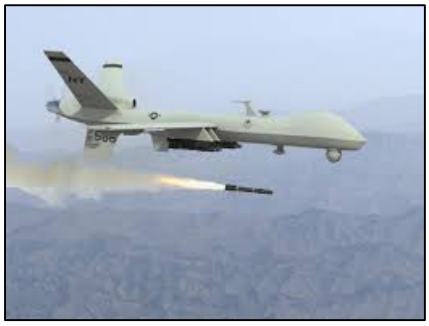
UNITED STATES AIR FORCE
ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

MQ-9A, T/N 11-4138

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



LOCATION: UNITED STATES AFRICA COMMAND AREA OF RESPONSIBILITY

DATE OF ACCIDENT: 05 MAY 2015

BOARD PRESIDENT: LT COL ERIC N. SCHULZE

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.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR COMBAT COMMAND
JOINT BASE LANGLEY-EUSTIS VA

OFFICE OF THE VICE COMMANDER
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27 MAY 2016

ACTION OF THE CONVENING AUTHORITY

The Report of the Accident Investigation Board, conducted under the provisions of AFI 51-503, that investigated the 5 May 2015 mishap, in the United States Africa Command Area of Responsibility, involving an MQ-9A, T/N 11-4138, assigned to the 432nd Wing, Creech Air Force Base, Nevada, complies with applicable regulatory and statutory guidance; on that basis it is approved.

//Signed//

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

EXECUTIVE SUMMARY
ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION

MQ-9A, T/N 11-4138
AFRICOM AOR
05 May 2015

On 5 May 2015, at approximately 0134 Local (4 May 2016 at 2234 Zulu (Z)), the mishap aircraft (MA), an MQ-9A, tail number 11-4138, assigned to the 432d Wing, Creech Air Force Base (AFB), Nevada (NV) and operated by the 33rd Expeditionary Special Operations Squadron, 435th Air Ground Operations Wing, veered off the runway after landing and crashed after conducting an intelligence, surveillance, and reconnaissance mission in the United States Africa Command Area of Responsibility. The MA sustained extensive damage and the wreckage was recovered. The damage to U.S. government property totaled approximately $6,703,852.06. There were no fatalities, injuries or damage to civilian property.

Two separate flight crews operated the MA during the launch and recovery of the mishap flight. The recovery mishap crew (MC1) consisted of mishap pilot 1 (MP1) and mishap sensor operator 1 (MSO1). The launch mishap crew (MC2) consisted of mishap pilot 2 (MP2) and mishap sensor operator 2 (MSO2). All crews were current and qualified. All MA and Ground Control Station (GCS) maintenance records and inspections were completed and reviewed.

At approximately 0415Z on 4 May 2015, MC2 conducted an uneventful launch of the MA. At the end of the mission, the Mission Operations Supervisor completed a handover with MC1 to take control of the MA. At 2141Z, MC1 noticed they had a nosewheel steering problem while conducting normal control checks during the descent to the deployed airfield. MP1 noticed after the control check that the nosewheel was frozen left at approximately 12 degrees from center. MC1 reviewed the emergency procedures section of their technical orders, noting that it did not cover a procedure for landing with the nosewheel frozen off-center. After troubleshooting, MC1 and maintenance concluded that the nosewheel servo had failed and was unfixable while airborne.

MP1 landed MA at 2234Z on the main landing gear while holding the nosewheel off the runway in order to reduce airspeed before the nosewheel touched down. Approximately 3000 feet down the runway, the nosewheel touched down and the MA veered left towards the runway edge. MP1 immediately applied full right rudder and right brake to maintain runway heading, but MA continued off veer off the runway. The MA departed the runway and came to rest approximately 20 yards from the runway edge, damaging the airframe and equipment.

The Abbreviated Accident Investigation Board President found by a preponderance of evidence that the cause of this mishap was a failed nosewheel servo driver that resulted in the inability of MC1 to safely maintain runway heading after landing.

