Nichols is referred to as AMT2 Nichols, his pay grade at the time of the mishap flight.

Salvage operations commenced shortly after the recovery of the three victims and numerous pieces of surface debris by responding surface units. An attempt to lift the fuselage from the ocean to a naval support vessel of opportunity failed because the positive buoyancy from the aircraft flotation system and the integrity of internal spaces began to degrade. On 05 September 2008, the wrecked fuselage was eventually taken under a slow tow by a commercial water taxi into Pearl Harbor, hoisted by crane to a pier and moved via truck to a secure hangar on Hickam Air Force Base. Deep water salvage operations in the vicinity of the incident commenced on 07 October 2008 using the USNS SALVOR and commercially-provided surveillance and Remotely Operated Vehicle (ROV) resources. Most of the critical components of the aircraft, including the fuselage, engines, main rotor blades, main rotor head including gear box, and avionics including the Voice and Flight Data Recorder (VFDR) were recovered during the shallow and deep water salvage processes.

Damage to the MLB 47317 was minimal, and there were no injuries among the crew. CG 6505 was destroyed in this mishap. The wreckage is now physically located at the Aviation Logistics Center in Elizabeth City, NC.

3. **Findings and Directed Action:**

A. I find that no misconduct was associated with the Class A flight mishap involving the CG 6505 on 4 September 2008, and that the deaths of CDR Nelson, LCDR Wischmeier, AMT2 Nichols and AST1 Skimin occurred in the line of duty.

I base these findings upon the following facts:

1. The flight crew and boat crew members were all properly qualified in their crew positions and completed the requisite pre-flight responsibilities.

2. There is no indication that any member of the flight crew intentionally violated any procedures required by regulations, official policy, or directives governing the operation of a Coast Guard H65 from Air Station Barbers Point.

3. There is no indication that any member of the boat crew intentionally violated any procedures required by regulations, official policy, or directives governing the operation of a Coast Guard 47 foot motor life boat (MLB) from Station Honolulu.

4. In reference to both the MLB 47317 and the CG 6505, there is no indication that any maintenance actions or procedures factored in the mishap.

5. The Pilot in Command is authorized to deviate from published procedures when immediate action is necessary.

6. There is a culture of professionalism and a focus on safety at both Air Station Barbers Point and Station Honolulu that was evident to board members in every interaction with unit officers and crew.

7. The crewmembers of MLB 47317 displayed professionalism and adherence to safety and risk management procedures. They were focused on the mission at hand, wearing appropriate personal protective equipment, and followed approved operational and safety procedures to prepare for and conduct support of the helicopter hoist operations.

8. The flight crew of the CG 6505 was professional, focused on the training mission, and wearing all required personal protective gear.

B. I find that this mishap initiated when the hoist cable from CG 6505 became fouled on the dewatering standpipe of MLB 47317 and parted.

I base this finding upon the following facts:

1. The engine room dewatering standpipe on the aft buoyancy chamber of the 47 foot MLB can be a snag hazard (due to its location, geometry and location in the crowded after deck) during hoist operations with helicopters.

2. The foul of the hoist cable on the small boat was inadvertent as the boat crew used proper procedures for tending the trail line, hoist cable, and rescue basket. During the hoist, extra slack in the hoist cable, taken up when the stern of MLB 47317 fell in a swell, resulted in a hard snag on the standpipe. The aircraft was pulled down and rolled to the right until the hoist cable parted under extreme tension. The aircraft then rolled violently in the opposite direction during recovery procedures, and experienced severe damage to the gearbox and rotor system.

Action: As a result of this finding, I direct:

1. The Deputy Commandant for Operations to continue to implement interim provisions which have reduced the risk of hoist operations with the 47 foot MLB until a risk mitigation strategy is finalized and implemented.

2. The Chief of Staff and the Deputy Commandant for Operations to continue accelerated efforts to develop a fleet-wide modification of the hoist winch assemblies for Coast Guard H-65 helicopters. To dampen the dynamic hoist cable shock load during hoisting operations, this modification shall include hoist cable shock load mitigation, thereby reducing the potential for hoist cable failures.

