

**UNITED STATES AIR FORCE**  
**AIRCRAFT ACCIDENT INVESTIGATION**  
**BOARD REPORT**



**HH-60G, TAIL NUMBER 88-26109**  
**56TH RESCUE SQUADRON**  
**48TH FIGHTER WING**  
**ROYAL AIR FORCE LAKENHEATH**



**LOCATION: CLEY NEXT THE SEA, NORFOLK,  
UNITED KINGDOM**

**DATE OF ACCIDENT: 7 JANUARY 2014**

**BOARD PRESIDENT: BRIGADIER GENERAL JON A. NORMAN**

**CONDUCTED IN ACCORDANCE WITH AIR FORCE INSTRUCTION 51-503**

**EXECUTIVE SUMMARY  
AIRCRAFT ACCIDENT INVESTIGATION**

**HH-60G, TAIL NUMBER 88-26109  
CLEY NEXT THE SEA, NORFOLK, UNITED KINGDOM  
7 JANUARY 2014**

On 7 January 2014, at approximately 1805 local time (L), the mishap aircraft (MA), an HH-60G, Tail Number 88-26109, assigned to the 56th Rescue Squadron, 48th Fighter Wing, Royal Air Force (RAF) Lakenheath, United Kingdom (UK), experienced multiple bird strikes during a training mission and impacted privately-owned, grass-covered marshland near Cley next the Sea, UK. The four crewmembers were fatally injured in the mishap. There were no civilian injuries or fatalities. The MA was destroyed upon impact. The cost to the United States government is estimated at \$40,302,061. Damage to private property consisted of minimal burning to grass at the crash site.

The purpose of the training mission was to conduct a nighttime rescue scenario of a downed F-16 pilot. The training mission included two aircraft, the flight lead aircraft and the MA, collectively known as the mishap formation (MF). All members of the flight lead crew and mishap crew wore night vision goggles. The MF departed RAF Lakenheath at 1733L and proceeded to an initial point to verify the status of the simulated downed pilot and conduct threat analysis. Strong winds pushed the MF toward a populated area. To avoid causing a noise disturbance, the MF reestablished its initial point to the north near the coastline.

The MA departed the new initial point at 1804L, flying east at approximately 110 feet above ground level and 110 knots indicated air speed toward a landing zone near Salthouse, UK. The flight path took the MF over Cley Marshes in the Norfolk Wildlife Trust near Cley next the Sea. A flock of geese took flight from Cley Marshes, likely startled by the noise of the approaching helicopters, and struck the MA. At least three geese penetrated the windscreen, rendering the mishap pilot and mishap co-pilot unconscious, and at least one goose struck the mishap aerial gunner in the performance of special mission aviator duties, rendering the mishap aerial gunner unconscious. In addition, at least one goose hit the nose of the MA, disabling the Trim and Flight Path Stabilization systems. With the mishap pilot and mishap co-pilot unconscious and the Trim and Flight Path Stabilization disabled, the MA's cyclic stick, which controls pitch and roll of the aircraft, was free to move randomly. The MA banked left to a point where it had no vertical lift. Without vertical lift, and without pilot input to correct the left roll, the MA was not able to remain airborne or maintain controlled flight. The MA impacted the ground at 1805L—approximately three seconds after being struck by the geese.

The Accident Investigation Board President found by clear and convincing evidence that multiple bird strikes caused the mishap by rendering the mishap pilot and mishap co-pilot unconscious and disabling the Trim and Flight Path Stabilization systems.

*Under 10 U.S.C. § 2254(d) the opinion of the accident investigator as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report, if any, may not be considered as evidence in any civil or criminal proceeding arising from the accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements.*

**SUMMARY OF FACTS AND STATEMENT OF OPINION**  
**HH-60G, TAIL NUMBER 88-26109**  
**7 JANUARY 2014**

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## ACRONYMS AND ABBREVIATIONS

3 AF	Third Air Force	FLA	Flight Lead Aircraft
48 FW	48th Fighter Wing	FLAG	Flight Lead Aerial Gunner
56 HMU	56th Helicopter Maintenance Unit	FLC	Flight Lead Crew
56 RQS	56th Rescue Squadron	FLCP	Flight Lead Co-pilot
748 AMXS	748th Aircraft Maintenance Squadron	FLFE	Flight Lead Flight Engineer
ADO	Assistant Director of Operations	FLIR	Forward Looking Infrared
AFE	Aircrew Flight Equipment	FLP	Flight Lead Pilot
AFCC	Automatic Flight Control Computer	FOIA	Freedom of Information Act
AFCS	Automatic Flight Control System	FPS	Flight Path Stabilization
AFI	Air Force Instruction	ft	Feet
AFMAN	Air Force Manual	FTU	Formal Training Unit
AFPAM	Air Force Pamphlet	G	Gravitational Force
AFSC	Air Force Specialty Code	GAC	Guidance and Control
AGL	Above Ground Level	GPS	Global Positioning System
AHAS	Aviation Hazard Advisory System	HHAR	Helicopter Air-to-Air Refueling
AIB	Accident Investigation Board	HIT	Health Indicator Test
APU	Auxiliary Power Unit	HMU	Helicopter Maintenance Unit
ATC	Air Traffic Control	HLZ	Helicopter Landing Zone
ATLC	Authentication, Threats, Location, and Condition	ICS	Intercom System
BAM	Bird Avoidance Model	IDMT	Independent Duty Medical Technician
BASH	Bird/wildlife Aircraft Strike Hazard	IFCS	Instrument Flight Control Systems
BAMGIS	Bird Avoidance Model Geographical Information System	IFF	Identify Friend or Foe
CAA	Civil Airspace Authority	IMDS	Integrated Maintenance Data System
Capt	Captain	IO	Investigating Officer
CAT	Crisis Action Team	IP	Initial Point
CFPS	Combat Flight Planning System	IR	Infrared
COMAFRICA	Commander in Chief United States Air Forces in Africa	IRC	Instrument Refresher Course
COMM	Communication	ISB	Interim Safety Board
COMM/NAV	Communication and Navigation	IVHMS	Integrated Vehicle Health Monitoring System
COMUSAFE	Commander in Chief United States Air Forces in Europe	KAL	Korean Airlines
CP	Countermeasure Procedure	KIAS	Knots Indicated Airspeed
CT	Computer Tomography	L	Local Time
DCC	Dedicated Crew Chief	LARS	Lightweight Airborne Recovery System
DDO	Duty Desk Officer	LED	Light-Emitting Diode
DLO	Desired Learning Objective	LH	Left Hand
DO	Director of Operations	LPU	Life Preserver Unit
DOD	Department of Defense	Lt Col	Lieutenant Colonel
DME	Distance Measurement Equipment	LZ	Landing Zone
DNIF	Duties Not Including Flying	MA	Mishap Aircraft
E&E	Electrical and Environmental	MAG	Mishap Aerial Gunner
ELMO	Electronic Linked Mission Overlay	MAJCOM	Major Command
EOD	Explosive Ordnance Disposal	Maj	Major
EOT	Element on Timing	MC	Mishap Crew
ER	Exceptional Release	MCP	Mishap Co-pilot
EUCOM	United States European Command	MDS	Mission Design Series
FCF	Functional Check Flight	MF	Mishap Formation
FE	Flight Engineer	MFE	Mishap Flight Engineer
FOD	Foreign Object Debris	MFR	Memorandum for Record
		MGRS	Military Grid Reference System
		MOA	Military Operating Area
		MOD	Ministry of Defense

MP	Mishap Pilot	SEFE	Standardization and Evaluation
Nav	Navigation		Flight Examiner
NAS	Naval Air Station	SERB	Selective Early Retirement Board
NDI	Non-Destructive Inspection	SIB	Safety Investigation Board
NM	Nautical Miles	[sic]	Said in Context
NOTAMs	Notices to Airmen	SIM	Simulator
NRR	Night Rotary Region	SMA	Special Mission Aviator
NVGs	Night Vision Goggles	SME	Subject Matter Expert
OCF	Operational Check Flight	SOF	Supervisor of Flying
OG	Operations Group	SOP	Standard Operating Procedure
Ops	Operations	SUPT	Specialized Undergraduate Pilot Training
ORM	Operational Risk Management	TAC	Tactical
OTS	Over The Shoulder	TACAN	Tactical Air Navigation System
PA	Public Affairs	TBA	Training Business Area
PAS	Protective Aircraft Shelter	TCTO	Time Compliance Technical Order
PCS	Permanent Change of Station	TDY	Temporary Duty, Yonder
PDU	Panel Display Unit	TFM	Tactical Formation Maneuvering
PJ	Pararescue Jumper	TO	Technical Order
PR	Personnel Recovery	TOLD	Take-Off and Landing Data
QA	Quality Assurance	TTP	Tactics, Techniques, and Procedures
QC	Quality Check	USAFE	United States Air Forces in Europe
RAF	Royal Air Force	UAV	Unmanned Aerial Vehicle
RH	Right Hand	UIF	Unfavorable Information File
RIF	Reduction in Force	UK	United Kingdom
RT	Receiver/Transmitter	U.S.C.	United States Code
RTB	Return-To-Base	Vh	Velocity Horizontal
SA	Situational Awareness	VSI	Vertical Situation Indicator
SAR	Search and Rescue	VVI	Vertical Velocity Indicator
SAS	Stability Augmentation System	WOPS	Weapons Officer
SATCOM	Satellite Communication	Z	Zulu
SAV	Staff Assistance Visit		

The above list was compiled from the Summary of Facts, the Statement of Opinion, the Index of Tabs, and Witness Testimony (Tab V).

## SUMMARY OF FACTS

### 1. AUTHORITY AND PURPOSE

#### a. Authority

On 7 February 2014, Lieutenant General Noel T. Jones, Vice Commander, United States Air Forces in Europe (USAFE), appointed Brigadier General Jon A. Norman to conduct an aircraft accident investigation of a mishap that occurred on 7 January 2014 involving an HH-60G aircraft near Cley next the Sea, Norfolk, United Kingdom (UK). The aircraft accident investigation was conducted in accordance with Air Force Instruction (AFI) 51-503, *Aerospace Accident Investigations*, at Royal Air Force (RAF) Lakenheath, UK, from 21 February 2014 through 23 March 2014. Board members included a Medical Member, Legal Advisor, Human Factors Member, Pilot Member, Recorder, Maintenance Member, Aircrew Flight Equipment Member, and Court Reporter (Tab Y-3).

#### b. Purpose

This board is a legal investigation convened to inquire into the facts surrounding the aircraft accident, to prepare a publicly-releasable report, and to gather and preserve all available evidence for use in litigation, claims, disciplinary actions, administrative proceedings, and for other purposes (Tab BB-102).

### 2. ACCIDENT SUMMARY

On 7 January 2014, at approximately 1805 local time (L), the mishap aircraft (MA), an HH-60G, Tail Number 88-26109, assigned to the 56th Rescue Squadron (56 RQS), 48th Fighter Wing (48 FW), RAF Lakenheath, experienced multiple bird strikes during a training mission and impacted privately-owned, grass-covered marshland near Cley next the Sea, UK (Tabs J-6, Q-11, and CC-23). All four members of the mishap crew (MC) were fatally injured on impact (Tabs N-10, Q-9 to Q-11, DD-3, DD-5, and DD-7). There were no civilian injuries or fatalities (Tab V-1.17, V-3.28, V-4.20, and V-5.10). The MA was destroyed upon impact (Tab S-12). The cost to the United States government is estimated at \$40,302,061 (Tab P-5). Damage to private property consisted of minimal burning to grass at the crash site (Tab V-3.27). Numerous media outlets reported the mishap (Tab OO-3 to OO-9).