SUMMARY OF FACTS AND STATEMENT OF OPINION
MQ-9A, T/N 11-4138
05 May 2015

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

1 Lt/1st Lt	First Lieutenant
2 Lt/2nd Lt	Second Lieutenant
12 AF	12th Air Force
12 SOS	12th Special Operations Squadron
17 EAF	17th Expeditionary Air Force
33 ESOS	33rd Expeditionary Special Operations
432 WG	432nd Wing
435 AGOW	435th Air Ground Operations Wing
449 AEG	449th Air expeditionary Group
A1C	Airman First Class
AAIB	Abbreviated Aircraft Investigation Board
ACC	Air Combat Command
AES CC	Air Expeditionary Squadron Commander
AES DO	Air Expeditionary Director of Operations
AFOM	Airfield Management Operations Member
AFB	Air Force Base
AFI	Air Force Instruction
AF	Air Force
AFRICOM	Africa Command
AFSEC	Air Force Safety Center
AFTO	Air Force Technical Order
ATC	Air Traffic Controller
AOR	Area of Responsibility
AWBS	Aircraft Weight and Balance Form
Capt	Captain
CC	Commander
CEFM 1	Civil Engineering Flight Member 1
CEFM 2	Civil Engineering Flight Member 2
DoD	Department of Defense
FES	Field Engineer Senior
Flt	Flight
GA	General Atomics
GA-ASI	General Atomics Aeronautical Systems International
GCS	Ground Control Station
HMU	Hot Mockup
IAW	In Accordance With
ISB BP	Interim Safety Board President
ISB HFC	Interim Safety Board Human Factors Consultant
ISB IO 1	Interim Safety Board Investigating Officer 1
ISB IO 2	Interim Safety Board Investigating Officer 2
ISB IO 3	Interim Safety Board Investigating Officer 3
ISB IO 4	Interim Safety Board Investigating Officer 4
ISR	Intelligence, Surveillance, and Reconnaissance
ISB MXP	Interim Safety Board Maintenance member
ISB PM 1	Interim Safety Board Pilot Member 1
ISB PM 2	Interim Safety Board Pilot Member 2
Kts	Knots
MA	Mishap Aircraft
MAJCOM	Major Command
Maj	Major
MC 1	Recovery Mishap Crew
MC 2	Launch Mishap Crew
MMCC	Mishap Mission Commander
MMX 1	Maintenance Member 1
MMX 2	Maintenance Member 2
MMX 3	Maintenance Member 3
MOS	Mishap Operations Supervisor
MOSFET	Metal-Oxide semiconductor Field Effect Transistor
MP 1	Mishap Pilot 1
MP 2	Mishap Pilot 2
MSO 1	Mishap Sensor Operator 1
MSO 2	Mishap Sensor Operator 2
MSgt	Master Sergeant
NOTAMs	Notices to Airmen
NV	Nevada
ORM	Operational Risk Management
RPA	Remotely Piloted Aircraft
SFM	Security Forces member
SIBAFSEC	Safety Investigation Board AFSEC Member
SIB	Safety Investigation Board
SIBBP	Safety Investigation Board President
SIBIO	Safety Investigation Board Investigating Officer
SIBPM	Safety Investigation Board Pilot Member
SIBMXM	Safety Investigation Board Maintenance Member
SIBMM	Safety Investigation Board Medical Member
SIBR	Safety Investigation Board Recorder
Sim	Simulator
SIPR	Secure Internet Protocol Reuter
SO 1	Sensor Operator 1
SO 2	Sensor Operator 2
SrA	Senior Airman
SSgt	Staff Sergeant
SMSgt	Senior Master Sergeant
TCTO	Time Compliance Technical Order
T/N	Tail Number
TO	Technical Order
TSgt	Technical Sergeant
U.S.	United States

USAFE-AFAFRICA	United States Air Forces in Europe – Air Forces Africa
Z	Zulu Time

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 4 April 2016, Major General Jerry D. Harris Jr., Vice Commander, Air Combat Command (ACC), appointed Lieutenant Colonel Eric N. Schulze to conduct an Abbreviated Accident Investigation Board to investigate a mishap that occurred on 5 May 2015 involving an MQ-9A, tail number (T/N) 11-4138, in the United States (U.S.) Africa Command (AFRICOM) Area of Responsibility (AOR) (Tabs Y-3 to Y-4). The Convening Order appointed a Board President, a legal advisor (Major), and a recorder (Senior Airman) (Tabs Y-3 to Y-4). 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 11 April 2016 through 26 April 2016 (Tabs Y-3 to Y-4).