3. Force Readiness Command (FORCECOM) to conduct a thorough analysis of the helicopter/small boat interface for operational and training hoisting procedures with the small boat, aviation, training and engineering program managers. This analysis should include, but not be limited to, consideration of improved training for boat or flight crews,

including the potential benefits of improved standard hand signals for boat crews and improved communications systems between the boat crew and the flight crew.

4. The Chief of Staff to continue to pursue engineering and training solutions to appropriately minimize snag hazards for all standard boats. The boat-helicopter interface for hoisting operations should, to the extent practical, be an engineering and design consideration in new acquisition programs for standard boats.

C. I find that the non-performance of required emergency procedures contributed to the severity of the mishap.

I base this finding upon the following facts:

1. As evidenced by the abnormal oscillations in audio recordings and instrument readings, the damage to the main rotor system, and the almost immediate MAYDAY call referencing vibrations, the CG 6505 experienced significant abnormal vibrations for the duration of the flight from the time the hoist cable parted until the aircraft impacted the water.

2. There was no clear verbal annunciation of emergency procedures among the flight crew during the 3 minutes and 15 seconds between the parting of the hoist cable and CG 6505's impact with the water.

3. Review of available data regarding the mishap flight, after the parting of the hoist cable, shows that the aircrew knew the aircraft was experiencing significant vibrations and multiple simultaneous emergencies. It appears from the flight profile that the pilots were task-saturated with maintaining control of the aircraft and their instinctive actions were to fly out a still controllable aircraft following the cable failure.

Action: As a result of this finding, I direct:

1. The Deputy Commandant for Operations to coordinate a debriefing of the risk factors and decision-making in this mishap with pilots and aircrew of both the H-65 and H-60 communities

2. The Deputy Commandant for Operations to examine these findings and the Aviation Safety Mishap Investigation to provide additional learning points for aircrews and operational commanders.

3. FORCECOM to conduct a review of the initial and recurrent training syllabus for helicopter pilots, in view of potential lessons learned from this mishap, with specific focus on a review of the emergency procedures in the HH-65C Flight Manual, the training syllabus, and the execution of those procedures in recurrent simulator training and Standardization Visits for re-certification with greater emphasis on ditching scenarios.

D. I find that the breakdown of Crew Resource Management (CRM) contributed to the severity of this mishap.

I base this finding upon the following facts:

1. Crew Resource Management is a tool that is taught and highly emphasized in the aviation community. In an effort to minimize human error, CRM stresses verbalizing all symptoms and then emergency procedures as they are completed in an effort to increase situational awareness of the entire crew. It also enables the entire crew to act as backup ensuring the procedures are completed correctly.

2. There was minimal verbal communication reflecting evidence that the flight crew identified the parting of the hoist cable and the subsequent damage to the rotor system; that they discussed any symptoms they were experiencing, or that they completed any emergency procedures during the 3 minutes and 15 seconds between the parting of the hoist cable and CG 6505's impact with the water.

3. The flight crew was likely experiencing extreme difficulty communicating with each other due to the severe aircraft vibrations from the out of balance condition combined with aural and visual warnings and intense radio chatter. Even though any critical non-verbal communications between the flight crew will never be known, this difficulty communicating verbally likely contributed to the breakdown in CRM during the final phase of the flight.

Action: As a result of this finding, I direct:

1. FORCECOM to conduct a review of the initial and recurrent training syllabus for helicopter pilots and aircrew, in view of potential lessons learned from this mishap, with specific focus on the role of CRM during the execution of emergency procedures in the HH-65C Flight Manual.

4. **Summary:**

I commend the extraordinary performance by all Coast Guard units, Department of Defense assets, Honolulu Fire Department, Coast Guard investigators, and other involved entities who responded immediately to, and in the aftermath of, this tragic mishap. Special recognition is merited for the Coast Guard Foundation and those who met the unique needs of families, friends, and shipmates impacted by this loss.

