

UNITED STATES AIR FORCE
ABBREVIATED AIRCRAFT ACCIDENT
INVESTIGATION BOARD REPORT



MQ-9A, T/N 10-4090

33RD EXPEDITIONARY SPECIAL OPERATIONS SQUADRON
435TH AIR EXPEDITIONARY WING
INSTALLATION WITHHELD



LOCATION: UNITED STATES AFRICA COMMAND
AREA OF RESPONSIBILITY

DATE OF ACCIDENT: 04 FEBRUARY 2015

BOARD PRESIDENT: LT COL JEREMY L. THIEL

Abbreviated Accident Investigation, conducted pursuant to
Chapter 11 of Air Force Instruction 51-503

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.



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AUG 14 2015

ACTION OF THE CONVENING AUTHORITY

The Report of the Abbreviated Accident Investigation Board, conducted under the provisions of AFI 51-503, that investigated the 4 February 2015 mishap, near United States Africa Command Area of Responsibility, involving an MQ-9A, T/N 10-4090, assigned to the 33rd Expeditionary Special Operations Squadron, 435th Air Expeditionary Wing, complies with applicable regulatory and statutory guidance; on that basis it is approved.

**JERRY D. HARRIS, JR.
Major General, USAF
Vice Commander**

Agile Combat Power

EXECUTIVE SUMMARY
ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION

MQ-9A, T/N 10-4090
AFRICOM AOR
04 February 2015

On 4 February 2015, at approximately 1133 Zulu time (Z), the mishap aircraft (MA), an MQ-9A, tail number 10-4090, assigned to the 33rd Expeditionary Special Operations Squadron, 435th Air Expeditionary Wing, crashed during an intelligence, surveillance, and reconnaissance mission in the United States Africa Command Area of Responsibility. The MA was destroyed upon impact with the water. Loss of government property is valued at \$13,203,658.00. No portion of the MA wreckage was returned to the manufacturer for analysis. No injuries, deaths or damage to private property were reported from the mishap.

Two separate flight crews operated the MA during the mishap flight. The mission control element mishap crew (MC1) consisted of mishap pilot 1 (MP1) and mishap sensor operator 1 (MSO1). The launch and recovery element mishap crew (MC2) consisted of mishap pilot 2 (MP2) and mishap sensor operator 2 (MSO2). A pre-flight inspection of MA maintenance records and inspections was completed without issue.

The MA took off at 0530Z on 4 February 2015 and had an uneventful sortie until approximately 0835Z, when the MA's starter-generator failed. Approximately one minute after the starter-generator failed, MC1 reversed the flight direction of the MA and began its return flight to base. MC1 ran the applicable emergency procedures checklists and restarted the starter-generator shortly thereafter. MC1 turned off several pieces of equipment that used electrical power in an attempt to maximize battery life. At approximately 0914Z, the starter-generator failed for the second time. MC1 tried multiple times to restart the starter-generator but was unsuccessful. All non-essential systems were turned off and MC1 programmed the MA to return to base.

At 1032Z, MC2 gained control of the MA. MP2 reported that the MA's batteries had 24 volts (V) of power remaining when the MA was approximately thirty miles from base. Because of the MA's reduced battery power, MC2 established a holding pattern over international waters in order to assess the situation. While the MA maintained a holding pattern over international waters, the MA's power continued to drop at a rate of .1V every five to ten minutes. Based on the inability to guarantee complete control of the MA during approach and landing, MC2 was ordered by the Joint Forces Air Component Commander to purposefully fly the MA into international waters. At 1133Z, the MA responded to pilot commanded inputs and impacted the water.

The Abbreviated Accident Investigation Board President found by a preponderance of evidence that the cause of this mishap was a starter-generator failure that resulted in the inability of MC2 to safely land the MA.

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
MQ-9A, T/N 10-4090
04 February 2015