b. Purpose

In accordance with AFI 51-503, this accident investigation board conducted a legal investigation to inquire into all the facts and circumstances surrounding this Air Force ground 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 5 May 2015, at approximately 0134 Local (4 May 2016 at 2234 Zulu (Z)), an MQ-9A, T/N 11-4138, assigned to the 432d Wing, Creech AFB, NV and operated by the 33rd Expeditionary Special Operations Squadron (33 ESOS), 435th Air Ground Operations Wing (435 AGOW), 17th Expeditionary Air Force (17 EAF), United States Air Forces in Europe – Air Forces Africa (USAFE-AFAFRICA), veered off of the runway and crashed during the recovery phase of an intelligence, surveillance, and reconnaissance (ISR) mission in the AFRICOM AOR (Tabs K-2, R-3 to R-4, R-35, R-88 to R-89, R-91 to R-92, R-101, V-1.1, V-3.1, V-4.1, V-5.1 and V-6.1). Two separate flight crews operated the MA during the mishap flight launch and recovery (Tabs R-3 to R-4, V-1.1, and V-3.1). The recovery mishap crew (MC1) consisted of mishap pilot 1 (MP1) and a mishap sensor operator (MSO1). Both were assigned to the 33rd ESOS (Tabs R-3 to R-4, R-35, R-88 to R-89, R-91 to R-92, R-101, V-1.1, V-5.1 and V-6.1) The launch mishap crew (MC2) consisted of mishap pilot 2 (MP2) and mishap senor operator 2 who were both assigned to the 33 ESOS (Tabs V-3.1, V-4.1). Damage to U.S. government property totaled $6,703,852.06 (Tab P-4). There were no fatalities, injuries or damage to civilian property (Tabs P-2 to P-3). The MA was returned to Creech AFB, NV, and five pieces of the MA wreckage were returned to the manufacturer for analysis (Tab Q-2).

3. BACKGROUND

The MA belonged to the 432nd Wing (432 WG), Twelfth Air Force (12 AF), ACC, stationed at Creech AFB, NV, but was operated by deployed aircrew of the 33 ESOS, 435 AEW, 17 AEF, USAFE-AFARICA during the mishap mission (Tab Q-5, R-3 to R-4, R-18, V-1.1, V-2.1, V-3.1, V-4.1).

a. Air Combat Command

Air Combat Command is the primary force provider of combat airpower to America's warfighting commands (Tab CC-3). To support global implementation of national security strategy, ACC operates fighter, bomber, reconnaissance, battle-management and electronic-combat aircraft (Tab CC-3). It also provides command, control, communications and intelligence systems, and conducts global information operations (Tab CC-3).

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-3). 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-3). ACC also augments forces to U.S. European, Pacific and Strategic Command (Tab CC-3).

b. Twelfth Air Force

12th AF 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 across the full spectrum of operations (Tab CC-9). It is responsible for the readiness of seven active duty wings and one direct reporting unit (Tab CC-9). 12th AF's subordinate commands operate more than 360 aircraft with more than 20,300 uniformed and civilian Airmen (Tab CC-9). 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-9). As the air and space component to U.S. Southern Command, Air Forces Southern conduct security cooperation and provide air, space and cyberspace capabilities throughout Latin America and the Caribbean (Tab CC-9).

c. 432nd Wing

The 432nd Wing and 432nd Air Expeditionary Wing "Hunters" consist of combat-ready Airmen who fly MQ-1 Predator and MQ-9 Reaper remotely piloted aircraft (RPA) in direct support to the joint forces war fighter (Tab CC-15). The RPA systems provide real-time intelligence, surveillance and reconnaissance, and precision attack against fixed and time-critical targets (Tab CC-15). The "Hunters" also conduct RPA initial qualification training for aircrew, intelligence, weather, and maintenance personnel (Tab CC-15).