A mitigation strategy to reduce the risk of hoist operations has been implemented with interim provisions to include revised checklists and procedures, updated flight manuals, Rotary Wing Hoist Safety Summit, and a shroud for the 47 foot MLB to reduce snag hazards. Accelerated efforts continue to develop a fleet-wide modification of the hoist winch assemblies for Coast Guard H-65 helicopters. This modification shall include hoist cable

shock load mitigation to dampen the dynamic shock load during hoisting operations, thereby reducing the potential for hoist cable failures.

This terrible accident is a reminder that as Guardians, we operate in an extremely hazardous environment. Coast Guard men and women go into harm's way to train and conduct operations each day and we must diligently direct our energies to performing operations safely and effectively. The aircrew of CG 6505 epitomized the Guardian Ethos and the Nation is grateful for their service.

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MEMORANDUM

From: D. P. Pekoske, VADM
COMDT (CG-09)

To: Distribution

Subj: FINAL DECISION LETTER ON COAST GUARD AIR STATION BARBERS POINT CLASS "A" AVIATION FLIGHT MISHAP INVOLVING HH-65C CGNR 6505 ON 04 SEP 2008

Ref: (a) Safety and Environmental Health Manual, COMDTINST M5100.47
(b) Department of Defense Human Factors Analysis and Classification System (DoD HFACS): A mishap investigation and data analysis tool

1. SYNOPSIS. At 2011 Hawaii-Aleutian Standard Time (HST) on September 4th 2008, Air Station Barbers Point Coast Guard Helicopter Number (CGNR) 6505 was taking part in a night hoisting training evolution with Station Honolulu Motor Life Boat (MLB) 47317 approximately six miles south of Honolulu, HI. CGNR 6505 was carrying 4 people: two pilots, one flight mechanic (FM) and one rescue swimmer (RS). CG 47317 had four people onboard: one coxswain, one crewmember/ break-in coxswain, one engineer and one break-in crewmember.

CGNR 6505 was in the recovery phase of a hoist following a standard delivery of the rescue basket with trail line to the "dead in the water" (DIW) MLB when the mishap occurred. As the helicopter maneuvered overhead it descended as the MLB rose on a swell. The relative motion created excess slack in the hoist cable. Despite the efforts of the attending MLB crewmen, the excess cable entangled on the MLB engine room dewatering standpipe on the aft buoyancy chamber's forward face. As the MLB rode down the swell and the helicopter maneuvered to regain altitude, the cable became taut, physically pulled the helicopter down to the right, and then parted under extreme tension at the engine room dewatering standpipe.

The cable parting induced an unusual attitude (rapid right and left roll with extreme yaw to the left), during which the main rotor blades contacted the hoist boom assembly. This disrupted the normal finely-tuned motion of the rotating helicopter rotor blades (up and down / forward and aft) and created a significant out of balance condition resulting in severe vibrations that existed for the remainder of the flight. The main gearbox suspension system was also compromised resulting from a severe overtorque and attendant system degradation from the forces of tensional loading (as the hoist cable became taut) and instantaneous unloading (as the hoist cable parted).

Despite the severe vibrations, the aircrew recovered from the unusual attitude, and in the process, flew away from the water. They also made several "MAYDAY" calls that were overheard by the MLB crew, Sector Honolulu and Honolulu International Airport Air Traffic Control Tower (ATC).

Approximately three minutes later, after gaining altitude and moving closer to shore, the damage to the airframe caused in the hover was compounded by deterioration of components of

the rotor system, compromising the airworthiness of the helicopter. The aircraft departed controlled flight at approximately 500 feet and 40 kts and impacted the surface.