### 3. BACKGROUND

The MA belonged to 56 RQS, 48 FW, Third Air Force (3 AF), United States Air Forces in Europe (USAFE) stationed at RAF Lakenheath, UK (Tab K-12).

**a. United States Air Forces in Europe**

USAFE directs air and space operations in Europe and Asia to achieve the objectives of the United States and the North Atlantic Treaty Organization. Its assets stand ready to perform close air support, air interdiction, air defense, in-flight refueling, long-range transport, and support of maritime operations. More than 39,000 active-duty, Reserve, Air National Guard, and civilian employees are assigned to USAFE. USAFE is headquartered at Ramstein Air Base (AB), Germany (Tab CC- 3).



**b. Third Air Force**

Third Air Force is responsible for supporting the strategic objectives of the United States European Command (EUCOM). The commander of 3 AF assumes the role of Joint Forces Air Component Commander and Commander Air Forces when a joint task force is created in EUCOM. Third Air Force consists of its headquarters operations directorate, the 603rd Air and Space Operations Center, and 10 wings, consisting of more than 33,000 personnel. It is located at Ramstein AB, Germany (Tab CC-10).



**c. 48th Fighter Wing**

The mission of 48 FW is to provide responsive combat airpower, support, and services to meet the international objectives of the United States. As USAFE's only F-15 fighter wing, 48 FW provides essential air combat capability to the region. In addition, 48 FW is host to the HH-60G Pave Hawk, which provides combat search and rescue capabilities. The 48th Fighter Wing is located in the UK at RAF Lakenheath, approximately 70 miles northeast of London (Tab CC-11).



**d. 56th Rescue Squadron**

The 56th Resque Squadron provides combat and peacetime personnel recovery and search and rescue capabilities. Its primary mission is to recover downed aircrew and isolated personnel from friendly, denied, hostile, or sensitive areas. Members of 56 RQS deploy to conduct combat search and rescue with dedicated, specially trained aircrews and support personnel in response to theater commander taskings. Aircraft and crew qualifications allow performance of rescue operations during military operations other than war, to include civil search and rescue, aeromedical evacuation, and disaster relief (Tab V-12.7).



### **e. HH-60G Pave Hawk**

The HH-60G Pave Hawk is a twin-engine, medium-lift helicopter (Tab CC-16). Its primary mission is to conduct day or night personnel recovery operations into hostile environments to recover isolated personnel during war (Tab CC-11 and CC-15). The HH-60G is a highly modified version of the Army Black Hawk helicopter and features upgraded communications and navigation systems. All HH-60G helicopters have forward-looking infrared systems that greatly enhance nighttime low-level personnel recovery operations (Tab CC-15). The HH-60G is also tasked to perform military operations other than war, including civil search and rescue, medical evacuation, disaster response, and humanitarian assistance (Tab CC-11 and CC-15).

The standard HH-60G crew is comprised of two pilots and two special mission aviators (SMAs). They fill the pilot, co-pilot, flight engineer, and aerial gunner crew positions. In addition to ensuring safe and effective operations while the helicopter is in the air, after a mission, the pilot ensures all required debriefing is accomplished. The co-pilot assists the pilot with all on-the-ground and in-the-air operations (Tab BB-233.1 to BB-233.2).

The SMA fulfilling the flight engineer duties is the systems expert for the helicopter. Among other things, the flight engineer is responsible for computing the weight and balance of the helicopter prior to flight and ensuring all equipment is aboard and properly secured. During flight, the flight engineer operates the rescue hoist and cargo sling, and monitors aircraft systems for proper performance. The SMA fulfilling the aerial gunner duties is responsible for the inspection, security, and operation of the helicopter's armament, defensive, and radio systems. All four crewmembers visually scan outside the aircraft during flight for threat and obstacle avoidance using overlapping sectors (Tab BB-233.2).



**Figure 1: Two HH-60G Pave Hawk helicopters Fly over Royal Air Force Lakenheath**

## 4. SEQUENCE OF EVENTS

### a. Mission

The MA was the second helicopter in a formation of two HH-60G helicopters during a training mission departing from RAF Lakenheath on 7 January 2014 (Tab K-4 and K-6). The MA followed the flight lead aircraft (FLA) for the duration of the flight. The FLA and the MA comprised the mishap formation (MF). The MA contained two pilots, the mishap pilot (MP) and mishap co-pilot (MCP), and two SMAs, the mishap flight engineer (MFE) and the mishap aerial gunner (MAG), collectively known as the MC. The FLA contained two pilots, the flight lead pilot (FLP) and the flight lead co-pilot (FLCP), and two SMAs, the flight lead flight engineer (FLFE), and the flight lead aerial gunner (FLAG), collectively known as the flight lead crew (FLC) (Tabs K-4, K-6, and BB-233.1 to BB-233.2).

The purpose of the mission was to conduct a training flight to complete the annual checkride for MP (Tab K-12). The checkride required the FLC and MC to perform a nighttime tactical low-level (less than 500 feet above ground level (AGL)) formation, followed by an air-to-ground weapons employment exercise at a nearby range (Tabs K-4, K-12, and V-3.2 to V-3.3). Low-level training at night is essential to prepare HH-60G crews for combat missions (Tab V-3.45 to V-3.46).

The training mission also included a simulated rescue scenario of a downed pilot who had ejected from an F-16 fighter (Tabs K-9 and V-3.5). The requirements of the training mission dictated that the helicopters fly at 100 to 150 feet AGL and approach the rescue location at 110 knots indicated airspeed (KIAS) under cover of darkness to avoid a simulated enemy (Tabs V-18.3, BB-131, and MM-12).

### b. Planning

MP and FLCP developed the mission plan on 6 January 2014 (Tab V-3.4). The plan included takeoff from RAF Lakenheath, orbits at an initial point (IP) south of Blakeney, UK (approximately 36 nautical miles from RAF Lakenheath), and a low-level formation run-in to a pre-defined landing zone (LZ) near Salthouse, UK (approximately 3.54 nautical miles from the IP) (Tab S-16). The planned training mission duration was four hours, with a takeoff time of 1730L and return to RAF Lakenheath at 2130L (see Figure 2 below) (Tab K-4 and K-12).

The 56th Rescue Squadron frequently used the LZ near Salthouse for similar training missions. Because the 7 January 2014 training mission included low-level flying at night, there were limited options for flight routes, given the noise disturbance helicopters cause over populated areas, the necessity to avoid obstacles, and the availability of airspace (Tab V-2.9 and V-4.30).

The mission planning complied with 56 RQS, 48 FW, and Air Force requirements, to include: AFI 11-202, Volume 3, *Flying Operations*, 22 October 2010; AFI 11-202, Volume 3, *Flying Operations*, 22 October 2010 USAFE Supplement, 19 March 2012; AFI 11-2HH60, Volume 3, *Flying Operations*, 5 January 2011; AFI 11-2HH60, Volume 3, *Flying Operations*, 5 January 2011, Royal Air Force Lakenheath Supplement, 31 December 2012; and the United Kingdom

Low Level Flying Handbook, 8 March 2012 (Tab V-3.17, V-4.2, and V-4.30). On 7 January 2014, 56 RQS Assistant Director of Operations properly authorized the mission (Tab K-4).

## **(1) Bird Information**

### **(a) Guidance and Bird Location Information**

The UK Military Low Flying Handbook (UK Handbook) uses the Bird Avoidance Model Geographical Information Service to provide guidance for avoiding bird strikes during low-level flights. The 56th Rescue Squadron complies with the UK Handbook when flying in Night Rotary Region 5 (NRR 5), in accordance with AFI 11-202, Volume 3, *Flying Operations*, 22 October 2010, USAFE Supplement, 19 March 2012 (Tabs V-2.12 to V-2.13 and BB-15.6 to BB-15.9). NRR 5 includes the coastline from Blakeney to beyond Salthouse (Tab NN-9). The UK Handbook advises aircrews to consider the bird avoidance guidance during the flight planning process (Tab NN-8). The handbook further states rotary wing aircraft in NRR 5 should remain below 500 feet AGL to help facilitate tactical landing and airdrop training by other aircraft operating at higher altitudes (Tab NN-9). It also states aircrews should cross coastlines at right angles above 500 feet AGL to avoid bird strikes (Tab NN-8). However, rescue operations above 500 feet AGL did not and do not support mission requirements for tactical rescue operations (Tab V-3.43 to V-3.46).

The 56th Rescue Squadron receives bird activity maps monthly from the United Kingdom Ministry of Defense (MOD). These maps indicate bird hazard areas and code each area by time of day and severity using a low-medium-high hazard scale. The legend defines dusk at one hour before and after sunset (Tab NN-3 and NN-5). The 56th Rescue Squadron posts these maps for aircrew reference during mission planning (Tab V-3.39).

The Norfolk Wildlife Trust (Wildlife Trust) near Cley next the Sea conducts daily bird counts (Tab V-13.8 and V-13.14).

There is no real-time tracking of birds flying over the UK (Tab V-12.4).

### **(b) Blakeney Point Nature Reserve**

The Blakeney Point Nature Reserve (Blakeney Reserve) located next to Blakeney, UK, is host to large flocks of migratory birds (Tab V-13.9). Consequently, the MOD designated the area as avoid by 500 feet vertically or 2 nautical miles horizontally for flying operations (see Figure 2 below) (Tab V-3.40 and NN-9). This restriction was appropriately marked on the maps of the FLC and MC, and the MF did not enter that area (Tab S-15).

A storm surge in early December 2013 caused several flocks of birds to move southeast of the Blakeney Reserve to alternate night roosting locations (Tab V-13.9).

### **(c) Bird Activity**

The December 2013 and January 2014 UK bird activity maps were available to the FLC and MC (Tab PP-7 to PP-8). The December 2013 UK bird activity map indicated an area of moderate

bird activity at dusk to the west of the LZ (Tab NN-3). The January 2014 UK bird activity map indicated an area of low bird activity over Cley Marshes in the Wildlife Trust at the time of the mishap (Tab NN-5). The map legend defines the mishap area as low bird activity at all times, day and night (Tab NN-5). The effective date of the January 2014 UK bird activity map was 7 January 2014, the day of the mishap (Tab PP-7).

The 48th Fighter Wing safety briefing for January 2014 instructed all aircrew to assume a moderate en route (as opposed to airfield) bird hazard condition for the duration of the migration season (Tab PP-5 and V-12.6).

The day prior to the mishap (6 January 2014), the Wildlife Trust counted a flock of approximately 400 various geese, along with other birds. On 7 January 2014, the Wildlife Trust counted zero geese (Tab V-13.13 to V-13.14).

The sunset was 1602L on 7 January 2014—approximately one hour and thirty minutes prior to the scheduled takeoff time. The MF planned to arrive to the LZ at 1756L—almost one hour after the moderate dusk bird hazard warning expired (Tabs F-4, K-10, K-12, NN-3, and NN-5).

## **(2) Roll Call and Crew Mission Briefing**

The FLC and MC attended squadron roll call at 1400L on 7 January 2014 (Tab V-3.17 and V-4.2). The roll call briefing discussed aircraft parking locations, maintenance issues, aircraft configurations, airfield notices, weather, bird watch conditions, and other administrative matters (Tab V-3.4). The bird watch condition at the airfield, separate and apart from the en route condition, was low for 7 January 2014 (Tab PP-3).