d. 12th Special Operations Squadron

The mission of the 12th Special Operations Squadron is to launch and recover RPA operationally employed by the 2d, 3d and 33d Special Operations Squadrons (Tab CC-18). To avoid the inherent delay in transmitting commands through satellite communications to RPAs from distant stations, the squadron deploys to locations where it can operate the craft for takeoff and landing using line of sight signals (Tab CC-18). This minimizes risk during critical flight operations, while permitting mission operations to be performed from more remote secure locations (Tab CC-18).

e. United States Africa Command

United States Africa Command, (AFRICOM) is one of six of the U.S. Defense Department's geographic combatant commands and is responsible to the Secretary of Defense for military relations with African nations, the African Union, and African regional security organizations (Tab CC-21). A full-spectrum combatant command, U.S. AFRICOM is responsible for all U.S. Department of Defense operations, exercises, and security cooperation on the African continent, its island nations, and surrounding waters (Tab CC-21). AFRICOM began initial operations on Oct. 1, 2007, and officially became an independent command on Oct. 1, 2008 (Tab CC-21).

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

As the air component for both United States Air Forces in Europe (EUCOM) and U.S. Africa Command, USAFE-AFAFRICA executes the Air Force, EUCOM and AFRICOM missions with forward-based airpower and infrastructure to conduct and enable theater and global operations (Tab CC-23). 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-23).

g. Third Air Force and Seventeenth Expeditionary Air Force

3d Air Force (3 AF) and 17th Expeditionary Air Force (17 EAF) is USAFE-AFAFRICA's component numbered air force for EUCOM and AFRICOM (Tab CC-25). Based at Ramstein Air Base, Germany, 3 AF and 17 EAF directs all USAFE-AFAFRICA forces engaged in contingency and wartime operations in the EUCOM and AFRICOM areas of responsibility (Tab CC-25). Along with its headquarters operations directorate, the command is comprised of 10 wings, two groups, and the 603rd Air Operations Center (Tab CC-25).

h. 435th Air Ground Operations Wing

The 435th Air Ground Operations Wing has five mission areas: Expeditionary Airfields on Demand, Joint Airpower Integration, Multi-theater Operational Support and Sustainment, Premier Specialty Training, and Building Partnership Capacity. (Tab CC-26). The 435th AGOW consists of over 1,400 personnel divided into three groups and nine squadrons with 11 geographically separated units located across 8 sites (Tab CC-26).

i. 33rd Expeditionary 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).

j. 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).

k. Lockheed Martin Logistics and Sustainment

Lockheed Martin logistics and sustainment solutions deliver performance reliability and support the full life cycle of our customers' platforms and products, ensuring relevant capabilities at the lowest total cost (Tab CC-35).

4. SEQUENCE OF EVENTS

a. Mission

The purpose of the MA mission on 04 May 2015 was to conduct ISR operations in support of AFRICOM operations (Tab K-2). The mission was authorized via a Crew Flight Authorization, under the authority of the 33 ESOS Supervisor (Tab K-2).

b. Planning

MC1 and MC2's mission planning, individual crew briefs and handover were in accordance with standard briefing guides and executed without deviations (Tabs V-1.1, V-3.1, V-4.1 and V-5.1). Squadron leadership was not present for the briefs, but did sign the crew flight authorizations prior to each flight (Tab V-3.1).

c. Preflight

MC1 and MC2 completed reviewing mission planning documents and individual crew briefings in accordance with squadron flying standards (Tab V-3.1). Pre-flight inspections of MA maintenance records were completed and no discrepancies were noted (Tabs D-3 to D-21, R-67, V-3.1 and V-4.1). In addition, MC1 and MC2 verified with GCS maintenance that the GCS was cleared and ready for use on the day of the mishap (Tabs D-3 to D-21, V-1.1, V-3.1, and V-4.1). MC1 ran their handover with Mishap Operations Supervisor (MOS) and entered the GCS to assume control of the MA (Tabs R-3 to R-4, V-1.1, and V-6.1).