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ACRONYMS AND ABBREVIATIONS

1st Lt	First Lieutenant	Ft	Feet
105 ATKS	105th Attack Squadron	HUD	Heads Up Display
12 AF	Twelfth Air Force	GA-ASI	General Atomics Aeronautical Systems Incorporated
17 EAF	Seventeenth Expeditionary Air Force	GCS	Ground Control Station
138 ATKS	138th Attack Squadron	GDT	Ground Data Terminal
174 ATKW	174th Attack Wing	GSMS	Ground Stores Management System
184 ATKS	184th Attack Squadron	IAW	In Accordance With
2Lt/2dLt	Second Lieutenant	IFF	Friend or Foe Identification
3 AF	Third Air Force	ISB	Interim Safety Board
33 ESOS	33rd Expeditionary Special Operations Squadron	ISBIO	Interim Safety Board Investigating Officer
33 SOS	33rd Special Operations Squadron	ISBPM	Interim Safety Board Pilot Member
432 WG	432nd Wing	ISBSO	Interim Safety Board Sensor Operator
432 EOG	432 Expeditionary Operations Group	ISR	Intelligence Surveillance and Reconnaissance
435 AEW	435th Air Expeditionary Wing	IQT	Initial Qualification Training
449 AEG	449th Air Expeditionary Group	JFACC	Joint Forces Air Component Commander
ACC	Air Combat Command	JOC	Joint Operations Center
AEG	Air Expeditionary Group	JOCC	Joint Operations Commander
AF	Air Force	KIAS	Knots Indicated Air Speed
AFAFRICA	Air Forces Africa	KTS	Knots
AFB	Air Force Base	L	Local Time
AFI	Air Force Instruction	LNO	Liaison Officer
AFRICOM	Africa Command	LRE	Launch and Recovery Element
AFSOC	Air Force Special Operations Command	Lt	Lieutenant
AFTO	Air Force Technical Order	Lt Col	Lieutenant Colonel
AGL	Above Ground Level	MA	Mishap Aircraft
AIB	Accident Investigation Board	Maj	Major
AMXS	Aircraft Maintenance	MAJCOM	Major Command
ANG	Air National Guard	MC	Mission Control
AOC	Area of Concern	MCC	Mission Commander
AOR	Area of Responsibility	MC1	Mishap Crew 1
ATKW	Attack Wing	MC2	Mishap Crew 2
Capt	Captain	MCE	Mission Control Element
CCIR	Commander's Critical Information Requirement	METAR	Meteorological Terminal Aviation Routine Weather Report
CENTCOM	Central Command	MIRC	Interact Relay Chat
COA	Course of Action	MP1	Mishap Pilot 1
COCOM	Combatant Command	MP2	Mishap Pilot 2
CJTF HOA	Combined Joint Task Force – Horn of Africa	MSO1	Mishap Sensor Operator 1
CLDJ	Camp Lemonier Djibouti	MSO2	Mishap Sensor Operator 2
DAF	Department of the Air Force	MC1MC	Mishap Crew 1 Mission Commander
DET	Detachment	MOC	Maintenance Operations Center
DoD	Department of Defense	MSgt	Master Sergeant
DDBA	Direct Drive Brushless Alternator	MSL	Mean Sea Level
EGT	Exhaust Gas Temperature	MTS	Multi-Spectral Targeting System
EP	Emergency Procedures	MQT	Mission Qualification Training
EUCOM	European Command	MW1	Mishap Witness 1
ESOS	Expeditionary Special Operations Squadron	MW2	Mishap Witness 2
FCIF	Flight Crew Information File	MW3	Mishap Witness 3
Flt	Flight	NAV	Navigation
FL	Flight Level	NM	Nautical Miles
		NOTAMs	Notices to Airmen

NTS	Negative Torque Sensing	SPMA	Sensor Processor Modem Assembly
NY ANG	New York Air National Guard	SrA	Senior Airman
PRC	Predator Resource Center	SSgt	Staff Sergeant
PEX	Patriot Excalibur	TACON	Tactical Control
OG	Operations Group	TDY	Temporary Duty
Op/Ops	Operation/Operations	TCTO	Time Compliance Technical Order
OP Mission	Operational Mission	T/N	Tail Number
OpSup	Operations Superintendent	TO	Tech Order
Ops Tempo	Operations Tempo	TSgt	Technical Sergeant
PA	Public Affairs	UHF	Ultra High Frequency
ROC	Rehearsal of Concept	U.S.	United States
RPA	Remotely Piloted Aircraft	USAF	United States Air Force
RTB	Return-To-Base	USAFE-AFAFRICA	US Air Forces in Europe- Air Forces Africa
SAR	Synthetic Aperture Radar	V	Volts
SATCOM	Satellite Communications	WOC-D	Wing Operation Center
SIB	Safety Investigation Board	Z	Zulu
SMS	Stores Management System		
SOS	Special Operations Squadron		

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 2 July 2015, Major General Jerry D. Harris Jr., Vice Commander, Air Combat Command (ACC), appointed Lieutenant Colonel Jeremy L. Thiel to conduct an Abbreviated Accident investigation Board to investigate a mishap that occurred on 4 February 2015 involving an MQ-9A, tail number (T/N) 10-4090, in the United States (U.S.) Africa Command (AFRICOM) Area of Responsibility (AOR) (Tabs V-4.1 through V-4.2, Y-2 through Y-3). The Convening Order appointed a Board President, a legal advisor (Captain), and a recorder (Staff Sergeant) (Tab Y-2 through Y-3). The abbreviated accident investigation was conducted in accordance with (IAW) Air Force Instruction (AFI) 51-503, *Aerospace and Ground Accident Investigations*, Chapter 11, at Nellis Air Force Base (AFB), Nevada (NV), from 9 July 2015 through 24 July 2015.

b. Purpose

In accordance with AFI 51-503, *Aerospace and Ground Accident Investigations*, this accident investigation board conducted a legal investigation to inquire into all the facts and circumstances surrounding this Air Force aerospace accident, prepare a publicly releasable report, and obtain and preserve all available evidence for use in litigation, claims, disciplinary action, and adverse administrative action.