2. CLASSIFICATION. Per reference (a), this is a Class "A" mishap due to the four fatalities and loss of the aircraft.

3. CAUSAL FACTORS. The factors that contributed to this accident are listed in chronological order using the descriptors from reference (b), and organized into three main acts that occurred or should have occurred during the incident. (ACT A: Overcontrol/Overtorque that resulted in the fouled cable, ACT B: Procedural error to not clear the fouled cable, ACT C: Procedural error to not execute the ditching procedure.) Each section starts with the individual act and is followed by the existing preconditions, supervisory influences, and organizational influences that affected them.

a. Act: Overcontrol: Just prior to the hoist cable snag, the aircrew experienced a momentary misperception of the relative distance between the helicopter and MLB. This resulted in a minor overcontrol (overtorque) that was the Pilot at the Control's (PAC's) response to either the aircraft entering a slight descent, the stern of the MLB rising up on the crest of a swell, or more likely a combination of the two. The variance in altitude and aircrew response was not unusual for a standard hoisting evolution, however it led to a scenario where enough slack rapidly built up between the helicopter and vessel for the hoist cable to become wrapped around the MLB's aft dewatering standpipe.

    (1) Precondition: Vision restricted by Darkness: Darkness makes routine tasks more challenging. In this case it contributed in some part to the position keeping of the aircraft and snag event because all of the members involved were operating in an environment with limited visual cues. The PAC was also practicing the planned (and necessary) skill set of hoisting without the aid of Night Vision Goggles (NVGs), which further reduced the visual cues available. Finally, the environmental conditions that evening included a surf advisory of 6-8 feet, winds from the East/Northeast (070 degrees) and reported seas of 1-2 feet. The aircraft was pointed into the wind which placed the PAC on the side of the aircraft where terrain features (lights from shore) would not have been seen and therefore offered no relief from the reduction in visual cues. The conditions existing at the time of this incident were demanding but well within normal training parameters.

    (2) Precondition: Misperception of Operational Conditions: The assessment of operational conditions during any hoisting evolution is a dynamic process requiring innumerable inputs, corrections and re-corrections. The rate of small corrections is so great and the control input so miniscule that hoisting itself can almost be considered a nonstop series of changing perceptions and/or misperceptions that are acted upon and corrected. From all of the evidence gathered, this description accurately matches the profile of the mishap aircraft in the seconds prior to the overtorque and snag. Even though the movement of the aircraft wasn't far out of the range of a standard hoisting evolution, it was enough to allow the combined relative positions of the aircraft and

small boat to converge and create sufficient slack in the hoist cable so that it collected on deck and became wrapped around the aft dewatering standpipe.

b. Act: Procedural Error: Although precursors to the event occurred in rapid succession, had the aircrew realized the cable was snagged, they should have initiated the "Hoist Cable Fouled/Damaged" emergency procedure. This would have prompted the PAC to reduce the distance between the helicopter and MLB, the FM to pay out more cable, or either of them to shear the hoist cable before it reached the severity of the ultimate overload. In this case the environmental conditions, relatively short span of time, design of the hoist system, and design of the surface platforms used in hoist training hindered them from taking action quickly enough to influence the final outcome.

(1) Precondition: Vision restricted by Darkness: The FM is expected to keep track of several things during any hoist evolution: aircraft position relative to the vessel, obstructions and altitude, the rescue device, personnel in the hoist area, and the condition and location of the hoist cable. In relative terms, the last task of keeping track of the entire length of hoist cable with certainty at night is far more difficult. In this case, boat crew members observed slack in the hoist cable in the aft buoyancy chamber, but given the lack of visual cues, it is likely that the FM lost sight of the cable and failed to recognize the excess slack or that it had become snagged.

(2) Precondition: Instrumentation and Sensory Feedback Systems: Hoisting in the H-65 is predominately a visual maneuver augmented by tactile feedback through the FM's hand on the hoist cable and through the aircrew's perception of the physical shift of the aircraft's attitude as a heavy load is picked up. While either of these feedback cues could have potentially alerted the aircrew to a dangerous situation, neither is quantifiable or adequate as the primary backups to the visual sense in a short time span.

(3) Organizational Influence: Acquisition Policies / Design Process: In this case, there were two factors in the acquisition and design process that influenced the outcome of the incident. The first is the design integration of the hoist system on the H-65 and the second is the systems safety design of Coast Guard small boats.