d. Summary of Accident

At approximately 0415Z on 4 May 2015, MC2 was responsible for the launch of the MA (Tabs U-2, V-3.1 and V-4.1). There were no noted anomalies during pre-flight, taxi and takeoff (Tabs R-67, V-3.1, and V-4.1). MC1 reported to the GCS and conducted one or two uneventful landings prior to the approach of the MA (Tab V-1.1). MC1 received control of the MA without incident and the MA approached the deployed airfield normally, weather was not a factor during the landing (Tabs F-28, R-4, and V-1.1). At approximately 2141Z, as the MA approached the airfield, MC1 ran the before-landing checklist (Tabs N-12, R-4, and V-1.1). After lowering the landing gear, MC1 performed a routine performance and visual check of the landing gear (Tabs R-4, R-19, V-1.1, and V 2.1). MC1 performed the performance check by pushing the rudder pedals right and left to confirm actual movement (Tab R-4). The visual checks consisted of confirming the gear was down using the sensor ball camera, while also checking the condition of the main wheel tires and nosewheel steering (Tabs R-4, R-19, V-1.1, and V 2.1). During these visual checks, MC1 noted that the nose wheel was not situated in the normal configuration (Tabs R-4, R-19, V-1.1, and V 2.1). Further inspection with the camera and readouts from the heads-down display showed that the nosewheel was not straight, but turned approximately 12 degrees to the left (Tabs R-4, V-1.1, and V-2.1).

MC1 ran their emergency checklists and consulted with the MOS, MP2, and maintenance personnel, but was unable to straighten out the nosewheel (Tabs R-4, R-19, V-1.1, V-2.1, V-3.1, and V-6.1). MC1 consulted with the Mishap Mission Commander (MMCC) who further consulted with the local group commander (Tabs R-4, R-19, R-97, R-101 to 102, V-1.1, V-1.2, V-2.1, and V-5.1). MMCC ran through a decision matrix considering the risks associated with attempting to land the MA at the deployed location (Tabs R-97 to 98, R-101 to 122, and V-5.1). MMCCs decision matrix included options to continue to troubleshoot the failure, ditch the MA in an unpopulated location, or attempt to land the MA (Tabs R-97 to 98, R-101 to 122, and V-5.1). After consulting with higher authorities, MMCC ordered MC1 to attempt to land the MA at the deployed airfield (Tabs R-4, R-19, R-97, R-101 to 102, V-1.2, V-2.1, and V-5.1). MC1

received clearance and observed weather from the tower prior to landing the MA at the deployed airfield. (Tab N-4).

At approximately 2234Z, MP1 landed MA on the main landing gear while holding the nosewheel off the runway in order to reduce airspeed before final nosewheel touchdown (Tabs R-4, R-19, and V-1.2). At approximately 3000ft down the runway, the nosewheel touched down, and the MA immediately veered left towards the runway edge (Tabs N-6, R-4, R-19, and V-1.2). MP1 applied full right rudder and right brake to maintain runway heading, but the MA continued veering off the runway. The MA continued to move left, so in an attempt to keep the MA from leaving the prepared surface, MP1 applied full right and left brakes, while continuing to apply full right rudder (Tabs N-5, R-4, R-19, and V-1.2). When it became clear that the MA was about to leave the runway MP1 pulled the condition lever aft, which cut off all fuel to the engine (Tabs R-4, R-19, V-1.2, and V-2.1). The MA then left the paved surface and bounced through a section of dirt and large rocks until it stopped about 20 yards from the runway (Tabs N-5, R-4, R-19, V-1.2, and V 2.1).

e. Impact

The MA was configured for normal landing with exception of the nosewheel, which was frozen 12 degrees to the left of center (Tabs R-4, R-19, V-1.2, and V 2.1). At 2234Z, the MA touched down on the runway then departed the prepared surface approximately 3000 feet down the runway (Tabs N-5 to N-6, R-4, R-19, V-1.2, and V 2.1). The MA came to rest approximately 20 yards from the runway edge, damaging the airframe and other equipment (Tabs N-5 and P-4).

f. Egress and Aircrew Flight Equipment

Not applicable.

g. Search and Rescue

Not applicable.

h. Recovery of Remains

Not applicable.