2. ACCIDENT SUMMARY

On 4 February 2015, at approximately 1133 Zulu time (Z), the mishap aircraft (MA), an MQ-9A, T/N 10-4090, assigned to the 33rd Expeditionary Special Operations Squadron (33 ESOS), 435th Air Expeditionary Wing (435 AEW), impacted international waters during the launch and recovery phase of an intelligence, surveillance, and reconnaissance (ISR) mission in the AFRICOM AOR (Tabs U-3, R-58, V-2.1, V-4.1 through V-4.2). Two separate flight crews operated the MA during the mishap flight (Tab V-2.1, V-4.1). The mission control element (MCE) mishap crew (MC1) consisted of mishap pilot 1 (MP1) and mishap sensor operator 1 (MSO1), both assigned to the 138th Attack Squadron (138 ATKS), 174th Attack Wing (174 ATKW), New York Air National Guard (NYANG) (Tab V-2.1). MC1 was under Title 10 orders to conduct the mishap mission (Tab V-2.1). The launch and recovery element (LRE) mishap crew (MC2) consisted of mishap pilot 2 (MP2) and mishap sensor operator 2 (MSO2), both assigned to 33 ESOS, 435 AEW, 17th Expeditionary Air Force (17 EAF), United States Air Forces in Europe – Air Forces Africa (USAFE-AFAFRICA) (Tab V-4.2). The impact destroyed the MA and damage to U.S. government property totaled \$13,203,658.00 (Tabs R-58, P-4). There were no fatalities, injuries or damage to civilian property (Tab P-2 through P-3). Only small pieces of debris remained following impact and no portion of the MA wreckage was returned to the manufacturer for analysis (Tabs R-58, U-3).

3. BACKGROUND

The MA belonged to the 432nd Wing (432 WG), Twelfth Air Force (12 AF), ACC, stationed at Creech AFB, NV, but was assigned to 33 ESOS during the mishap mission (Tabs DD-2, V-4.1). At the time of the mishap, MC1 controlled the MA from a Ground Control Station (GCS) owned by the 138 ATKS, 174 ATKW, NYANG (Tab V-2.1) and MC2 controlled the MA from a GCS operated by the 33 ESOS, 435 AEW, 17 EAF, USAFE-AFAFRICA (Tab V-4.1).

a. Air Combat Command

ACC is a major command of the U.S. Air Force and the primary force provider of combat airpower to America's warfighting commands (Tab CC-2). To support global implementation of national security strategy, ACC operates fighter, bomber, reconnaissance, battle-management and electronic-combat aircraft (Tab CC-2). It also provides command, control, communications and intelligence systems, and conducts global information operations (Tab CC-2). As a force provider, ACC organizes, trains, equips and maintains combat-ready forces for rapid deployment and employment while ensuring strategic air defense forces are ready to meet the challenges of peacetime air sovereignty and wartime air defense (Tab CC-2). ACC numbered air forces provide the air component to U.S. Central, Southern and Northern Commands, with Headquarters ACC serving as the air component to Joint Forces Commands (Tab CC-2). ACC also augments forces to U.S. European, Pacific and Strategic Command (Tab CC-2).



b. Twelfth Air Force

12 AF has the warfighting responsibility for U.S. Southern Command as well as the U.S. Air Forces Southern (Tab CC-4). It is responsible for the readiness of nine active duty wings and one direct reporting unit (Tab CC-4). 12 AF's subordinate commands operate more than 600 aircraft with more than 55,000 uniformed and civilian Airmen (Tab CC-4). The command is also responsible for the operational readiness of 17 Twelfth Air Force-gained wings and other units in the Air Force Reserve and Air National Guard (Tab CC-4). As one of four numbered air forces assigned to ACC, 12 AF's mission is to enable combat-ready forces for rapid global employment; and receive, command and control, and employ joint air component assets to meet U.S. strategic objectives in the U.S. Southern Command area of responsibility, across the full spectrum of operations (Tab CC-4).



c. 432nd Wing

Following a period of inactivity, the 432 WG returned to active service in May 2007 at Creech AFB, NV (Tab CC-6). The 432 WG consists of combat-ready Airmen who fly MQ-1 Predator and MQ-9 Reaper remotely piloted aircraft in direct support to the joint forces war fighter (Tab CC-6). The "Hunters" also conduct remotely piloted aircraft initial qualification training for aircrew, intelligence, weather, and maintenance personnel (Tab CC-6).



d. Air National Guard

The Air National Guard (ANG) has both a federal and state mission (Tab CC-8). The federal mission is to maintain well-trained units available for prompt mobilization during war and provide assistance during national emergencies such as natural disasters or civil disturbances (Tab CC-8). When ANG units are not mobilized or under federal control, they report to the governor of their respective state, territory, or the commanding general of the District of Columbia National Guard (Tab CC-8).



e. 174th Attack Wing

The 174 ATKW is a unit of the NYANG located in Syracuse, New York (NY), adjacent to Hancock International Airport (Tab CC-15). The wing has both a federal and state mission (Tab CC-15). The federal mission is to provide qualified Airmen and weapon systems engaging in global air, space, and cyberspace operations, as well as support homeland defense and joint operations (Tab CC-15). The state mission is to support civil authorities at the direction of the Governor in times of crisis (Tab CC-15). The 174 ATKW flies the state-of-the-art MQ-9 Reaper (Tab CC-15).