1. Hoist Assembly: When the H-65 was purchased in the 1980s, there was no service requirement to conduct a formal system safety and hazard analysis. This requirement has been established with the incorporation of the Major Systems Acquisition Manual (MSAM), COMDTINST M5000.10A, but is not yet a mature and well defined process in application. In this case, the hoist assembly as integrated into the H-65 at the time of acquisition had latent hazards that were not envisioned, documented or experienced until this incident. The H-65 hoist assembly safely performed countless hoists over decades of service, but it is now known that under certain conditions, it is capable of transferring loads onto the aircraft that are well in excess of the airframe limitations. It is also attached to the airframe in a location where,

under unusual attitude scenarios, it can physically contact the main rotor blades.

2. Small Boat Platforms: A snag hazard on the MLB (the dewatering standpipe) contributed to the mishap in that it is located in the primary hoist training area and was not specifically identified as a potential hazard. Multiple snag hazards exist on all boats; the significance of the dewatering standpipe is that its presence in the hoist area was not widely known by aircrews.

(4) Organizational Influence: Program and Policy Risk Assessment: The current Coast Guard model of reporting hazards and developing mitigation strategies through engineering solutions, modifications to operational procedures, and focused training and education is sound and has successfully prevented mishaps or reduced the severity of mishaps in countless situations. The identification of organizational risk assessment as a factor in this case is a sobering reminder that in the world of complex systems and competing demands, improvement is always possible. In this case, there were opportunities for further analysis and risk assessment that may have exposed some of the latent hazards associated with this hoist assembly and/or routine methods of employment. As previously mentioned regarding the hoist assembly itself, one of those opportunities was at the time of purchase. For the assessment of operational hazards on vessels used in training, had more thorough formal dynamic interface tests been conducted between the two platforms (or for all other routine training platform combinations), then the specific snag hazard underneath the aft buoyancy chamber on the MLB could have been identified.

c. Act: Procedural Error: It was determined that the aircraft damage to the gearbox and main rotor system (and associated severe vibrations) occurred immediately after the aircraft was recovered from the unusual attitude induced by the cable parting. The aircrew flew for approximately three minutes after the damage occurred without any crewmember directly articulating symptoms (vibrations) or causes (rotor blade/airframe damage), or clearly initiating any specific emergency procedure or discussing which landing criteria should be applied. While there might be plausible environmental, mental, cultural and preconditioned training responses that can explain their actions, it is also reasonable to have expected the aircrew in this case to diagnose the vibrations as severe enough to warrant ditching.

(1) Precondition: Vibration: The out of balance condition caused by the rotor system contacting the hoist boom created severe vibrations that impeded situational awareness, crew coordination, internal communications, initiation of emergency procedures, and the ability of the aircrew to complete basic duties such as manipulation of switches and flight controls.

(2) Precondition: Vision restricted by Darkness: During the unusual attitude recovery the aircrew lost sight of their only reliable visual reference, the MLB. While visual reference with a surface asset is not required to maintain a hover at night, the

degraded visual cues caused by darkness combined with the vibrations and traumatic nature of the unusual attitude recovery are plausible factors that contributed to the aircraft's observed flight profile away from the water. The same factors also explain the absence of ditching procedures as events progressed due to the difficulty of executing a survivable approach to the water with a degraded aircraft and severe vibrations.

(3) Precondition: Channelized Attention: The H-65 flight manual states in the beginning of the emergency procedure section that regardless of the nature and severity of the emergency the overriding consideration is to: "Maintain Aircraft Control, Analyze the Situation, and Take Appropriate Action." The initial recovery from the unusual attitude following the cable parting was highly commendable and clearly placed the aircrew in the "Maintain Aircraft Control" mindset. However, once the aircrew gained control of the aircraft, there was no indication, from internal communications, that they progressed into the analysis phase. This channelized attention on flying the aircraft, combined with the shock and induced stress of the initial incident, the unusual attitude following the cable parting, and the severe vibrations, distracted the aircrew from effectively completing the analysis phase in sufficient time to affect the outcome.