5. MAINTENANCE

a. Forms Documentation

A review of the Air Force Technical Order (AFTO) 781-series forms and Time Compliance Technical Orders for the MA were conducted and no relevant discrepancies were found (Tabs D-3 to D-21). A Lockheed Martin contract maintainer assigned to the MA signed the Exceptional Release on 3 May 2015 to certify the active forms were reviewed, confirming the MA was safe for flight on the day of the mishap (Tabs D-3, D-6, and D-9). A Lockheed Martin

contract maintainer assigned to the mishap GCS signed the Exceptional Release on 4 May 2015 confirming mishap GCS was operational on the day of the mishap (Tabs D-14, D-16, and D-18).

b. Inspections

There were no major discrepancies found for all scheduled inspections for both the mishap GCS and MA (Tabs D-6, D-9, D-14 and D-18). MC1 also reviewed all inspection documentation prior to assuming control of the MA and no major discrepancies were identified (Tabs R-3 and V-1.1).

c. Maintenance Procedures

All Preflight inspections, servicing operations, launch and recovery procedures were accomplished without incident prior to the mishap flight (Tabs D-3 to D-21, R-51, R-67, and R-73).

d. Maintenance Personnel and Supervision

Lockheed Martin contract maintenance personnel assigned to the MA and GCS were properly trained and had adequate supervision prior to the mishap (TabsV-7.1 and V-8.1).

e. Fuel, Hydraulic, and Oil Inspection Analyses

According to the MA's AFTO Form 781H and the post flight analysis from Air Force Petroleum Agency Laboratory, the MA's fluid levels were adequate to conduct the mishap mission (Tabs D-9, and J-2 to J-4).

f. Unscheduled Maintenance

The MA did not undergo any unscheduled maintenance (Tabs D-3 to D-21).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

The MA sustained substantial damage during the landing after the MA departed the prepared runway surface: including the airframe and other equipment (Tab P-4). The nosewheel servo, W107 cable, steering driver, W134 cable and W135 cable were removed from the MA and sent to the manufacturer, General Atomics (GA) for further analysis (Tab Q-2).

b. Evaluation and Analysis

(1) Nosewheel steering driver

GA manufactures the MA nosewheel steering servo and steering driver unit (Tab CC-31). The nosewheel steering servo is controlled by rudder pedal movements (Tab DD-8). The nosewheel steering servo is located in a cylindrical housing mounted on top of the nosewheel assembly (Tab

DD-8). A steering driver unit, located in the forward auxiliary bay, responds to digital commands received from the redundant control module and provides left or right steering commands to the nosewheel steering servo (Tab DD-8). Data shows that after the landing gear was extended, the data bus was showing no faults and all servo and data bus voltages were indicating normal (Tab DD-5).

Analysis by GA technicians determined the root cause of the nosewheel steering failure was an electrical overstress event within one of the metal-oxide-semiconductor field effect transistors (MOSFET) in the nosewheel steering driver (Tab DD-4). Analysis of the driver components revealed that two of the MOSFETs that control the steering servo motor were shorted closed (Tab DD-4). The power input fuses were also blown (Tab DD-4). The failure sequence most likely included one of the MOSFETs failing first (Tab DD-4). This would quickly cause the other MOSFET to fail and blow the input power fuses (Tab DD-4).

Hot mockup (HMU) testing was conducted with the mishap hardware (Tab DD-9) The HMU equipment includes MQ-9A avionics, most servos, a GCS half-rack, and uses simulation software to replicate flight conditions (Tab DD-9). GA HMU testing found the nosewheel steering servo was unable to move the nose gear, but the servo motor could be heard running when the potentiometer position was not aligned with the commanded position (Tab DD-9). The mishap nosewheel steering driver was also non-operational in the HMU (Tab DD-9). The light emitting diode on top of the driver did not illuminate and the driver would not communicate over the MA's data bus (Tag DD-9). The software version initially reported FF (not valid) (Tab DD-9). A new software load was attempted twice, but was unsuccessful both times, resulting in a reported a software version of 00 (Tab DD-9). The blown input fuses and the failed MOSFETs would result in the nosewheel remaining at a fixed position as occurred prior to landing the MA (DD-11).