f. 138th Attack Squadron

The 138 ATKS is a unit of the NYANG 174 ATKW located at Hancock Field ANG Base, Syracuse, NY (Tab CC-16). On 9 September 2012, the 138th Fighter Squadron was renamed the 138 ATKS (Tab CC-16). As a component of the 174 ATKW, 138 ATKS has assisted the federal mission by conducting 24-hour, 7-day a week Combat Air Patrols with the MQ-9 Reaper in support of Operation Enduring Freedom (Tab CC-17).



g. United States Air Forces in Europe – Air Forces Africa

USAFE-AFAFRICA is a major command of the U.S. Air Force and serves as the air component for two Department of Defense unified commands (Tab CC-18). USAFE-AFAFRICA executes missions with forward-based airpower and infrastructure to conduct and enable theater and global operations (Tab CC-18). USAFE-AFAFRICA directs air operations in a theater spanning three continents, covering more than 15 million square miles, containing 104 independent states, and possessing more than one-fifth of the world's population and more than a quarter of the world's gross domestic product (Tab CC-18).



h. Third Air Force and Seventeenth Expeditionary Air Force

In 1985, for the first time ever, 17th Air Force (17 AF) brought together all European-based electronic warfare aircraft under a single command before later being inactivated in 1996 (Tab CC-21). Following a period of inactivity, 17 AF was reactivated at Ramstein Air Base on 1 October 2008, to serve as the air component for the newly established combatant



command, AFRICOM (Tab CC-21). On 20 April 2012, 17 AF was integrated with 3rd Air Force (3 AF) and became the 17 EAF (Tab CC-21 through CC-22). Based at Ramstein Air Base, Germany, 3 AF and 17 EAF direct all USAFE-AFAFRICA forces engaged in contingency and wartime operations in the U.S. European Command and AFRICOM AOR (Tab CC-22). Today, along with its headquarters operations directorate, 17 EAF and 3 AF are comprised of ten wings, two groups and the 603rd Air and Space Operations Center (Tab CC-22).

i. 435th Air Expeditionary Wing

As a component of the 435th Air Ground Operations Wing, 435 AEW specializes in establishing expeditionary airfields on demand (Tab CC-23). In 2009, the wing converted from an air base support mission to a theater-wide, expeditionary operations and support mission that focuses on contingency response and air-ground operations (Tab CC-27).



j. 449th Air Expeditionary Group

As a USAFE-AFAFRICA forward operating location, the 449th Air Expeditionary Group provides combat search and rescue for the Combine Joint Task Force, Horn of Africa (Tab CC-20). It is comprised of HC-130P Hercules from the 81st Expeditionary Rescue Squadron, and para-rescuemen from the 82nd Expeditionary Rescue Squadron (Tab CC-20).



k. 33rd Special Operations Squadron

The 33rd Special Operations Squadron (SOS) became an active component of the 27th Operations Wing on 31 July 2009 (Tab CC-28). The squadron was formed in direct response to combat needs of today's overseas contingency operations (Tab CC-28). The 33 SOS is assigned to Cannon AFB, New Mexico (Tab CC-28).



l. MQ-9A Reaper

The MQ-9 Reaper is an armed, multi-mission, medium-altitude, long-endurance remotely piloted aircraft that is employed primarily as an intelligence-collection asset and secondarily against dynamic execution targets (Tab CC-30). Given its significant loiter time, wide-range sensors, multi-mode communications suite, and precision weapons -- it provides a unique capability to perform strike, coordination, and reconnaissance against high-value, fleeting, and time-sensitive targets (Tab CC-30). Reapers can also perform the following missions and tasks: intelligence, surveillance, reconnaissance, close air support, combat search and rescue, precision strike, buddy-laser, convoy/raid overwatch, route clearance, target development, and terminal air guidance (Tab CC-30). The MQ-9's capabilities make it uniquely qualified to conduct irregular warfare operations in support of combatant commander objectives (Tab CC-30).



4. SEQUENCE OF EVENTS

a. Mission

The purpose of MC1's 4 February 2015 MQ-9A mission was to conduct ISR operations in the AFRICOM AOR (Tab V-2.1, V-4.1). The ANG members of MC1 were on Title 10 orders and received flight orders to conduct their segment of the mission (Tab V-2.1). The mission was authorized via the daily Air Tasking Order published by the 603d Air and Space Operations Center under the authority of the Joint Forces Air Component Commander (JFACC) (Tab V-4.1).

b. Planning

MC1's mission planning was adequate and consisted of standard mission briefing procedures and briefing guides developed by their unit (Tab V-2.1). MC1's briefing was supervised by the mishap crew 1 mission commander (MC1MC) (Tab V-2.1). MC1's crew briefings included a changeover brief with previous crew members, a review of applicable weather forecasts, aircraft status, and any applicable Notices to Airmen (Tab V-2.1). MC2 used standard mission briefing procedures for LRE operations (Tab V-4.1).

c. Preflight

After MC1 completed mission planning and briefing, MC1 accomplished final preflight paperwork and checked currencies (i.e., "stepped to the GCS to take control of the MA") IAW squadron standards (Tab V-2.1). MC1 consisted of MP1 and MSO1 (Tab V-2.1).