After roll call, MP completed an Operational Risk Management (ORM) worksheet (K-19). ORM is a decision-making process to systematically evaluate risks, consider possible courses of action, identify risks and benefits, and determine the best course of action for any given situation (Air Force Pamphlet 90-803, *Risk management Guidelines and Tools*: 11 February 2013, paragraph 1.1). In accordance with the information from the January safety briefing mentioned above, MP identified the bird hazard as moderate and incorporated that hazard condition into the ORM accordingly (Tab K-19).

A detailed crew mission briefing occurred at approximately 1500L (Tab V-3.4 and V-4.2). FLC briefed the details of the training mission to the FLC and MC (Tab V-3.17 and V-4.6).

The mission briefing complied with 56 RQS, 48 FW, and Air Force requirements, and was briefed in accordance with AFI 11-2HH60, Volume 3, *Flying Operations*, 5 January 2011 (Tab V-3.17, V-4.2, and V-4.30).

### **c. Preflight**

Prior to departing 56 RQS for the MA, the MC gathered and inspected their Aircrew Flight Equipment (AFE), finding no irregularities (Tabs R-70 and GG-3). The 56 Rescue Squadron Duty Desk Officer (DDO) briefed FLC and MC on weather updates, airfield conditions, flight authorizations, and changes to aircraft tail numbers (due to normal maintenance updates) (Tab V-

3.9). The Operations Supervisor then approved the planned ORM before the MC left the squadron area for the MA (Tab K-21).

A daytime crew flew the MA prior to the MC's arrival (Tab V-15.13). The MC performed an engine running crew change with the daytime crew (Tab V-15.13). An engine running crew change is a routine procedure where one crew takes the place of another crew while the helicopter engines are still running (Tab V-3.18). The MC met the MA at a previously planned ramp parking location (Tab V-15.13). The daytime crew reported the MA had no issues during the preflight inspection or during flight. The MC then accepted the MA (Tab V-15.13 and V-15.14). The engine running crew change was uneventful (Tab V-4.7 and V-15.13).

#### d. Summary of Accident

Taxi, takeoff, and departure of the MA were uneventful (Tab R-30). The MF departed RAF Lakenheath at 1733L and flew to a reserved training area to separate the MF from other aircraft (Tabs K-25 and V-3.2). Aircrews are required to fly below 500 feet AGL in the training area (Tab V-3.47 and V-3.48). The FLC and MC donned their night vision goggles (NVGs) at takeoff (Tab V-4.14 to V-4.15).

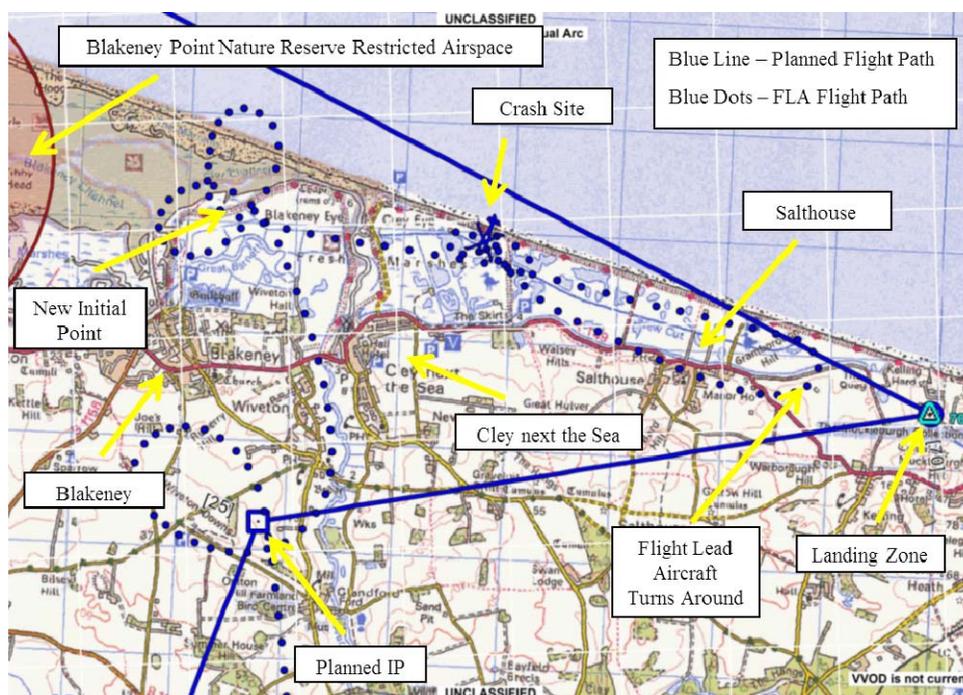


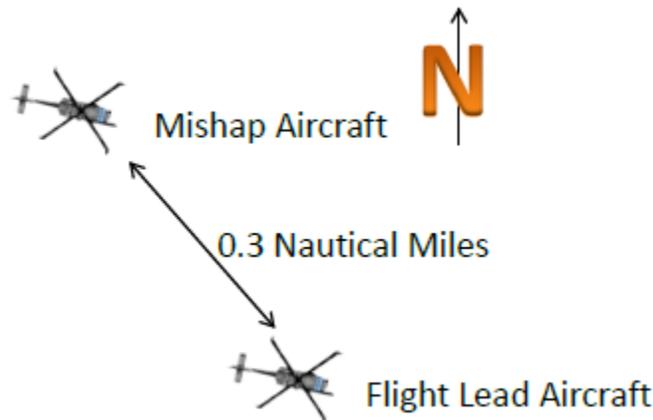
Figure 2: Flight Path of the Flight Lead Aircraft (Tab S-16).

The MF conducted simulated threat countermeasures en route to the IP (Tab S-15). Threat countermeasures are training maneuvers designed to train crews to react to various threats while in flight (Tab V-1.10). An IP is a pre-planned point where a helicopter formation enters a circular pattern, known as an orbit, where the crew conducts threat analysis, verifies the status of a downed pilot, and completes other mission-related tasks prior to picking up the downed pilot (Tab BB-132). The MF completed the simulated threat countermeasures without incident (Tab R-5 and R-30).

The FLA and MA arrived at the planned IP, located approximately one mile south of Blakeney, 27 minutes into flight. The MF executed a left orbit and began verifying the status of the simulated downed pilot in accordance with HH-60G procedures (Tabs R-5, S-15, and BB-132). At the IP, winds came from 210 degrees at 20 knots and gusted to 31 knots (Tab F-7). The wind pushed the MF north toward Blakeney (Tabs R-5 and S-16). To comply with noise abatement procedures and address safety concerns, FLP ordered the MF to move the orbit 1.3 miles north and establish a new IP closer to the coastline (Tabs R-5, S-16, V-3.14, and V-4.12). The new IP stayed clear of the nearby Blakeney Reserve—a known no-fly area—and any known moderate or severe bird hazard areas (Tabs R-5, S-15, V-3.40, NN-3, and NN-5).

The January 2014 UK bird map depicted a low bird hazard for the route between the new IP and LZ near Salthouse (Tab NN-5). The route from the new IP to the LZ crossed over an area known as Cley Marshes in the Wildlife Trust (see Figure 2 above) (Tab S-16).

Once established at the new IP, the formation completed two left orbits (Tab S-16). MP verified the status of the downed pilot (Tab R-5). FLCP announced the rescue plan to be performed at the LZ located approximately 3.5 nautical miles away from the new IP (Tabs S-16 and V-3.27). MP acknowledged the plan (Tab V-3.27). The formation then left the second orbit in an eastward direction, with a heading of 110 degrees (Tab S-16). The MA flew 0.3 nautical miles behind and to the left of the FLA (Tab R-30). Both aircraft flew at an altitude of approximately 110 feet AGL and traveled at 110 KIAS (Tab V-1.11 and MM-12). The FLA and MA were separated by approximately ten seconds (Tabs V-4.15, V-4.16, and MM-12).



**Figure 3: Relative Position of the Mishap Formation after Departure from the Initial Point (Tab V-3.11).**

At some point during the MF's approach to the LZ, a flock of geese took flight from Cley Marshes. The sound of the approaching MF likely startled the geese (Tab V-13.2 to V-13.3). The geese took approximately one minute to reach 110 feet AGL—the altitude of the MA (Tabs V-13.3 and EE-6 to EE-7).

No one from the FLC saw any geese on the way to the LZ (Tab V-3.24 and V-4.16). NVGs have a limited field of view and inherently less than perfect visual acuity (*Fundamentals of Aerospace*

*Medicine*, 4th Edition, Jeffrey R. Davis, Jan Stepanek, Robert Johnson, Jennifer A. Fogarty, Lippincott Williams and Wilkins, Philadelphia, 2008, p. 359). Although NVGs provide better vision at night, it is nevertheless still difficult to see birds (Tab V-3.11, V-3.23 and V-4.14).

Approximately one mile east of the new IP, multiple geese struck the MA (Tabs S-13 and MM-12). At least three geese impacted the MA, destroyed the windscreen, and entered the aircraft (Tabs J-87, J-89, J-90, J-95 to J-98, S-13, and EE-5). One or more of the geese struck MP and MCP with such force that it rendered them unconscious. In addition, at least one goose struck MAG in the performance of SMA duties, rendering MAG unconscious (Tabs X-4 and II-77 to II-82). The MA entered a rapid left roll, descended, and impacted the ground (Tab EE-9 and EE-10).

The types of geese that hit the MA weigh between 6 and 12 pounds (Tabs V-13.4 and II-62). A bird weighing 7.5 pounds would impact with 53 times the kinetic energy of a baseball moving at 100 miles per hour (Tab EE-5). The impact from the geese exceeded the design tolerance of the MA's windscreen (Tabs J-87, J-89, J-90, and S-13). Pieces of the windscreen and remains of geese were found starting approximately 720 feet behind the location where the MA impacted the ground (Tab S-13).

At least one goose struck the nose of the MA, disabling the Trim and Flight Path Stabilization (FPS) systems—two key components of the Automatic Flight Control System (AFCS) (Tab EE-7). The AFCS helps improve aircraft performance by assisting the pilot with aircraft control. It has five subsystems. The Trim and FPS systems provide control positioning and force gradient functions, as well as basic autopilot functions when the FPS is engaged. The force gradient functions cause increasing resistance on the cyclic stick (which controls aircraft pitch and roll) the further the cyclic stick is moved from center (Tab BB-222). Because the impact from the geese rendered MP and MCP unconscious and disabled the Trim and FPS, the cyclic stick was free to move randomly (Tabs V-17.12 to V-17.13 and BB-220). The free-floating cyclic stick fell to the left, inducing a rapid left roll (Tab V-17.17 and V-17.18). Once the MA passed 50 degrees angle of bank, the MA began a descent and continued rolling (Tab BB-133). Simulator testing also showed that the MA could not recover once it passed 50 degrees at 110 feet AGL (Tab EE-9 and EE-10). The MA continued to roll and descend (Tab EE-7).