Aircraft maintenance records indicated that the mishap nosewheel steering servo had been an original component of the MA (Tabs D-8 and D-13). It had been in operation for 250.2 hours and was going to be inspected at the 800-hour mark (Tabs D-8 and D-13). The mishap nosewheel steering servo and driver had never previously been returned to the GA depot for rework (Tab DD-7). A review of the return history of the nosewheel steering servo drivers found 59 returns since the part was created (Tab DD-10). Out of these 59 returns, 8 had one or more MOSFETs replaced (Tab DD-10).

7. WEATHER

a. Forecast Weather

The weather forecast for the MA's recovery was reported as no significant weather (Tab F-28). In addition, clouds were reported as clear with winds forecast at 7 knots (kts) 110 degrees off of runway heading, with no thunderstorms, icing, or precipitation forecasted for the day (Tab F-28).

b. Observed Weather

The weather at the time of the mishap and post-mishap was reported as winds at 5 kts, 90 degrees off runway heading, with unlimited visibility and clear of clouds (Tab N-4).

c. Space Environment

Not applicable.

d. Operations

There is no evidence to suggest the MA was being operated outside its prescribed operational weather limits.

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 (Tabs K-2, G-2, and G-25 to G-31). MP1 had 142.8 hours of MQ-9A simulator (sim) time and 1060.5 hours of total MQ-9A flight (flt) hours (Tab G-10).

Recent flight and simulator time is as follows (Tab G-4).

	Flt Hours	Flt Sorties	Sim Hours	Sim Sorties
Last 30 Days	14.2	25	0	0
Last 60 Days	33.0	48	0	0
Last 90 Days	44.8	65	0	0

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 (Tabs K-2, G-14, and G-41 to G-57). MSO 1 had 135.4 hours of MQ-9A simulator time and 1259.2 hours of total MQ-9A flight hours (Tab G-15).

Recent Flight and simulator time is as follows (Tab G-16).

	Flt Hours	Flt Sorties	Sim Hours	Sim Sorties
Last 30 Days	29.2	24	0	0
Last 60 Days	55.7	52	0	0
Last 90 Days	75.9	70	0	0

9. MEDICAL

a. Qualifications

The MP1 and MSO1 were medically qualified for flight duty at the time of the mishap and had current annual flight physical examinations on record (Tabs G-5 and G-17).

b. Health

A review of the 72-Hour and 14-Day History forms for MP1 and MSO1 indicate they were in good health and had no duty performance limiting conditions or illness (Tabs R-6 to R-17, and R-21 to R-32). There is no evidence to suggest health factors were a factor in the mishap (Tabs R-6 to R-17, and R-21 to R-32).

c. Pathology

Toxicology results were negative for MC1 (Tab T-3 to T-4).

d. **Lifestyle**

There is no evidence to suggest lifestyle factors were a factor in the mishap (Tabs R-6 to R-17, and R-21 to R-32).

e. Crew Rest and Crew Duty Time

Aircrew members must have proper rest, as defined in AFI 11-202, Volume (V) 3, *and General Flight rules*, (ACC Supplement), dated 7 November 2014, paragraph 2.1, prior to performing in-flight duties (Tab BB-3). AFI 11-202 V3, paragraph 2.1, 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-4). MC1 met all requirements for crew rest (Tabs R-46, V-1.1, and V-2.1).

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 conducting ISR operations (Tabs V-1.1, V-2.1, V-3.1, and V-4.1)

b. Supervision

MC1 was supervised by the MMCC during the recovery operation (Tabs R-3 to R-4, R-97, V-1.1, and V-5.1). MMCC fully supported MC1's actions and worked through a detailed decision matrix before directing MP1 to land the MA at the deployed location (Tabs N-4, R-3 to R-4, R-88, R-97-R-98, V-1.1, and V-5.1). The decision to land the MA at the deployed location was supported by higher authorities based on the risk analysis conducted by the MMCC and MOS (Tabs R-97 to R-98, V-5.1, and V-6.1).