A pre-flight inspection of MA maintenance records and inspections was completed and no discrepancies with the MA were noted (Tab V-2.1). In addition, MC1 verified with GCS maintenance that the GCS was cleared and ready for use on the day of the mishap (Tab V-2.1 through V-2.2). MC1 ran their pre-flight checklist and entered the GCS to assume control of the MA (Tab V-2.1).

Prior to receiving the MA from MC1, MC2 completed all required preflight mission planning and briefings before preparing to take control of the MA (Tab V-4.1). MC2 consisted of MP2 and MSO2 (Tab V-4.1).

d. Summary of Accident

The MA took off at 0530Z on 4 February 2015 without incident from its base (Tabs K-2, R-5). MC1 gained control of the MA and had an unremarkable sortie until approximately 0819Z, when the MA's starter-generator exhaust air temperature began to increase and the GCS registered a "battery leaking current" warning (Tabs R-22 through R-23, V-2.2, U-4). At approximately 0835Z, the MA's generator failed (Tab R-22). Approximately one minute after the starter-generator failed, MC1 aborted the mission and began their return flight to base (Tab U-4). MC1 ran the most current version of the emergency procedures electronic technical order and restarted the starter-generator approximately three minutes later (Tabs R-22, U-3, V-2.2 through V-2.3).

MC1 declared an in-flight emergency, increased the MA's altitude, and max performed the aircraft by increasing its maximum airspeed within operational limits (Tab R-22 through R-23). MC1 began load shedding (i.e., the flight crew shut down several non-essential aircraft systems that used electrical power) in an attempt to maximize battery life (Tabs R-23, V-2.2). MC1 also programmed an Operational Mission (OP Mission) profile to ensure the MA returned to base with the least amount of battery consumption in the event that the starter-generator failed again (Tabs R-23, V-2.2). At approximately 0914Z, the starter-generator failed for the second time (Tab R-23). MC1 tried multiple times to restart the starter-generator but was unsuccessful (Tabs V-2.2, U-5). After the starter-generator's second failure, the MA was approximately two hours from base (Tab V-2.2). MC1 shut down all non-essential systems and activated the MA's OP Mission (Tabs R-42, V-2.2).

At 1032Z, MC2 gained control of the MA (Tab R-58). MP2 reported that the MA's batteries had 24 volts (V) of power remaining when the MA was approximately thirty miles from base (Tab V-4.1). The MA's landing gear was up at this point and lowering the landing gear could further deplete the battery (Tab V-4.1). Because of the MA's reduced battery power, MC2 established a holding pattern over international waters in order to assess the situation (Tabs R-58, V-3.1, V-4.2). While the MA maintained a holding pattern over international waters, the MA's power continued to drop at a rate of .1V every five to ten minutes (Tab V-4.2). With only battery power remaining, MC2 was unable to guarantee control of the MA during approach and landing because every control input could further deplete battery power (Tab R-63 through R-64). Based on the inability to guarantee complete control of the MA during approach and landing, MC2, with concurrence by the JFACC, was ordered at approximately 1105Z to purposefully fly the MA into international waters (Tabs R-58, V-4.2).

e. Impact

After receiving orders to purposefully fly the MA into international waters, MP2 input a modified OP Mission into the GCS computer system that set the intended flying altitude to zero feet, which would ensure the MA would impact the water (Tab V-3.1, V-4.2). As the MA descended, the aircraft lost power and the flight control servers froze (Tab V-3.1 through V-3.2). Another ISR asset in the area observed the last moments of the mishap flight and confirmed the MA was unable to maintain altitude and impacted international waters at approximately 1133Z (Tabs R-6, R-58, V-3.1 through V-3.2, V-4.2).

f. Egress and Aircrew Flight Equipment (AFE)

Not applicable.

g. Search and Rescue (SAR)

Not applicable.

h. Recovery of Remains

Not applicable.

5. MAINTENANCE

a. Forms Documentation

A production superintendent from the 432d Aircraft Maintenance Squadron reviewed the Integrated Maintenance Data System and Air Force Technical Order (AFTO) 781-series forms for the MA and found no relevant discrepancies during his review (Tab U-20). Furthermore, a review of the MA's maintenance records indicated that there were no overdue MA Time Compliance Technical Orders, time change items, or special inspections that would have prevented the MA from flying on the day of the mishap (Tab U-20). In addition to the production superintendent's review, a maintainer assigned to the MA signed the Exceptional Release on 2 February 2015 to certify the active forms were reviewed, confirming the MA was safe for flight on the day of the mishap (Tab D-3).

b. Inspections

MA records indicated the mishap starter-generator was upgraded in April/May 2014 and had been overhauled seven times since it was installed (Tab U-7). Prior to the mishap flight, the mishap starter-generator had 908 hours of operation time since its previous overhaul (Tab U-7). On 20 January 2015, a 200 Hour Engine inspection was conducted and no discrepancies were identified (Tab D-2). The MA's AFTO Form 781H indicated the aircraft was inspected two days prior to the mishap and cleared for subsequent missions (Tab D-3). MC1 also reviewed all inspection documentation prior to assuming control of the MA and no discrepancies were identified (Tab V-2.1).