(4) Precondition: Response Set: After the unusual attitude recovery, despite a degraded communications environment, there was little to no discussion among the aircrew regarding what they were seeing or their intentions. Through their actions and the flight profile, it can be inferred that they were potentially responding in a predisposed and conditioned manner to do two things: first to fly out (get away from the water) and second to continue to a landing site (not ditch and get to the beach). For the fly out portion of the event, the flight profile matches the recovery steps from the unusual attitude recovery to gain airspeed with the instrument reference of the nose and wings level on the horizon. This profile is also further supported by the ingrained response in the H-65 community to fly out from a partial power loss (engine failure) scenario. For the second portion of the event, the continued flight toward land with significant airframe damage and severe vibrations, it can be inferred that the aircrew was influenced by a cultural instinct to "bring the aircraft and crew home." In this aspect, their potential confidence in the airframe and perception that they could possibly make it the last few miles, despite the vibrations, likely kept them from descending and ditching the aircraft.

(5) Precondition: Crew / Team Leadership: Prior to the hoist cable parting, the aircrew was the perfect model of standardization and effective communications. Following the event however, there was a clear breakdown in several aspects of Crew Resource Management (CRM) that significantly impacted the aircrew's ability to take the appropriate action. In an environment of severe vibration and distracting visual and aural warnings, the absence of assertiveness by any member of the crew and lack of procedural adherence to challenge and reply protocol led to a situation where the aircrew was operating independently with regard to actions and communications and

not cross-checking each other's performance. Neither pilot communicated an intention to continue flying toward land or solicited the aircrew for a description of what had occurred or was occurring in the back of the aircraft to aid the decision making process. The FM did not report the cable snag, its parting, or any aircraft damage that he might have witnessed as the rotor blades contacted the hoist boom assembly. It is also probable that the FM and/or RS witnessed, heard or felt the departure of the hoist boom assembly since it was determined to have departed shortly after the initial damage. Communicating any critical information could have helped the aircrew collectively diagnose and focus on the severity of the situation. Later in the sequence of events there were calls from the FM and RS to conduct certain steps from the ditching emergency procedure, but they were not acknowledged nor were they clear requests to initiate a ditching scenario.

(6) Organizational Influence: Organizational Training Issues / Programs: Although aircrews are exposed to ditching scenarios in annual simulator sessions, they are not required to demonstrate proficiency in these procedures during search and rescue procedures check-flights conducted during annual standardization visits. In addition, due to lack of simulator fidelity, ditching scenarios are rarely practiced to and beyond the point of water landing. If these scenarios were practiced and evaluated more routinely and with greater realism, the aircrew might have responded more quickly to their symptoms and carried through with what was likely the best option at the time, to ditch the aircraft shortly after the damage occurred.

4. ADDITIONAL FINDINGS. The following items were not determined to be directly causal to this incident, but were so closely related to the incident that they are listed here for continual process improvement and mishap prevention in similar situations.

a. Precondition: Controls and Switches: There was no indication that anyone attempted to shear the hoist cable, but the investigation revealed that there is potential room for improvement in the design and location of the shear switches for quick access. Shear switches are located on the pilot's collective (covered thumb switch) and the flight mechanic's hoist control panel. There is no shear switch on the hoist pendent, used for remote hoist operation. Although no determination has been made that the design and location of the switches are sub-optimal or that they were a factor in the mishap, a human factors review of this system will be conducted.

b. Precondition: Communicating Critical Information: While it might not have changed the outcome of this incident due to the compressed period of time, boat crewmembers on Coast Guard platforms have limited means of transmitting critical information, either through verbal means (radio) or visual hand or light signals to the aircrew. In this case, a boat crewmember on the MLB tending the basket saw the cable get snagged, but was not able to convey the hazard to anyone in a timely manner.

c. Organizational Influence: Procedural Guidance / Publications: While there was no clear indication that any of the aircrew were executing published emergency procedures, several

were noted in the course of the investigation as needing further review for clarity and emphasis of content. They include the "Hoist Cable Fouled/Damaged," "Rotor Blade Damage," "Abnormal Vibration," and "Ditching (Power On)" emergency procedures.

d. Organizational Influence: Attrition Policies: The engineering investigation revealed that the elastomeric stops (dampening elements in the suspension system between the main gearbox and the aircraft) have no determined service life and are not tracked. The only inspection currently performed on these parts is visual, which has been determined by independent engineering analysis to be insufficient in determining internal damage caused by overloading or fatigue.