#### **e. Impact**

The MA impacted the ground at 1805L in Cley Marshes, 2.4 miles west of the LZ (Tabs J-6 and S-16). At the time of impact, the MA had banked left in excess of 90 degrees, where it had no vertical lift and could not maintain altitude (Tab J-6 and V-17.18). The MA hit the ground approximately three seconds after the initial goose strikes (Tab EE-6). The main wreckage dispersed from west to east over approximately 180 feet in the direction of the LZ and along the route of flight (Tab J-8). The crash was not survivable (Tab J-17).

#### **f. Egress and Aircrew Flight Equipment**

At the time of the mishap, all members of the MC wore the HGU-56/P helmet, which provides ear, eye, and head protection (Tabs R-132, R-155 to R-156, R-158 to R-159, V-1.15, V-1.21, V-4.15, V-4.18 to V-4.19, V-5.10, V-12.2, and GG-5 to GG-6). The helmet is designed to

withstand a force of 150 Gs (Tab GG-5 to GG-6). All of the helmets suffered significant cracks in the outer shell (Tabs R-132, R-137 to R-138, and II-77 to II-78). In addition, goose feathers that indicated forceful impact were found on the inside and outside of the helmets of MP, MCP, and MAG (Tabs V-12.2 and II-77 to II-81).

The Combat Integrated Armor Carrier system survival vests worn by HH-60G aircrew provides protection and holds survival equipment (Tabs GG-7 to GG-8 and II-92). MFE's vest and helmet were removed during the course of impact (Tabs R-155, V-1.17, V-5.9, II-77 to II-78, and II-92 to II-97). Goose feathers were found at multiple locations on the vests worn by MP, MCP, and MAG (Tab II-78 to II-81). In addition, goose feathers that indicated forceful impact were found on the right torso region of MCP's aviation coveralls (Tab II-109 to II-110, II-121, II-122, and II-155).

All members of the MC wore battery-powered ANVIS-4949 NVGs mounted to their helmets to amplify ambient light and provide visual illumination for the flight (Tabs R-13, R-55, R-131, R-140 to R-141, V-3.22, and BB-292). The NVG field of view is more limited than the human eye's field of view, and causes a loss of peripheral vision. This loss of peripheral vision limits the ability of the person wearing NVGs to sense motion and attitude cues (Tab HH-4 to HH-5). As shown in Figure 4 below, the NVGs are attached to the helmet and sit immediately in front of the eyes (BB-292).



**Figure 4: ANVIS-4949 Night Vision Goggles Mounted to HGU-56/P Helmet (Front and Side Views) (BB-292).**

All four of the MC's NVGs were destroyed in the mishap (Tabs R-131, R-140 to R-141, V-1.17, V-1.21, V-4.15, V-4.18, and V-5.10).

Analysis of the seats indicated MP and MCP were seated at the time of impact (Tab II-13). MFE and MAG were likely not seated but were secured by restraint belt in their assigned positions, which is consistent with their duties at the time the mishap occurred (Tabs BB-233.1 to BB-233.2 and II-13).

There was no evidence to suggest aircrew flight equipment was a factor in the mishap.

### **g. Search and Rescue**

Almost immediately after the MA impacted the ground, FLAG announced to the FLC that the MA was no longer visible (Tab V-3.27). FLFE confirmed the MA could not be seen on his side of the aircraft (Tab V-3.27). The FLC immediately stopped all training, attempted to contact the MC by radio, and climbed to a safe altitude (Tab V-3.27). When the MC did not respond, the FLC circled back to Cley Marshes where FLAG noticed a small fire (Tab V-3.27).

The FLC acted as the initial emergency responders, circling back to search for the MA at approximately 1806L. The FLC spotted the MA on the ground and landed north of the crash site, approximately 3 minutes and 30 seconds after the crash (which is the time it took for the FLA to circle back to the mishap site) (see Figure 5 below) (Tabs S-16, V-4.17 and EE-4 to EE-5). FLFE and FLAG exited the FLA and began searching for survivors. FLP followed soon thereafter (Tab V-5.9 and V-5.10). FLCP began coordinating with RAF Lakenheath over the radio for emergency support at approximately 1809L (Tab V-3.27). The three crewmembers from FLA quickly found all four members of the MC and determined there were no survivors (Tab V-5.9 and V-5.10). FLC determined the tide would not affect the immediate area of the



**Figure 5: Crash Site (Tab S-12).**

crash site and left the MC in place for investigators (Tab R-7). The investigators covered the MC to protect them from the elements (Tab V-4.18 and JJ-17).

## **h. Recovery of Remains**

The remains of the MC, which were protected from the elements while at the crash site, were taken by UK authorities to the Norfolk Norwich University Hospital on 9 January 2014. The UK authorities transferred the MC to the USAFE Chief of Mortuary Affairs on 11 January 2014 (Tab JJ-18). On 12 January 2014, the 48th Operations Group commander escorted the MC from the UK to the Armed Forces Medical Examiner System, Dover AFB, Delaware, with full military honors (Tabs V-12.3 and JJ-18).

Figure 6 below is a timeline from beginning at takeoff and ending shortly after impact (Tab EE-4 to EE-5).

<b>Composite Time</b>	<b>Summary of Mishap Timeline</b>
1733:33	Takeoff
1800:32	MF arrives at first IP; begins left orbit.
1801:56	Wind pushes MF near populated area. FLP moves IP 1.3 miles north.
1802:38	MF circles at new IP; verifies status of downed pilot.
1804:41	MF initiates run-in. Birds begin liftoff.
1805:13	FLA passes over approximate location of geese.
1805:24	Geese impact MA.
-	Geese render MP, MCP, and MAG unconscious.
-	Goose disables Trim and FPS systems.
-	MA experiences un-commanded left roll and descent.
1805:27	MA impacts ground.
1806:05	FLC unable to contact or see MA; turns around to search.
1809:01	FLA lands north of impact site; FLC check for survivors.

**Figure 6: Summary of Mishap Timeline (Tab EE-4 and EE-5).**

## **5. MAINTENANCE**

### **a. Forms Documentation**

#### **(1) General Definitions**

Air Force maintenance and inspection histories are documented through Air Force Technical Order (AFTO) 781 series forms and the Integrated Maintenance Data System (IMDS). The 781 series forms are maintained in hardcopy by the airframe's unit. In addition to scheduling and documenting routine maintenance actions, these tools allow aircrew to report discrepancies, and maintenance personnel to document actions taken to resolve those discrepancies (Tab BB-154 and BB-200 to BB-205).

AFTO 781 series forms are divided into active forms and inactive forms. The active forms are those currently in use by maintenance personnel to record aircraft inspections, conditions, and

repair actions. The inactive forms consist of historical forms, but the unresolved (open) discrepancies are moved to the active forms for resolution (Tab BB-157 to BB-199).

Time Compliance Technical Orders (TCTOs) are used to process aircraft system changes, such as parts upgrades, which must be accomplished within a specific timeframe, depending on the severity of the issue, as indicated by the TCTO. A TCTO may also direct inspections or adjustments to parts or equipment already installed on the aircraft. The change items are routine maintenance actions involving the removal and replacement of parts at a given interval (e.g. flight hours, engine operating hours, engine cycles, calendar days) (Tab BB-136 to BB-138, BB-140, and BB-141).

## **(2) Documentation Review**

A review of the MA's IMDS information, maintenance logbooks, and active and inactive AFTO 781 series forms did not reveal any issues that were factors in the mishap (Tab FF-3, FF-4, and FF-7). There were no significant recurring maintenance issues with the MA (Tabs V-7.2, V-7.3, V-8.2, V-8.3, V-9.2, V-9.3, V-11.3, V-16.4, FF-3, FF-4, and FF-7).

### **(a) Active Forms**

The physical AFTO 781 forms binder was on the MA at the time of the mishap and was recovered (Tabs D-5, D-16, and FF-3 to FF-4). The most recent forms were reviewed, revealing open discrepancies; however, none of the discrepancies were factors in the mishap (Tabs D-5, D-16, and FF-3 to FF-4).

On 7 January 2014, there were seven open discrepancies in the active AFTO 781 series forms (Tabs D-5 to D-31, FF-3, and FF-4). None of the open discrepancies were factors in the mishap. All inspection items were current, and there were no TCTOs or time change items pending that were relevant to the mishap (Tabs D-5 to D-31 and FF-3 to FF-4).

Maintenance personnel completed the MA's preflight inspection prior to 0200L on 7 January 2014, documenting the inspection in both the physical AFTO 781 series forms and in IMDS (Tabs D-5 to D-16 and FF-3 to FF-4). The preflight remained valid for 72 hours (Tab BB-286). The exceptional release was completed prior to the first flight of the day and indicated the MA had a valid preflight inspection and had been released by maintenance for takeoff and flight operations (Tabs D-5, D-10, V-6.3 to V-6.5, and BB-145).

### **(b) Inactive Forms (Historical)**

The MA's inactive (historical) AFTO 781 series forms had minor documentation errors; however, none of the errors were factors in the mishap (Tab FF-3 and FF-4). The MA's 12-month historical files, including TCTOs, AFTO Form 95s (*Significant Historical Data Form*), major inspection packages, and archived IMDS data, revealed nothing relevant to the mishap (Tab FF-3 and FF-4).

## **b. Inspections**

Maintenance personnel conducted inspections on the MA according to schedule and documented the inspections in accordance with applicable Technical Orders (T.O.s) (Tab FF-3 and FF-4). All inspections were completed satisfactorily (Tab FF-3 and FF-4). At the time of the mishap, there were no past-due inspections (Tab D-11, D-17 to D-31, FF-3, and FF-4).

### **(1) Aircraft Inspections**

Phase inspections are scheduled based on flying hour utilization rates and are accomplished upon accrual of the number of flying hours specified in the T.O. (Tab BB-144 to BB-153 and BB-262 to BB-275). The HH-60G has a 1,200-hour depot inspection cycle, with Phase inspections being conducted after every 600 flight hours logged (Tab BB-262 to BB-275 and BB-278). The MA underwent a routine 1,200-hour depot-level inspection and full overhaul on 12 May 2013 when the MA reached 6,611.9 flying hours (Tabs J-7, FF-3, FF-4, and FF-7). This depot-level inspection and maintenance was performed at Kimhae (also written Gimhae), Korea via a contract with Korean Airlines (KAL) (Tabs J-7, V-8.3, V-16.4, FF-3, FF-4, and FF-7). Several witnesses noted the quality of work performed by KAL was exceptional and a significant improvement to the depot-level maintenance performed by the previous contractor (Tabs V-8.3, V-16.4, FF-3 to FF-4, and FF-7). The MA also underwent 50-hour inspections on 29 August 2013 and 8 November 2013, and a 150-hour inspection on 13 December 2013, with no significant findings (Tab FF-3 and FF-4).

The preflight inspection lasted approximately two hours and was completed at 0200L on 7 January 2014 (Tabs D-5 to D-31, V-9.2 to V-9.5, and V-16.4 to V-16.7, FF-3, and FF-4). The preflight inspection includes fluid servicing, inlet and exhaust inspection, and a complete walk around inspection of the aircraft (Tabs V-16.4, V-16.5 and BB-286 to BB-289). The preflight inspection was valid at the time the MA departed RAF Lakenheath (Tabs D-11, D-17 to D-31, FF-3, and FF-4).

IMDS data confirmed all inspections were accomplished in accordance with applicable maintenance directives (Tabs D-11, D-17 to D-31, FF-3, FF-4, and FF-7).