c. Maintenance Procedures

All maintenance procedures were properly conducted IAW all applicable technical orders and guidance (Tabs U-20, V-2.1 through V-2.2, V-4.1).

d. Maintenance Personnel and Supervision

According to the forms review, all preflight maintenance for the MA was properly performed prior to the mishap flight (Tab U-20). Maintenance personnel assigned to the MA were properly trained and had adequate supervision prior to the mishap (Tab V-4.1).

e. Fuel, Hydraulic, and Oil Inspection Analyses

According to the MA's AFTO Form 781H and MP1's testimony, the MA's fluid levels were adequate to conduct the mishap mission (Tabs D-4, V-2.1). Due to the destruction of the MA, post-mishap fluid analysis was not conducted nor provided (Tab D-2, U-3).

f. Unscheduled Maintenance

The MA did not undergo any unscheduled maintenance (Tabs U-21, V-2.2).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

Only small pieces of debris remained following impact and no portion of the MA wreckage was returned to the manufacturer for analysis (Tabs R-58, U-3).

b. Evaluation and Analysis

(1) Starter-generator

The MA's starter-generator is manufactured by Skurka Aerospace, Inc. (Skurka) (Tab U-8). The starter-generator is the primary source of in-flight energy for the MQ-9A (Tab V-4.2). In the event of starter-generator failure, flight crew can continue to operate the aircraft only if there is additional battery power remaining (Tab V-4.2). MQ-9A batteries cannot be charged during flight (Tab V-4.2). When battery voltage drops below 22V, the aircraft can become unstable and unreliable during flight (Tab V-3.1, V-4.2).

Analysts from General Atomics Aeronautical System Incorporated (GA-ASI) analyzed the data loggers for the mishap flight (Tab U-3 through U-7). Approximately sixteen minutes before the first loss of starter-generator current, generator exhaust air temperature began to increase and voltage measurements became increasingly erratic (Tab U-4). Shortly thereafter, the MA experienced a loss of starter-generator current (i.e., the starter-generator failed to generate electricity) (Tab U-3 through U-4). Approximately three minutes after the first starter-generator failure, the generator restarted (Tab U-3). The MA's starter-generator produced current for the next 41 minutes, but then failed again and was not successfully restarted at any point before the mishap (Tab U-3).

Aircraft records indicated the mishap starter-generator was upgraded in April/May 2014 and had been overhauled seven times since it was installed (Tab U-7). Prior to the mishap flight, the mishap starter-generator had 908 hours of operation time since its previous overhaul (Tab U-7). GA-ASI analysts indicated the MA's erratic voltage measurements and increasing generator-exhaust air temperature development several minutes before the first starter-generator failure was consistent with previous starter-generator failures experienced in other aircraft (Tab U-3).

7. WEATHER

a. Forecast Weather

The forecast for the MA's operational area consisted of unlimited visibility, with no significant weather issues (Tab F-2). In addition, clouds were scattered at 4000 feet (ft) Above Ground Level (AGL) with no thunderstorms, icing, or precipitation forecast for the day (Tab F-2).

b. Observed Weather

The weather at the time of the mishap was reported as winds at 7 knots (kts), gusting to 15 kts, with easterly winds (Tab F-3). In addition, there was unlimited visibility with few clouds at 3200 ft AGL (Tab F-3).

The weather post-mishap was reported as unlimited visibility with 5 kts, gusting to 16 kts, with variable wind direction (Tab F-3). There was unlimited visibility with few clouds at 2800 ft AGL (Tab F-3).

c. Space Environment

Not applicable.

d. Operations

The MA was operated within its prescribed weather limitations (Tab V-2.1 through V-2.2, V-3.1).

8. CREW QUALIFICATIONS

a. Mishap Pilot 1

MP1 received flight authorization to conduct the mission and was current and qualified on the MQ-9A at the time of the mishap (Tab V-2.1). MP1 had 62.5 hours of MQ-9A simulator time and 154.2 hours of total MQ-9A flying time (Tab G-5).

Recent flight and simulator time is as follows (Tab G-9 through G-10):

	Flt Hours	Flt Sorties	Sim Hours	Sim Sorties
Last 30 Days	11.9	4	1.0	1
Last 60 Days	13.9	5	2.0	2
Last 90 Days	18.4	7	6.0	5

b. Mishap Sensor Operator 1

MSO1 received flight authorization to conduct the mission and was current and qualified on the MQ-9A at the time of the mishap (Tab V-2.1). MSO1 had 65.8 hours of MQ-9A simulator time, 2.0 hours of MQ-9A instructor time, and 264.4 hours of total MQ-9A flying time (Tab G-28).