5. CORRECTIVE ACTIONS COMPLETED. The following actions have been initiated or completed since the incident.

a. The Aircraft Control Configuration Board (ACCB) has approved the installation and evaluation of a prototype hoist system on an H-65 that incorporates a dynamic overload (slipping clutch) system. The evaluation is expected to be completed in the spring of 2010.

b. COMDT (CG-41) has mandated the replacement of all H-65 laminated elastomeric stops during the Programmed Depot Maintenance (PDM) schedule. Service life remains to be determined.

c. A protective shroud has been created and mandated for use on the stern of the 47' MLB for all DIW training maneuvers. The shroud mitigates the specific snag hazard evident in this incident and others on this class of vessel. The requirement for shroud use for H60 hoist operations has been rescinded, because the hoist clutch on the H60 releases tension if the cable is stressed beyond normal limits. The use of the shroud shall remain in effect for H65 hoist operations as an interim measure pending analysis of a similar feature for the H65.

6. CORRECTIVE ACTIONS TO BE COMPLETED. The following items shall be accomplished through a reprioritization of existing resources or by using the resource proposal process.

a. COMDT (CG-1, CG-4, CG-6, CG-7 and CG-9) shall evaluate the current organizational requirements of system safety integration as applied to acquisition decisions at all levels and prepare a report on any identifiable gaps with solutions to CG-09 within six months of release of this report.

b. COMDT (CG-711) shall coordinate with all stakeholders to fund a formal system safety hazard analysis of the hoist assemblies on the H-65 and H-60. This is consistent with the requirements of the Major System Acquisitions Manual (MSAM), COMDTINST M5000.10A for systems purchased today, and shall be retro-actively applied in this case to both hoist systems based on the latent hazards identified in this report. COMDT (CG-711) shall also ensure that the results of this analysis are used to document a more detailed list of system requirements in the next version or update to the Operational Requirements

Documents (ORD) of both platforms. At a minimum, the analysis shall address the following discussion items from this incident:

(1) Element of cable strength in relation to other cable requirements (chaffing, bending, etc.).

(2) Overall design factor of the hoist cable strength and the effect it has on other airframe limitations.

(3) Design of the current hoist boom on the H-65 since it is physically possible to contact the main rotor blades in certain flight regimes.

(4) Potential engineering solutions that could mitigate latent hazards inherent to the hoist system (e.g., a cable with a lower design factor, a slipping clutch/ drag mechanism, a sensor system that would alert the crew of an overload condition, an automatic shear function that would prevent an extreme overload).

(5) Human factors engineering solutions in the design of the FM's shear switch to facilitate the location and identification through readily identifiable covers. Also consideration of an improved option for the left seat pilot to assist in shearing when needed.

c. ATC Mobile shall increase the realism and frequency of aircrew exposure to situations requiring analysis that would ultimately lead to ditching at sea. In aircrew simulator training, greater emphasis shall be placed on continuing the scenario to and beyond water landing. In addition, scenarios requiring a ditching decision shall be incorporated into annual unit standardization visits. Training scenarios should also incorporate the CRM discussions addressed in this report to punctuate the importance of solid crew coordination in all operations, but especially in highly complex and abnormal scenarios.