### **(2) Engine Inspections**

Maintenance personnel visibly inspect the HH-60G engine inlets and exhausts before and after every flight (Tab BB-72 to BB-79, BB-156, BB-236 and BB-290). In addition, the engines are inspected before and after every engine run for maintenance (Tab BB-71 and BB-74 to BB-79). Each engine also requires an inspection every 50 flight hours (Tab BB-280 to BB-283). All engine inspections were current for the MA at the time of the mishap (Tabs D-11, D-17 to D-31, FF-3, and FF-4).

Engine components and modules have limited lifetimes that are tracked in the maintenance records by using engine operating time and cycles (Tabs D-5 to D-31, BB-157 to BB-159, FF-3, and FF-4). The IMDS did not show any modules or components due for time change at the time of the mishap (Tabs D-5 to D-31, FF-3, and FF-4).

### **c. Maintenance Procedures**

All maintenance procedures on the MA were performed in accordance with applicable T.O.s and AFIs (Tabs D-5 to D-36, V-6.2, V-6.3, V-7.5, V-8.5, V-11.5, V-16.5, FF-3 to FF-4, and FF-7).

### **d. Maintenance Personnel and Supervision**

Maintenance procedures are specific to Air Force Specialty Code and consistent with the member's Career Field Education and Training Plan. These procedures require personnel to be trained and qualified on: theory of operations, system schematics, isolation of malfunctions, performance of operational checks, parts removal and installation, and various other general maintenance practices (Tab BB-82 to BB-99). Training and qualifications for maintenance personnel are tracked and monitored electronically in the Training Business Area (TBA) system (Tab BB-94.1 to BB-94.4).

All personnel assigned to the 48th Maintenance Group, RAF Lakenheath, who maintained the MA were trained and qualified (Tab FF-3, FF-4, and FF-7). The training records (i.e., AF Forms 623, *Individual Training Record Folder*, and AF Forms 797, *Job Qualification Standard Continuation/Command JQS*, and TBA equivalents), and special certification rosters (i.e., staff progress records and staff certification records) for all personnel performing maintenance on the MA reflected proper training and full qualifications on all tasks accomplished (Tab FF-3, FF-4, and FF-7). The operations supervision engaged with maintenance leadership on a daily basis and saw no issues with maintenance practices and procedures (Tabs V-3.36, V-6.2, V-6.3, V-10.3, V-10.4, BB-72, and FF-3 to FF-4).

The maintainers of the MA met or exceeded the Combat Air Force (CAF) standards in all inspected areas (Tab FF-3, FF-4 and FF-7). Maintenance leadership provided adequate direction, overview, and supervision of maintenance operations for the 748th Aircraft Maintenance Squadron and 56th Helicopter Maintenance Unit (Tabs V-6.2, V-6.3, V-7.5, V-7.6, V-8.4, V-8.5, V-9.4, V-10.3 to V-10.4, V-11.6, V-16.6, and BB-23 to BB-70). Maintenance of the MA was accomplished in an appropriate environment, with adequate time, tools, and support equipment to accomplish the maintenance actions required to support the mission of 56 RQS (Tab V-6.2, V-6.3, V-7.5, V-7.6, V-8.4, V-8.5, V-9.4, V-10.3 to V-10.4, V-11.6, and V-16.6).

There was no evidence to suggest maintenance personnel or supervision were factors in the mishap. (Tab FF-3)

### **e. Fuel, Hydraulic, and Oil Inspection Analyses**

Following the mishap, fuel samples were taken from the fuel tanks that supplied fuel to the MA (Tabs D-37 to D-41, and FF-3 to FF-4). These samples were tested by the Aerospace Fuels Laboratory, RAF Mildenhall, UK, under an approved waiver to T.O. 42B-1-1, paragraph 5.7 so that the analysis could be conducted overseas (Tabs D-37 to D-41, FF-3, and FF-4). The fuel analysis report shows the fuel used on the MA met specification requirements (Tabs D-37 to D-41, FF-3, and FF-4).

Hydraulic fluid and oil samples taken post-mishap were sent to the Air Force Petroleum Office (AFPET), Wright Patterson Air Force Base, Ohio, for analysis (Tabs D-42 to D-44, and FF-3 to FF-4). The hydraulic fluid and oil analyses reports show the hydraulic fluid and oil used on the MA met specification requirements (Tabs D-42 to D-44, FF-3, and FF-4).

There was no evidence to suggest abnormalities in the fuel, hydraulic fluid, or oil were factors in the mishap. (Tab FF-4)

#### **f. Unscheduled Maintenance**

Review of the 90-day history in IMDS and historical AFTO 781 series forms reflects numerous unscheduled maintenance actions, including repairs and part replacements. Maintenance members completed the corrective actions for all of the unscheduled maintenance items (Tabs V-6.3 to V-6.6, V-7.3 to V-7.6, V-8.3 to V-8.5, V-9.3 to V-9.5, V-10.4, V-11.3 to V-11.8, FF-3, and FF-4).

There was no evidence to suggest unscheduled maintenance was a factor in the mishap. (Tab FF-3 to FF-4)

#### **g. Aircraft Performance**

The MA was an exceptionally well-maintained aircraft (Tab FF-3 to FF-4 and FF-7). Ever since its return from the KAL depot in Korea, the MA had been the “flagship” of the 56 HMU (Tabs V-8.3, V-16.4, FF-3 to FF-4, and FF-7). Following this depot-level maintenance, the mission capability rates for the MA were well above the CAF standards and well above the average mission capacity rates for the HH-60G fleet worldwide (Tab FF-3, FF-4, and FF-7). The MA had no known flight characteristic irregularities, repeat discrepancies, or malfunctions and/or flight characteristic anomalies (Tabs V-3.36, V-7.2, V-7.3, V-8.2, V-8.3, V-9.2, V-9.3, V-11.3, V-15.10, V-16.4, FF-3 to FF-4, and FF-7).

## **6. AIRFRAME SYSTEMS**

### **a. Structures and Systems**

#### **(1) Airframe**

The MA was transferred to U.S. government ownership in October 1988 and was the 14th HH-60G ever delivered to the Air Force (Tab J-7). At the time of the incident, all relevant MA systems were operating properly (Tab J-7). The MA was completely destroyed during the mishap sequence (Tab J-8). The MA impacted the ground in excess of 90 degrees angle of left bank (Tab J-6). With the exception of the fractures due to bird impacts, the majority of the MA damage was secondary to the impact with the ground (Tab J-10). A more detailed description of the below-outlined aircraft systems are found at Tab FF.

## **(2) Rotor System**

The majority of the main rotor blades were recovered from the initial impact area (Tab J-10). A series of varying depth blade scars were noted in the mud, just south of the open water, at the start of the primary impact trail (Tab J-10). The direction of the impacts and soil motion are consistent with the aircraft rolled more than 90 degrees to the left (Tab J-10). The tail rotor system was destroyed by ground impact (Tab J-12). The main and tail rotor heads were examined to evaluate functionality prior to the mishap (Tab J-13). The main rotor head sustained damage consistent with blade impacts while being driven at moderate to high power level and full rotational rotations per minute (RPM) (Tab J-13). There was no evidence to suggest any preexisting anomalies on either the main or tail rotor systems were factors in the mishap (Tab J-14).

## **(3) Engines**

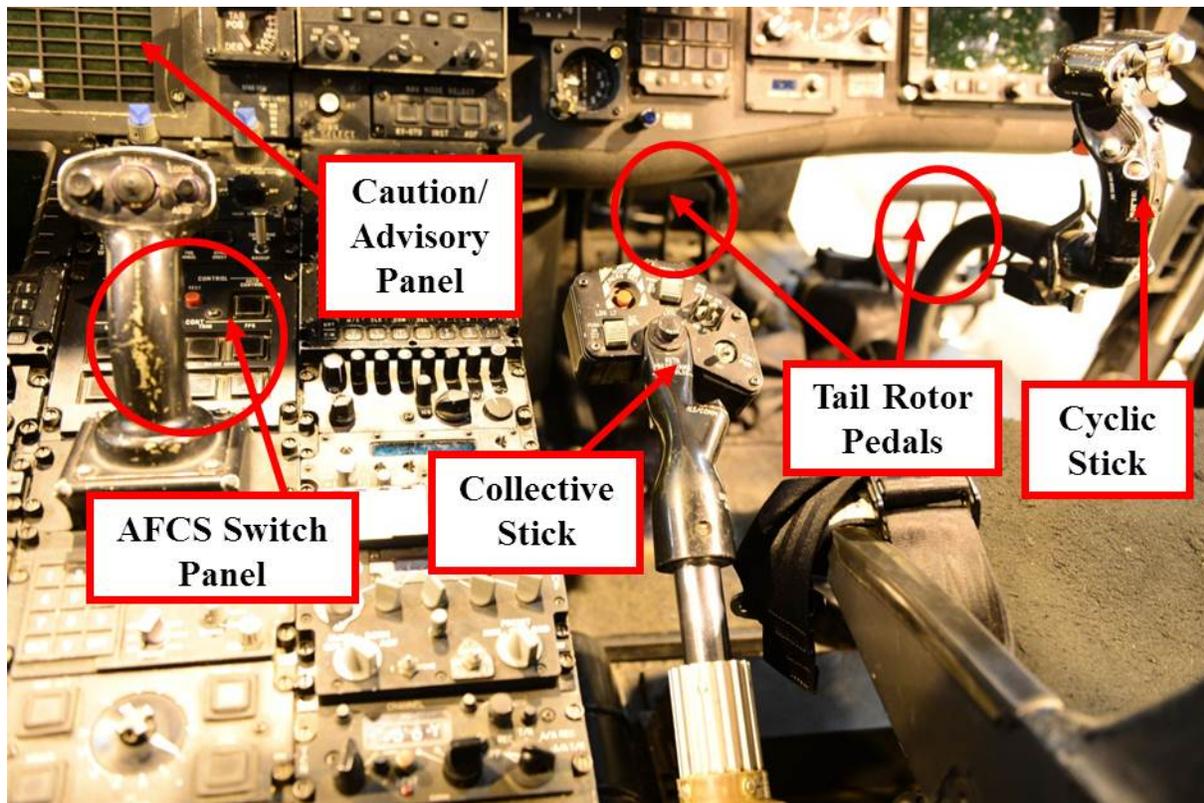
Neither of the engines from the MA exhibited any evidence of in-flight mechanical or structural defects. In addition, there was no evidence to suggest commanded or un-commanded engine shutdown during flight were factors in the mishap (Tab J-19 and J-85). All engine damage is consistent with heavy ground impact while operating (Tab J-16 and J-85). No bird remains were found in either engine (Tab J-16). The engines were rotating and capable of producing power up to the time of impact (Tab J-16 and J-85). No pre-existing anomalies were noted in the propulsion system (Tabs FF-3, FF-4, and J-16)

## **(4) Transmission and Powertrain**

The transmissions and drive shafting were visually inspected after the mishap (Tab J-14). Continuity was verified from the input to the output of the #1 input module (Tab J-14). The #2 input module drove and freewheeled smoothly (Tab J-14). The main module remained intact (Tab J-14). The intermediate and tail gearboxes could be rotated, indicating continuity (Tab J-15).

## **(5) Flight Controls/Hydraulic Systems**

Dual cockpit controls consist of a cyclic stick, collective stick, and tail rotor pedals for the pilot and co-pilot (see Figure 7 below) (Tab BB-220). The HH-60G has a triple redundant hydraulic system which powers the flight controls and associated systems which, in turn, controls the aircraft through the movement of the rotor system components (Tab BB-218).