11. HUMAN FACTORS ANALYSIS

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

//Signed//

26 APRIL 2016

ERIC N. SCHULZE, Lt Col, USAF
President, Accident Investigation Board

STATEMENT OF OPINION

MQ-9A, T/N 11-4138
AFRICOM AOR
05 May 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 5 May 2015, at approximately 0134 Local (L) (2234 Zulu time (Z) on 4 May 2015), the mishap aircraft (MA), an MQ-9A, Tail number 11-4138, assigned to the 33rd Expeditionary Special Operations Squadron, 435th Air Ground Operations Wing, veered off the runway after landing and crashed. Damage to United States (U.S.) government property totaled approximately $6,703,852.06. There were no fatalities, injuries or damage to civilian property. The MA was recovering into the deployed location after conducting an intelligence, surveillance, and reconnaissance mission in support of U.S. Africa Command operations. The aircraft wreckage was returned to Creech Air Force Base, Nevada, and five pieces of the MA wreckage were shipped to the manufacturer for analysis.

Two separate flight crews operated the MA during the launch and recovery phase of the mishap flight. The recovery mishap crew (MC1) consisted of mishap pilot 1 (MP1) and mishap sensor operator 1 (MSO1). The launch mishap crew (MC2) consisted of mishap pilot 2 (MP2) and mishap sensor operator 2 (MSO2). All crews were current and qualified. All MA and ground control station maintenance records and inspections were complete and reviewed without issue by both MC1, MC2 and maintenance.

At approximately 0415Z on 4 May 2015, MC2 conducted an uneventful launch of the MA. MC1 received the handover from the mishap operations supervisor and everything was normal until approximately 2141Z. At that time MC1 noticed they had a nosewheel steering problem while conducting normal control checks during the before landing checklist. These checks consist of confirming the gear was down using the sensor ball camera, while also checking the condition of the main wheel tires and nosewheel steering. MC1 performed this check by pushing the rudder pedals right and left to confirm actual movement. MP1 noticed after the control check that the nosewheel froze at approximately 12 degrees left from center. MC1 referenced current technical orders and emergency procedures to try to remedy the steering failure, but the technical orders did not cover this type of malfunction. After further analysis, MC1 and maintenance concluded that the nosewheel servo was frozen and was unfixable while airborne. MC1 consulted with the Mishap Mission Commander (MMCC) who further consulted with the local group commander. MMCC executed a detailed decision matrix and concluded the safest option for landing the MA would be at the deployed location.

MP1 landed MA at 2234Z on the main landing gear while holding the nosewheel off the runway in order to reduce airspeed before final nosewheel touchdown. At approximately 3000 feet down the runway, the nosewheel touched down, and the MA immediately veered left towards the runway edge. MP1 applied full right rudder and right brake to maintain runway heading, but MA continued veering off the runway. The MA departed the runway and came to rest approximately 20 yards from the runway edge, damaging the airframe and other equipment.

I find by a preponderance of evidence that the cause of this mishap was a failed nosewheel servo driver that resulted in the inability of MC1 to safely maintain runway heading after landing.

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 evidence that the cause of this mishap was a failed nosewheel servo driver that resulted in the inability of MC1 to safely maintain runway heading after landing.

The root cause of the nosewheel steering failure was an electrical overstress event within two field effect transistors in the nosewheel steering driver. This overstress caused an electrical short to the servomotor, which also caused two power input fuses to blow open resulting in a complete loss of nosewheel steering servo. Loss of nosewheel servo inhibited functionality of the steering controller, which not only prevented the nosewheel from auto centering back to its neutral position, but also loss of pilot control of the nosewheel steering through the rudder pedals. This failure caused the MA to sharply veer off the runway upon nosewheel touch down and damaging the MA after runway departure.

3. CONCLUSION

I find by a preponderance of evidence that the cause of this mishap was a failed nosewheel servo driver that resulted in the inability of MC1 to safely maintain runway heading after landing.

//Signed//

26 APRIL 2016

ERIC N. SCHULZE, Lt Col, USAF
President, Accident Investigation Board

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