d. COMDT (CG-711) shall coordinate with all stakeholders to conduct a formal COMDT (CG-113) Operational Hazard Assessment of each Coast Guard rotary wing asset working with routine small boat hoist training platforms (Coast Guard, contract or other agency vessels). The results shall be captured in a separate document, similar to the Navy's Shipboard Aviation Facilities Resume, to be a single reference point for aircrew and small boat crews for identifying and discussing hazards associated with their operations. If engineering or procedural processes are identified as deficient, then the appropriate change request or engineering modification form shall be initiated.

e. COMDT (CG-41) shall assess the materiel condition of the main gearbox (MGB) suspension system and its dynamic components for service life implications. The overload of the main gearbox suspension system was well outside of design parameters as a direct result of the forces imparted during the incident. This investigation also revealed that more information needs to be obtained on the life limits of MGB components. Since the initiative to document these concerns is already underway via the Supportability Analysis Plan (SAP), COMDT

(CG-41) shall ensure that it includes at a minimum the following discussion items from this incident:

(1) Potential incorporation of service life limits and updated examination criteria for the laminated elastomeric stops.

(2) Validation of the current C-channel design.

(3) Development of limits or tolerances permissible for the MGB base plate mechanical stops to make contact with the airframe stops as well as the laminated stop outboard ends being allowed to make contact with the stop supports or C-channels during flight.

(4) Potential updates to inspect the entire MGB suspension and drive shaft couplings when discovering any premature wear of the laminated stops or high speed flex couplings.

(5) Potential incorporation of more detailed inspections following a MGB overtorque/snagged hoist cable/hard landing or other events which could trigger an abnormal unloading of the MRH or imbalance of the engine drive shaft.

f. The appropriate policy and staff offices from CG FORCECOM, COMDT (CG-711, CG-731, and CG-41) shall ensure the following manuals, syllabi and training requirements are implemented:

(1) Analyze, develop and improve standardized "Boat-to-Helicopter" hand signals to be published in the Boat Crew Seamanship Manual and both rotary wing flight manuals. At a minimum, consideration should be given to the following routine communication scenarios: "Ready for pickup," "Cable snag," and "Abort hoist."

(2) Incorporate bold face (memory) steps into a new "Aircraft Ditching from a Hover" Emergency Procedure (EP) for the H-65 Flight Manual. It shall be short and conducive to memorized actions under extreme stress. One of the listed symptoms shall be "Severe vibrations of unknown origin." The current EP, "Aircraft Ditching from Forward Flight," shall continue to be used under a more deliberative ditching decision scenario.

(3) Re-write the "Abnormal Vibration" EP from the H-65 Flight Manual to include severity of vibrations in the symptoms section and to provide a definition of severe vibrations. The EP shall also be written from the most extreme scenario where severe vibrations would result in bold faced steps to land or ditch immediately to the benign scenario where diagnosis could occur with a different landing criteria applied.

(4) Include the more specific descriptors of abnormal vibrations from the Maintenance Manuals and Maintenance Procedure Cards (MPCs) in the H-65 Flight Manual abnormal vibrations section.

(5) Re-write the "Fouled Cable" EP from the H-65 Flight Manual to model the H-60 flight

manual in addressing the severity of "potential injury or danger imminent" in the beginning of the EP as a bold face item.

(6) Update the Air Operations Manual, COMDTINST 3700.1 (series) and the Boat Operations and Training Manual to include an initial and recurrent requirement for rotary wing aircrew and surface forces to conduct asset familiarization on platforms routinely encountered in each unit's operations. Aircrew and boatcrew members shall receive the training within three months of reporting to a new operational unit and periodically thereafter at appropriate intervals.

(7) Update the Flight Mechanic (FM) initial flight syllabus and re-qualification flights to incorporate fouled cable EPs that result in a scenario simulating shear procedures.

(8) Evaluate the feasibility of integrating enlisted aircrew into simulator training to improve proficiency in crew resource management during normal and emergency procedures scenarios.

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Dist: COMDT (CG-01, CG-DCO, CG-7, CG-711, CG-731, CG-5, CG-6, CG-4, CG-41, CG-1, CG-11, CG-113, CG-1121, CG-9)
CG PACAREA (P)
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