**Figure 7: Flight Controls in HH-60G Cockpit (FF-16).**

Three primary hydraulic servos are mounted above the cabin area forward of the main gearbox (Tab BB-220 and BB-221). The primary servos, with two independent redundant stages, have only the input linkage in common (Tab BB-221). Should one stage become inoperative due to pressure loss, a bypass valve within the depressurized stage will open to prevent a hydraulic lock of the flight control servos (Tab BB-221 and BB-222). If the input pilot valve to the servos becomes jammed, bypass automatically occurs (Tab BB-222). There was no evidence to suggest hydraulic systems were factors in the mishap.

The Automatic Flight Control System (AFCS) enhances the stability and aircraft handling (Tab BB-222). The AFCS is comprised of five basic subsystems: Stabilator, Stability Augmentation System (SAS-1 and SAS-2), Altitude Hold Hover Stabilization System (AHHS), Trim systems, and Flight Path Stabilization (FPS) (Tab BB-222). The Trim and FPS systems provide control positioning and force gradient functions, as well as basic autopilot functions when FPS is engaged (Tab BB-222). The SAS amplifier uses vertical gyro roll outputs to derive roll attitude and rate for roll SAS commands (Tab BB-224). Loss of power to the vertical gyros or SAS amplifier causes erratic operation of SAS-1 resulting in un-commanded flight control inputs (Tab BB-224). See Figure 8 below for the location of components in the nose of an HH-60G.

The Trim system permits the pilot or copilot to fly the helicopter with light control force (Tab BB-224). When the Trim is engaged, the pitch, roll, and yaw systems are activated to keep the cyclic and tail rotor controls in a fixed position (Tab BB-224). The pilot can override the Trim system by making any control input, but it requires more pressure to be applied to the controls than it would without the Trim system engaged (Tab BB-238 and BB-240). Once pressure is released, the controls return to their previously trimmed positions unless the Trim system is taken offline or repositioned (Tab BB-224). If the Trim and FPS systems are offline, the cyclic can free-float and induce a rapid, un-commanded roll (Tabs V-17.20 to V-17.21 and MM-10 to MM-12). No pre-existing anomalies were noted in the Flight Control Systems (Tab J-16). No problems were noted with the AFCS system before the mishap (Tab J-16).

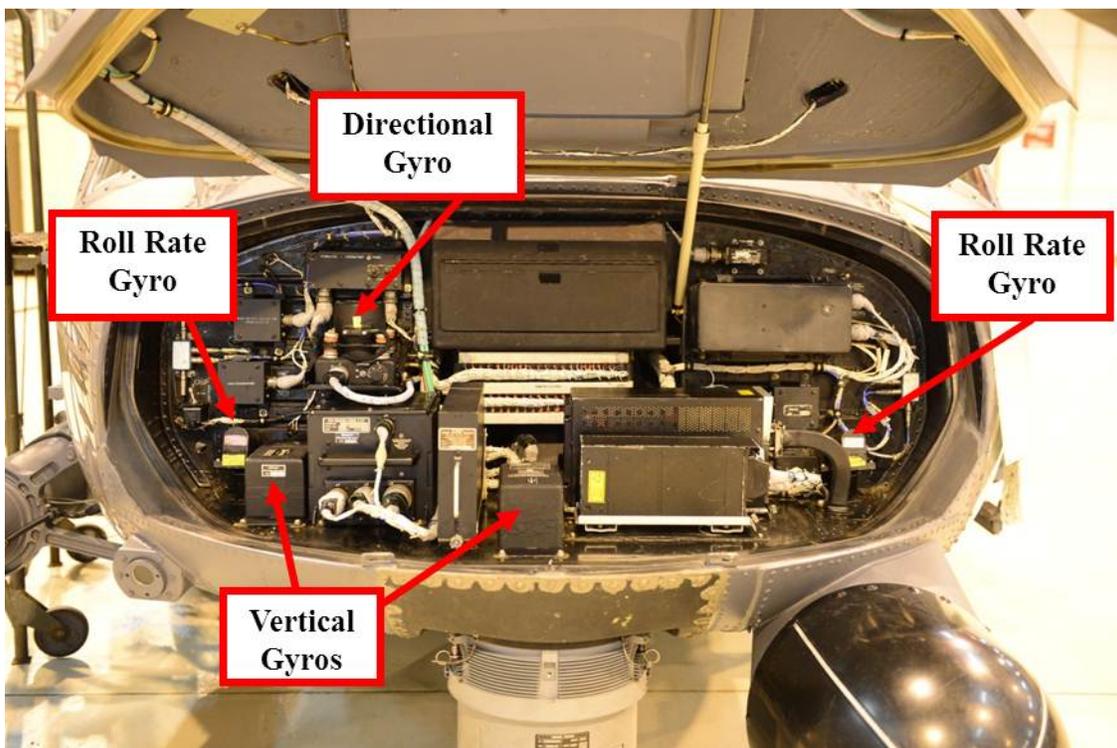


Figure 8: Nose Compartment Avionics (Tab FF-14).

## (6) Other Considerations

Fuel supply, electrical power supply, rotor blade de-ice and related sub-systems were evaluated and analyzed (Tab J-10 to J-14, J-15, and J-104). There was no evidence to suggest these sub-systems were factors in the mishap.

### b. Evaluation and Analysis

#### (1) Integrated Vehicle Health Monitoring System

The Integrated Vehicle Health Monitoring System (IVHMS) is an aircraft mounted maintenance data capturing and recording system (Tab J-82). IVHMS captures in-flight data to assist in the maintenance of the HH-60G helicopter, including the T700 engines, and stores

it for download to a ground based station (Tab J-82). Despite the IVHMS system not being designed to be crash survivable, the MA's IVHMS flight parameter data was recorded, recovered intact, and analyzed post-mishap (Tab J-82 and J-85).

## **(2) Cockpit Voice/Flight Data Recorder**

To complement the IVHMS, an airborne crash survivable recording device was installed on the MA (Tabs V-8.6 to V-8.8, V-11.5, and V-16.6, FF-3, FF-4). The Cockpit Voice/Flight Data Recorder (CVFDR), located inside the Integrated Vehicle Health Monitoring Unit (IVHMU), accommodates mandatory recording of cockpit voice and flight data (Tab BB-232).

## **(3) Analysis**

Analysis was conducted on the IVHMS data (Tabs J-82, and MM-3 to MM-14). The mishap data provided included engine speeds and torques, aircraft speed, and aircraft altitude data (Tabs J-82, and MM-3, MM-6, MM-7, MM-11, MM-12). At the time that the data file ended, the engine speed and torque signals were still consistent with an engine that was rotating and producing torque and applying it to the rotor system resulting in a 100% rotor speed (Tabs J-82, and MM-6, MM-7, MM-14). The Air Force Office of Special Investigation (OSI) conducted an analysis of the CVFDR data from the MA (Tab LL-3). The only recovered intelligible spoken audio tracks were from a maintenance radio check several weeks before the mishap (Tabs LL-3, FF-3, and FF-4). OSI was unable to recover any intelligible data from the MA audio files from the day of the mishap (Tab LL-3).

A certified Air Force Developmental Test Pilot (AFDTP) conducted a thorough ground test of the AFCS and focused particularly on the Trim and FPS systems. The tests verified the impact force from a bird strike to the front of the HH-60G could damage critical components, resulting in the Trim and FPS systems being disabled and taken offline.

An AFCS Switch Panel analysis confirmed the Trim system was off at the time of the mishap (Tab LL-11 and LL-13). The FPS is automatically disabled when the Trim System is disengaged and/or disabled (Tab BB-225). Component analysis indicated all other relevant systems were operating normally at the time of impact (Tab J-4 and J-85).

## **7. WEATHER**

### **a. Forecast Weather**

The forecasted weather at RAF Lakenheath, UK, was a ceiling greater than 10,000 feet mean sea level (MSL), visibility greater than 5,000 meters, and winds from 230 degrees at 15 knots gusting to 25 knots (Tab F-4). The forecast surface temperature was eight degrees Celsius, with a freezing level at 45,000 feet MSL (F-4). The moon illumination forecasted was 49 percent at a 190-degree azimuth (Tab F-4). The End of Effective Nautical Twilight (EENT) forecasted was 1726Z (Tab F-4). The forecasted altimeter setting was 29.67 inches of mercury, and pressure altitude was 264 feet MSL (Tab F-4).

The forecasted weather for the mission training area near the LZ was the same (F-4).

## **b. Observed Weather**

The observed weather at the mishap location at the time of the mishap was reported visibility at 30 kilometers. The temperature was 9.1 degrees Celsius and surface winds were from the southwest (210 degrees) at 20 knots gusting to 31 knots. Moon illumination was 43 percent with a 190 azimuth, and EENT was 1722Z (Tab F-9).

A witness present at the time of the mishap reported, “[t]here were no clouds in the sky. Because [C2 remembered] standing on the Woolsey Hills and identifying the constellations; it was very, very clear. There was a half moon, and [C2] could see everywhere [C2] was going, just by the light of the moon...There was a bit of a breeze.” (Tabs R-172 and V-14.2).

The FLC reported excellent weather conditions for flight, a clear sky and a bright, discernable horizon. There were no changes in weather during the mishap sequence (Tab V-1.10, V-3.21, V-4.14, and V-5.7 to V-5.8).

## **c. Space Environment**

Not applicable.

## **d. Operations**

Flight operations were conducted within the prescribed operational weather limitations for the aircraft systems (Tab BB-12 to BB-13 and BB-16 to BB-17).

## **e. Weather Impacts on Bird Locations**

On 5 December 2013 and 6 December 2013, the area surrounding the Blakeney Reserve experienced an unusual storm surge. Among other things, the storm surge resulted in the growth of vegetation that is undesirable to birds. Much of that storm surge affected the nearby city, as well as the reserve, which forced the birds to find alternate feeding and roosting sites (Tab V-13.9).

# **8. CREW QUALIFICATIONS**

## **a. Mishap Pilot**

MP graduated from the United States Air Force Academy in 2008 and completed Specialized Undergraduate Pilot Training (SUPT) Fort Rucker, Alabama, in 2009. MP earned seven Air Medals and an Air Force Commendation Medal. Prior to MP’s assignment at 56 RQS, MP served at the 41st Rescue Squadron, Moody AFB, Georgia (Tab T-3 to T-4).

MP was a qualified and experienced Mission Pilot in the HH-60G (Tab G-8). MP was current in all Combat Mission Ready (CMR) flight areas, in accordance with AFI 11-2HH-60, Volume 1, *Flying Operations*, 5 January 2011, Table 4.2 (Tab K-23). CMR establishes the minimum training required for aircrew to be qualified and proficient in all of the primary missions tasked to their assigned unit and weapons system (AFI 11-2HH-60, Volume 1, 1.2.5.1). MP completed

the most recent mission qualification checkride in the HH-60G on 7 November 2012 (Tab G-109). MP had 765.6 total flight hours and 547.3 HH-60G flight hours (Tab G-11).