Recent flight and simulator time is as follows (Tab G-30 through G-35):

	Flt Hours	Flt Sorties	Sim Hours	Sim Sorties
Last 30 Days	26.7	10	6.0	4
Last 60 Days	26.7	10	6.0	4
Last 90 Days	41.2	17	17.3	9

c. Mishap Pilot 2

MP2 was current and qualified on the MQ-9A at the time of the mishap (Tabs K-3, V-3.1). MP2 had 136.6 hours of MQ-9A simulator time, 1.0 hours of instructor time, and 983.2 hours of total MQ-9A flying time (Tab G-17).

Recent flight and simulator time is as follows (Tab G-18, Tab G-20 through G-24):

	Flt Hours	Flt Sorties	Sim Hours	Sim Sorties
Last 30 Days	10.0	17	0	0
Last 60 Days	25.5	38	0	0
Last 90 Days	28.9	47	0	0

d. Mishap Sensor Operator 2

MSO2 was current and qualified on the MQ-9A at the time of the mishap (Tabs K-3, V-3.1). MSO2 had 100.3 hours of MQ-9A simulator time and 2489.5 hours of total MQ-9A flying time (Tab G-42).

Recent flight and simulator time is as follows (Tab G-43):

	Flt Hours	Flt Sorties	Sim Hours	Sim Sorties
Last 30 Days	13.6	24	0	0
Last 60 Days	26.7	43	0	0
Last 90 Days	36.3	58	0	0

9. MEDICAL

a. Qualifications

At the time of the mishap, the MC1 and MC2 were medically qualified for flight duty at the time of the mishap and had current annual flight physical examinations on record (Tabs G-7, G-19, G-32, G-44, K-3).

b. Health

A review of the 72-Hour and 14-Day History forms for MC1MC, MP1, and MSO1 indicate they were in good health and had no duty or performance limiting conditions or illness (Tab R-8 through R-19, R-28 through R-39, R-44 through R-55). There is no evidence to suggest health factors were a factor in the mishap (Tab R-8 through R-19, R-28 through R-39, R-44 through R-55).

c. Pathology

Not applicable.

d. Lifestyle

There is no evidence to suggest lifestyle factors were a factor in the mishap.

e. Crew Rest and Crew Duty Time

Aircrew members must have proper rest, as defined in AFI 11-202, Volume (V) 3, *General Flight rules*, (ACC Supplement), dated 28 November 2012, prior to performing in-flight duties (Tab BB-3). AFI 11-202 V3 defines normal crew rest as a minimum of 12-hour non-duty period before the designated flight duty period begins, during which time an aircrew member may participate in meals, transportation, or rest (Tab BB-3).

MC1 and MC2 met all requirements for crew rest and were within their respective crew duty days at the time of the mishap (Tab V-2.1, V-3.1).

10. OPERATIONS AND SUPERVISION

a. Operations

MC1 and MC2 indicated the operations tempo for their respective units was normal and sustainable at the time of the mishap for ISR operations (Tab V-2.1, V-3.1).

b. Supervision

MC1 was supervised by the MC1MC during the mission brief and throughout the first segment of the mishap mission (Tabs R-4, V-2.1). Once MC2 gained the MA from MC1, supervision was elevated to the group level for the remainder of the mishap flight and command decisions related to aircraft disposition were made by the JFACC. (Tabs R-58, R-61 through R-63, V-4.2).

11. HUMAN FACTORS

Not applicable.

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

- (1) AFI 11-202, Volume 3, *General Flight Rules (ACC Supplement)*, 28 November 2012
- (2) AFI 51-503, *Aerospace Accident Investigations*, 14 April 2015
- (3) AFI 91-204, *Safety Investigations and Reports*, 12 February 2014, Corrective Actions Applied on 10 April 2014

b. Other Directives and Publications Relevant to the Mishap

- (1) T.O. 1Q-9(M) A-6WC-1, Preflight, Thruflight, Basic Postflight, Combined Basic Postflight/Preflight Inspection Requirements, 08 June 2015
- (2) T.O. 1Q-9(M) A-6WC-2, Aircraft Periodic Inspections and Maintenance Requirements, MQ-9A Remotely Piloted Aircraft, 1 April 2013
- (3) T.O. 1Q-9(M)A-1, Flight Manual MQ-9A Aircraft, 9 Jan 2014, Change 2, 1 Dec 2014

24 JULY 2015

JEREMY L. THIEL, Lt Col, USAF
President, Abbreviated Accident
Investigation Board

STATEMENT OF OPINION

**MQ-9A, T/N 10-4090
AFRICOM AOR
04 FEBRUARY 2015**

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

On 4 February 2015, at approximately 1133 Zulu time (Z), the mishap aircraft (MA), an MQ-9A, tail number 10-4090, assigned to the 33rd Expeditionary Special Operations Squadron, 435th Air Expeditionary Wing, crashed during an intelligence, surveillance, and reconnaissance mission in the United States Africa Command Area of Responsibility. The MA was destroyed upon impact with the water. Loss of government property is valued at \$13,203,658.00. Only small pieces of debris remained following impact and no portion of the MA wreckage was returned to the manufacturer for analysis. No injuries, deaths or damage to private property were reported from the mishap.

Two separate flight crews operated the MA during the mishap flight. The mission control element mishap crew (MC1) consisted of mishap pilot 1 (MP1) and mishap sensor operator 1 (MSO1). The launch and recovery element (LRE) mishap crew (MC2) consisted of mishap pilot 2 (MP2) and mishap sensor operator 2 (MSO2). A pre-flight inspection of MA maintenance records and inspections was completed and no issues with the MA were noted. In addition, MC1 verified with Ground Control Station (GCS) maintenance that the GCS was cleared and ready for use on the day of the mishap.

The MA took off at 0530Z on 4 February 2015 without incident from its base. MC1 gained control of the MA from the LRE and had an uneventful sortie until approximately 0819Z, when the MA's generator-exhaust air temperature began to increase and the GCS registered a "battery leaking current" warning. At approximately 0835Z, the MA's starter-generator failed. Approximately one minute after the starter-generator failed, MC1 reversed the flight direction of the MA and began its return flight to base. MC1 ran the applicable emergency procedures checklists and restarted the starter-generator approximately 3 minutes later.

MC1 declared an in-flight emergency, increased the MA's altitude, and max performed the aircraft by increasing its maximum airspeed within operational limits. MC1 turned off several pieces of equipment that used electrical power in an attempt to maximize battery life. MC1 also programmed an Operational Mission (OP Mission) profile to ensure the MA could return to base with the least amount of battery consumption in the event that the starter-generator failed again. At approximately 0914Z, the starter-generator failed for the second time. MC1 tried multiple

times to restart the starter-generator but was unsuccessful. All non-essential systems were turned off and the MA was sent on its OP Mission to return to base.

At 1032Z, MC2 gained control of the MA. Because of the MA's reduced battery power, MC2 established a holding pattern for the MA in order to assess the MA's condition. MC2 was unable to guarantee control of the MA during approach and landing, because with only battery power remaining, every control input could further deplete the battery. Because MC2 lacked the ability to guarantee complete control of the MA during approach and landing, MC2, with concurrence by the Joint Forces Air Component Commander, was ordered to purposefully fly the MA into international waters at 1105Z. After receiving orders to intentionally fly the MA into international waters, MP2 input a modified OP Mission into the GCS computer system that set the intended flying altitude to zero feet, which would ensure the MA would impact the water. The MA responded to pilot commanded inputs and began to descend. During the descent, the MA lost electrical power and the flight control servers froze, resulting in the MA impacting the water at 1133Z.

I find by a preponderance of the evidence that the cause of the mishap was a starter-generator failure that resulted in the inability of MC2 to safely land the MA.

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

2. CAUSE

I find by a preponderance of the evidence that the cause of the mishap was a starter-generator failure that resulted in the inability MC2 to safely land the MA.

During the mishap flight, the MA experienced increased air temperature in the generator exhaust and the starter-generator failed. Although MC1 successfully restarted the starter-generator after the first failure, the generator subsequently failed a second time and MC1 was unsuccessful in restarting the generator for the remainder of the mishap flight. As a result of losing starter-generator power, the MA was forced to return to base using only battery power. MC1 and MC2 correctly followed the applicable in-flight emergency checklists and attempted to reduce the amount of energy being consumed by the MA's batteries by load shedding (i.e., the flight crew shut down several non-essential aircraft systems that used electrical power in an effort to save power). By the time MC2 gained control over the aircraft and flew the MA to within thirty miles of base, battery voltage was hovering around 24 volts. At this point in time, the MA's landing gear was up and lowering the gear would have further depleted battery power prior to an attempted landing. When an MQ-9A's power level drops below 22 volts, the aircraft can become unstable and unreliable during flight.

MC1 and MC2 acted in accordance with all applicable technical orders in use at the time of the mishap. MC1 declared an in-flight emergency and executed a return to base after discovering the first indications of a starter-generator failure. When the starter-generator failed for the second time, MC1 attempted to restart the starter-generator numerous times by utilizing the emergency

procedure electronic checklists available at the time. Once the starter-generator was lost batteries were the MA's only remaining source of electrical power. Even with the red electrical demand on the batteries, there was not enough power remaining to ensure the could safely land.

Analysts from General Atomics-Aeronautical Systems Incorporated (GA-ASI) analyzed the loggers from the mishap flight. Datalog analysis indicated the MA experienced erratic vol measurements and increasing generator exhaust temperature developing several minutes before the first failure. This sequence was consistent with previous starter-generator failures. Once the starter-generator failed for the second time, the MA lacked the power necessary to safely land and MC2 was required to purposefully fly the MA into international waters rather than attempting to land with unreliable electrical power.

Based on the datalogs, the failure history of MQ-9A starter-generators, and MC1 and MC2's inability to successfully restart the starter-generator, I find by preponderance of the evidence that the internal starter-generator failure caused the mishap. Had the starter-generator remained operational during the mishap mission, it is highly likely the mishap would not have occurred.

3. CONCLUSION

I find by preponderance of evidence that the cause of the mishap was a starter-generator failure that resulted in the inability of MC2 to safely land the MA.

24 JULY 2015

JEREMY L. THIEL, Lt Col, USAF
President, Abbreviated Accident
Investigation Board

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