At the time of the mishap, MP's flight times were as follows (see Figure 9 below) (Tab G-12):

	<b>Hours</b>	<b>Sorties</b>
Last 30 Days	9.6	4
Last 60 Days	20.5	9
Last 90 Days	30.5	16

**Figure 9: Mishap Pilot's Flight Times.**

### **b. Mishap Co-pilot**

MCP graduated from Reserve Officer Training Corps at Embry Riddle University in 2005 and completed SUPT, Fort Rucker, Alabama, in 2007. MCP earned seventeen Air Medals, an Air Force Commendation Medal, and an Air Force Achievement Medal. Prior to MCP's assignment at 56 RQS, MCP served at the 41st Rescue Squadron, Moody AFB, Georgia (Tab T-5 to T-6).

MCP was a qualified and experienced Evaluator Pilot in the HH-60G (Tab G-8). MCP was current in all CMR flight areas, in accordance with AFI 11-2HH-60, Volume 1, Table 4.2 (Tab K-23). MCP completed the most recent mission qualification checkride in the HH-60G on 14 May 2013 (Tab G-115). MCP had 1533.6 total flight hours and 1302.5 HH-60G flight hours (Tab G-21).

At the time of the mishap, MCP's flight times were as follows (see Figure 10 below) (Tab G-22):

	<b>Hours</b>	<b>Sorties</b>
Last 30 Days	7.6	8
Last 60 Days	18.4	18
Last 90 Days	43.5	34

**Figure 10: Mishap Co-pilot's Flight Times.**

### **c. Mishap Flight Engineer**

MFE graduated from the Community College of the Air Force in 2007 and the Non-Commissioned Officer Academy in 2013. MFE earned seven Air Medals, two Aerial Achievement Medals, two Air Force Commendation Medals, and two Air Force Achievement Medals. Prior to MFE's assignment at 56 RQS, MFE served at the 512th Rescue Squadron, Kirtland AFB, New Mexico; the 37th Helicopter Squadron, F.E. Warren, AFB, Wyoming; and the 1st Helicopter Squadron, Andrews AFB, Maryland (Tab T-7 to T-8).

MFE was a fully qualified Special Mission Aviator (SMA) in the HH-60G (Tab G-9) and was current in all CMR flight areas, in accordance with AFI 11-2HH-60, Volume 1, Table 4.2 (Tab K-23). MFE completed the most recent mission qualification checkride in the HH-60G on 17 September 2013 (Tab G-123). MFE had 3745.6 total flight hours and 662.5 HH-60G flight hours (Tab G-36).

At the time of the mishap, MFE's flight times were as follows (see Figure 11 below) (Tab G-37):

	<b>Hours</b>	<b>Sorties</b>
Last 30 Days	16.8	12
Last 60 Days	38.2	20
Last 90 Days	62.1	33

**Figure 11: Mishap Flight Engineer's Flight Times.**

#### **d. Mishap Aerial Gunner**

MAG graduated from the Community College of the Air Force in 2007 and completed Airman Leadership School in 2010. MAG earned an Air Force Commendation Medal and an Air Force Achievement Medal. Prior to MAG's assignment at 56 RQS, MAG served at the 66th Rescue Squadron, Nellis AFB, Nevada (Tab T-9 to T-10).

MAG was a partially qualified Special Mission Aviator (SMA) and fully qualified Mission Aerial Gunner in the HH-60G (Tab G-9). MAG was current in all CMR flight areas, in accordance with AFI 11-2HH-60, Volume 1, Table 4.2 (Tab K-23). MAG completed the most recent mission qualification checkride in the HH-60G on 10 October 2013 (Tab G-129). MAG had 359.2 total flight hours and 359.2 HH-60G flight hours (Tab G-49).

At the time of the mishap, MAG's flight times were as follows (see Figure 12 below) (Tab G-50):

	<b>Hours</b>	<b>Sorties</b>
Last 30 Days	22.6	8
Last 60 Days	41.6	17
Last 90 Days	54.3	26

**Figure 12: Mishap Aerial Gunner's Flight Times.**

There is no evidence to suggest crew qualifications were factors in the mishap.

## **9. MEDICAL**

### **a. Qualifications**

The FLC and MC had current Annual Flight Physicals and were medically cleared for flight duty without restrictions at the time of the mishap (Tab X-3 to X-4).

### **b. Health**

All members of MC were in good health, and had no performance-limiting conditions or illnesses prior to the mishap (Tab X-3).

### **c. Pathology**

At the time of the mishap, MP, MCP, and MAG were struck by geese at estimated forces greatly exceeding the known level of human tolerance, immediately rendering them unconscious (Tab EE-5). All members of the MC sustained multiple, rapidly fatal traumatic injuries from blunt force trauma immediately upon impact with the ground (Tab X-4).

Based on an average of 3.4 seconds needed for a human to perceive and cognitively process a sensory input, MFE was likely unaware of the critical nature of the situation (Tab X-4 to X-5).

The toxicology test reports for the MC showed no positive results (Tab X-3). The reports included testing for carbon monoxide, ethanol, amphetamine, barbiturates, benzodiazepines, cannabinoids, cocaine, opiates and phencyclidine (Tab X-3). All FLC and maintenance personnel associated with the mishap provided samples for toxicology testing. All samples were negative (Tab X-4).

There is no evidence to indicate any legal or illegal substances were factors in the mishap (Tab X-3 to X-4).

### **d. Lifestyle**

No lifestyle factors were found to be relevant to the mishap (Tab X-3 to X-4).

### **e. Crew Rest and Crew Duty Time**

Air Force crewmembers must have a minimum of 12-hour non-duty period before the flight duty period begins (Tab BB-19 to BB-20). Aircrew require at least 10 continuous hours of restful activities (including an opportunity for at least 8 hours of uninterrupted sleep) during the 12 hours immediately prior to the flight duty period (Tab BB-20). The purpose of crew rest is to ensure crewmembers are adequately rested before flight or performing flight related duties. Crew rest is free time, and includes time for the crewmember to participate in meals, transportation, or rest, as long as he or she has the opportunity for at least eight hours of uninterrupted sleep (Tab BB-19 to BB-20).

The MC and FLC had adequate opportunity for rest prior to the mishap (Tabs R-17 to R-27, R-39 to R-49, R-58 to R-68, R-77 to R-87, R-190 to R-203, R-207 to R-218, R-221 to R-231, and X-3 to X-4). At the time of the mishap, MC and FLC were well within the 12-hour flight duty period (Tabs X-3 to X-4 and BB-19 to BB-20). There is no evidence to suggest crew rest and duty time requirements were factors in this mishap.

## **10. OPERATIONS AND SUPERVISION**

### **a. Operations**

The 56th Rescue Squadron has a total of 17 assigned and attached mission pilots, 14 of whom are experienced (Tab G-8). To be considered “experienced,” HH-60G mission pilots must have 100 HH-60G flight hours after attaining Mission Pilot qualification, with at least 120 NVG flight

hours, or 50 HH-60G flight hours after attaining Mission Pilot qualification with 120 NVG flight hours if previously qualified in another helicopter (Tab BB-5).

There are a total of five assigned and attached pilots to 56 RQS, three of whom are experienced (Tab G-8). To be considered “experienced,” HH-60G pilots must have 150 HH-60G flight hours after attaining First Pilot or Mission Co-pilot qualification, with at least 75 NVG flight hours, or 100 HH-60G flight hours after attaining First Pilot or Mission Co-pilot qualification with 75 NVG flight hours if previously qualified in another helicopter (Tab BB-5).

The 56th Rescue Squadron has a total of 16 assigned and attached Special Mission Aviators (SMAs), 15 of whom are experienced (Tab G-9). To be considered “experienced,” HH-60G SMAs must have 200 HH-60G flight hours after attaining Mission Flight Engineer or Mission Aerial Gunner qualification, with at least 100 NVG flight hours, or 100 HH-60G flight hours after attaining Mission Flight Engineer or Mission Aerial Gunner qualification with 100 NVG flight hours if previously qualified in another helicopter (Tab BB-5).

Nine of the 17 mission pilots are qualified as instructors, four of those instructors are also qualified as evaluators, and seven of the 16 SMAs are qualified as instructors, five of whom are also qualified as evaluators (Tab G-8 and G-9).

The 56th Rescue Squadron recently returned from a deployment and was conducting post-deployment reconstitution training (Tab V-12.3).

The ORM level of this mission was low (Tab K-19). A score of “low” is the lowest possible ORM category and places the authority to begin the mission with the Operations Supervisor (Tab K-19). Specific items considered in the ORM assessment included: (1) live fire operations, (2) over water flight, (3) moderate bird watch conditions, (4) crew exposure to prolonged cold leading to in-flight fatigue, and (5) the MC’s proficiency (Tab K-20). The Operations Supervisor on duty was experienced and qualified, in accordance with 56 RQS Letter of Certification (Tab G-8).

The operations tempo of 56 RQS at the time of the mishap was high (Tab V-12.2 to V-12.3). The squadron routinely deployed for three months, returned home for six months and then immediately deployed again (Tab V-12.3).

#### **b. Supervision**

The qualified Operations Supervisor reviewed and authorized the mission on the day of the mishap (Tabs G-8 and V-3.9). The Commander had previously reviewed and authorized the week’s flying schedule (Tab V-2.3 to V-2.4). The Director of Operations was present for the crew brief and the flight (Tabs K-25 and V-4.2). The Operations Supervisor briefed the MC immediately prior to the MC’s departure to the MA on 7 January 2014 (Tab V-3.9).

There was no evidence to suggest squadron operations or supervision were factors in the mishap.

## 11. HUMAN FACTORS

### a. Introduction

The following human factors, as prescribed in the Department of Defense Human Factors Analysis and Classification System (DoD HFACS) and delineated in AFI 91-204, *Safety Investigations Reports*, Attachment 6, were factors in the mishap (Tab BB-103 to BB-128). For more in-depth analysis on the human factors considered during the investigation, see Tab HH.

### b. Applicable Factors

***Operational Injury/Illness (PC303)*** is a factor when an injury is sustained or illness develops from the operational environment or during the mission, and the injury or illness results in an unsafe situation (Tab BB-116).

At least three geese struck the MA at 130 knots ground speed with 5,300 foot-pounds of force, breached the windscreen of the MA, and rendered MP and MCP unconscious (Tab EE-5). MP and MCP were injured and thus unable to control the MA, resulting in an unsafe situation (Tabs S-12 and X-3 to X-4).

***Sudden Incapacitation/Unconsciousness (PC304)*** is a factor when the individual has an abrupt loss of functional capacity or conscious awareness (Tab BB-116).

The force of impact from geese immediately rendered MP, MCP, and MAG unconscious (Tabs X-3 to X-4 and II-77 to II-81).

## 12. GOVERNING DIRECTIVES AND PUBLICATIONS

### a. Publicly Available Directives and Publications Relevant to the Mishap

- (1) AFI 11-2HH60, Volume 1, *Flying Operations*, 7 May 2010
- (2) AFI 11-2HH60, Volume 3, *Flying Operations*, 5 January 2011
- (3) AFI 11-2HH60, Volume 3, *Flying Operations*, 5 January 2011, Royal Air Force Lakenheath Supplement, 31 December 2012
- (4) AFI 11-202, Volume 3, *Flying Operations*, 22 October 2010
- (5) AFI 11-202, Volume 3, *Flying Operations*, 22 October 2010, United States Air Forces in Europe Supplement, 19 March 2012
- (6) AFI 21-101, *Aircraft and Equipment Maintenance Management*, 26 July 2010, Incorporating Change 1, 16 August 2011, Combat Air Forces Supplement, 11 July 2012, Royal Air Force Lakenheath Supplement, 6 March 2014

(7) AFI 36-2232, Maintenance Training, 22 February 2006, Incorporating Change 1, 21 June 2010

(8) AFI 51-503, *Aerospace Accident Investigations*, 26 May 2010, Incorporating Change 1, 21 June 2010

(9) AFI 91-204, *Safety Investigations Reports*, 12 February 2014

(10) Air Force Pamphlet 90-803, *Risk management Guidelines and Tools: Special Management*, 11 February 2013

(11) T.O. 00-5-1, *AF Technical Order System*, 15 January 2013

(12) T.O. 00-5-15, *Air Force Time Compliance Technical Order Process*, 1 January 2010

(13) T.O. 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures*, 15 June 2013, 48th Maintenance Group Supplement, 25 June 2013

(14) Title 10 United States Code, Section 1471, *Forensic Pathology Investigations*

(15) United Kingdom Low Level Flying Handbook, 8 March 2012

**NOTICE:** All directives and publications listed above are available digitally on the Air Force Departmental Publishing Office website at <http://www.e-publishing.af.mil> or are otherwise publicly available.

**b. Other Directives and Publications Relevant to the Mishap**

(1) Air Force Tactics, Techniques, and Procedures, 3-3.HH-60-G, *Combat Aircraft Fundamentals*, HH-60G, 28 October 2011

(2) T.O. 1H-60(H)G-1, *USAF Series HH-60G Helicopter, Policies, and Procedures*, 30 June 2009, Incorporating Change 14, 24 June 2013

(3) T.O. 1H-60(H)G-2-1CL-6, *Aircraft Engine Run Checklist*, 1 October 2005, Incorporating Change 1, 1 November 2012

(4) T.O. 1H-60(H)G-2-12-1, *Automatic Flight Controls and Communications Systems Fault Isolation Procedures Manual for HH-60 Series Helicopter*, 15 July 2004, Incorporating Change 15, 15 July 2013

(5) T.O. 1H-60(H)G-2-15, *Airframe and Rotor Systems Vibration Analysis and Balancing Procedures*, 1 November 2012, Incorporating Change 1, 15 May 2013

(6) T.O. 1H-60(H)G-2-15-1, *Integrated Vehicle Health Monitoring System (IVHMS) Conditioned Based Maintenance Manual for HH-60 Series Helicopter*, 15 July 2012

(7) T.O. 1H-60(H)G-5, *Basic Weight Checklist and Loading Data*, 16 August 2002, Incorporating Change 22, 24 June 2013

(8) T.O. 1H-60(H)G-6, *Scheduled Inspection and Maintenance Requirement*, 1 November 2011, Incorporating Change 4, 15 June 2013

(9) T.O. 1H-60(H)G-6WC-2, *Preventive Maintenance Service 600-hour Phase Inspection*, 1 November 2011, Incorporating Change 3, 15 June 2013

(10) T.O. 1H-60(H)G-6WC-3, *Preventive Maintenance Service 50-hour Inspection*, 15 November 2010, Incorporating Change 5, 15 June 2013

(11) T.O. 1H-60(H)G-6WC-6, *Organizational Maintenance Instructions, Preflight, Postflight, and Alert Inspection*, 1 November 2011, Incorporating Change 1, 1 February 2013

(12) T.O. 12S10-2AVS9-2, *Image Intensifier Set, Night Vision, Type AN/AVS-9*, 11 June 2008, Incorporating Change 8, 16 January 2014

### **13. ADDITIONAL AREAS OF CONCERN**

Not applicable

2 May 2014

JON A. NORMAN  
Brigadier General, USAF  
President, Accident Investigation Board

# STATEMENT OF OPINION

## HH-60G, TAIL NUMBER 88-26109 CLEY NEXT THE SEA, NORFOLK, UNITED KINGDOM 7 JANUARY 2014

*Under 10 U.S.C. § 2254(d) the opinion of the accident investigator as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report, if any, may not be considered as evidence in any civil or criminal proceeding arising from the accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements.*

### 1. OPINION SUMMARY

I find by clear and convincing evidence that multiple bird strikes to the mishap aircraft (MA) caused the mishap. At least three geese penetrated the windscreen of the MA and struck the mishap pilot (MP) and mishap co-pilot (MCP), rendering them unconscious and thus unable to control the MA. Additionally, at least one goose impacted the front of the MA, disabling the MA's Trim and Flight Path Stabilization (FPS) systems. The MA banked left to a point where it had no vertical lift. Approximately three seconds after being hit by the geese, the MA impacted the ground, fatally injuring all four members of the mishap crew (MC).

I developed my opinion by analyzing factual data from historical records, Air Force directives and guidance, engineering analysis, witness testimony, flight data, flight simulations, animated simulations, and information provided by technical experts.

### 2. BACKGROUND

The MA, an HH-60G Pave Hawk (Tail Number 88-26109), departed Royal Air Force Lakenheath (RAF), United Kingdom (UK) at 1733L on 7 January 2014. It followed the flight lead aircraft (FLA) for the duration of the flight. The FLA and the MA comprised the mishap formation (MF). The MA contained two pilots, the mishap pilot (MP) and mishap co-pilot (MCP), and two special mission aviators (SMAs), the mishap flight engineer (MFE) and the mishap aerial gunner (MAG), collectively known as the MC. The FLA contained two pilots, the flight lead pilot (FLP) and the flight lead co-pilot (FLCP), and two SMAs, the flight lead flight engineer (FLFE), and the flight lead aerial gunner (FLAG), collectively known as the flight lead crew (FLC). The FLC and MC wore night-vision goggles (NVGs). All members of the FLC and MC were assigned to the 56th Rescue Squadron (56 RQS), RAF Lakenheath.

The purpose of the mission was to conduct a training flight that included a rescue scenario for a downed F-16 pilot and a nighttime tactical low-level formation. The requirements of the training mission dictated the FLA and MA fly at 100 to 150 feet above ground level (AGL) and approach the landing zone (LZ) at 110 KIAS under cover of darkness to avoid a simulated enemy. The training mission included takeoff from RAF Lakenheath, orbits at an initial point (IP) near

Blakeney, UK (approximately 36 nautical miles from RAF Lakenheath), and a low-level formation run-in to the LZ near Salthouse, UK (approximately 3.54 nautical miles from the IP).

The MF arrived to the planned IP at 1800L, conducted a left orbit, and began verifying the status of the simulated downed F-16 pilot. Strong winds pushed the MF toward Blakeney, UK. Concerned about aircraft noise over a populated area, FLP ordered the MF to move eastward around Blakeney to a new IP located along the coastline one mile to the east of Blakeney Point Nature Reserve.

Once established at the new IP, the formation flew two additional orbits and completed all necessary mission tasks. At 1804L, the formation departed the IP heading east along the coastline toward the LZ located approximately 3.5 nautical miles away from the new IP. Both aircraft flew at an altitude of approximately 110 feet AGL and traveled at 110 KIAS. The MA flew 0.3 nautical miles behind and to the left of the FLA. The FLA and MA were separated by approximately ten seconds.

At some point during the MF's approach to the LZ, a flock of geese, likely startled by the approaching helicopters, took flight from Cley Marshes in the Norfolk Wildlife Trust (Wildlife Trust) near Cley next the Sea, UK. The FLC did not see any birds as they passed over Cley Marshes. At 1805L, multiple geese, impacted the MA. At least three geese penetrated the windscreen and struck MP and MCP. At least one goose struck MAG in the performance of SMA duties. Due to the force of impact, MP, MCP, and MAG were immediately rendered unconscious.

In addition, at least one goose struck the front of the MA and disabled the Trim and FPS systems. These systems are key components of the Automatic Flight Control System, which helps performance by assisting the pilot with maneuvering. Without the Trim and FPS systems, and because MP and MCP were unconscious, the cyclic stick (which controls aircraft pitch and roll) moved freely.

Due to a freely moving cyclic, the MA entered a rapid left roll. Once it passed 50 degrees angle of bank, the MA could not maintain altitude and continued to roll. As the MA reached an excess of 90 degrees angle of bank, it had no vertical lift. At 1805L—approximately three seconds after the initial bird strike—the MA impacted the ground, fatally injuring the MC.

### **3. CAUSE**

The MF followed the available guidance on bird hazards in the UK. Further, the MF properly followed the UK Military Low Flying Handbook as required by Air Force flying regulations and guidance. The December 2013 UK bird activity map indicated an area of moderate bird activity active at dusk to the west of the LZ. Dusk was outside of the MF's planned flight times. The January 2014 UK bird activity map indicated an area of low bird activity further to the east over Cley Marshes. The January 2014 48th Fighter Wing safety briefing instructed aircrews to assume a moderate bird hazard condition for the duration of the migration season, unless otherwise briefed. The MF accounted for the risk of bird activity, appropriately documented their assessment, and received approval from 56 RQS leadership to fly the mission. They

complied with all regulations applicable to low-level nighttime rotary wing training and flight. I found no evidence that mission planning or supervision contributed to the mishap.

Another aircrew flew the MA immediately prior to the MC's training mission. No problems were reported from the crew that flew the MA during the day. The MA had recently returned from a depot-level maintenance overhaul in Korea and its mission capability rates were above Combat Air Force standards. The MA had no known flight characteristic irregularities, repeating discrepancies, or malfunctions. The maintainers who serviced the MA were trained in accordance with Air Force standards. I found no evidence that maintenance personnel, maintenance procedures, or pre-existing mechanical issues contributed to the mishap.

All members of the FLC and MC had sufficient experience in the HH-60G to perform the training mission. I found no evidence that the acts or omissions of the MC or the FLC contributed to the mishap.

Although the field of view seen through the NVGs worn by the FLC and MC may have limited the ability to sense motion from the geese, I did not find sufficient evidence to conclude the NVGs caused or substantially contributed to the mishap.

A storm surge in early December 2013 forced several flocks of birds to relocate from the Blakeney Nature Reserve. This relocation likely resulted in a stronger presence of geese in the Wildlife Trust than were either forecast or observed that day. Strong winds near the planned IP forced the MF to move its operations north along the coastline, resulting in a flight path to the LZ that crossed over Cley Marshes in the Wildlife Trust. The noise from the approaching helicopters likely startled a flock of birds, causing the birds to take flight.

The types of geese that impacted the MA range in weight from 6 to 12 pounds. At least three geese penetrated the windscreen of the MA, immediately rendering MP and MCP unconscious. At least one goose struck MAG, in the performance of SMA duties, rendering MAG unconscious. At least one goose struck the nose of the MA, damaging critical components of the MA's Automatic Flight Control System, resulting in loss of control over the MA. Simulator testing showed the MA could not recover once it passed 50 degrees angle of bank at 110 feet AGL. Once the MA reached that point, it did not have sufficient vertical lift to maintain controlled flight.

The mishap sequence occurred instantaneously. The moment from the goose strike to the MA's impact to the ground lasted approximately three seconds. MP, MCP, and MAG were rendered unconscious at the moment of goose impact. Given the rapid sequence of events, MFE was unable to perceive and cognitively processed the mishap. MFE was likely unaware of the critical nature of the situation.

#### **4. CONCLUSION**

I find by clear and convincing evidence that multiple bird strikes caused the mishap by rendering the mishap pilot and mishap co-pilot unconscious and disabling the Trim and Flight Path Stabilization systems.

2 May 2014

JON A. NORMAN  
Brigadier General, USAF  
President, Accident Investigation Board

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