UNITED STATES AIR FORCE ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

MQ-1B, T/N 07-3198

15TH ATTACK SQUADRON
432D WING
CREECH AIR FORCE BASE, NEVADA

LOCATION: USCENTCOM AOR

DATE OF ACCIDENT: 8 MARCH 2016

BOARD PRESIDENT: LT COL THOMAS W. HANCOCK

Abbreviated Accident Investigation Conducted Pursuant to Chapter 11 of Air Force Instruction 51-503

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

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24 MAY 2017

ACTION OF THE CONVENING AUTHORITY

The Report of the Abbreviated Accident Investigation Board, conducted under the provisions of AFI 51-503, that investigated the 8 March 2016 mishap involving MQ-1B, T/N 07-3198, 15th Attack Squadron, 432d Wing, Creech Air Force Base, Nevada, complies with applicable regulatory and statutory guidance; on that basis it is approved.

//SIGNED//

JOHN K. MCMULLEN
Major General, USAF
Vice Commander

Agile Combat Power

EXECUTIVE SUMMARY
AIRCRAFT ABBREVIATED ACCIDENT INVESTIGATION

MQ-1B Predator, T/N 07-3198
USCENTCOM AOR
8 MARCH 2016

On 8 March 2016, at approximately 1500 hours Zulu (Z), while conducting a combat support mission in the United States Central Command (USCENTCOM) area of responsibility (AOR), the mishap remotely piloted aircraft (MRPA), an MQ-1B Predator, tail number 07-3198, forward deployed from the 432d Wing, Creech Air Force Base (AFB), Nevada, experienced a pilot sensor operator (PSO) 1 rack lock-up while simultaneously losing datalink. The MRPA impacted the ground and was not recovered. At the time of the mishap, the MRPA was operated by the mishap mission control element (MMCE) from the 15th Attack Squadron (15 ATKS), Creech AFB, Nevada. The estimated cost of aircraft and munition damage is $4,216,800. There were no injuries or damage to other government or private property.

The rack lock-up on PSO1 halted command control of the MRPA and was caused by a software anomaly that can occur following a specific sequence of operator selections on the heads-up display. Simultaneously, the MMCE lost datalink (transmission to and from the MRPA). After the MMCE executed the rack switch to another control setting (PSO2), datalink was re-established, but the return datalink was lost approximately 5 seconds later. On the PSO2 side, the throttle setting remained in the idle position with airspeed hold engaged. The MMCE believed the MRPA lost both command and return datalink and was therefore executing its emergency mission. In reality, the MRPA regained command datalink, unknowingly resulting in the MRPA to be "commanded in the blind." With the throttle set at idle and airspeed hold on, the MRPA started a descent until it impacted the ground.

The Abbreviated Accident Investigation Board (AAIB) President found by a preponderance of the evidence that the cause of the mishap was that the MRPA lost return datalink and did not provide the MMCE with any reasonably discernable indication that command datalink was still transmitting; which, when combined with the PSO2 throttle position being in idle and the airspeed hold engaged, led to a commanded descent and eventual ground impact.

The AAIB President found by a preponderance of the evidence that there were two factors which substantially contributing to the mishap: (a) existing emergency checklists (lost datalink, PSO1 rack lock) did not provide sufficient or clear guidance; and (b) the unscheduled presence of the mishap instructor pilot (MIP) which increased confusion.

SUMMARY OF FACTS AND STATEMENT OF OPINION
MQ-1B Predator, T/N 07-3198
8 MARCH 2016

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

12 AF	12th Air Force
15 ATKS	15th Attack Squadron
432 WG	432d Wing
AAIB	Abbreviated Accident Investigation Board
A/C	Aircraft
ACC	Air Combat Command
AF	Air Force
AFB	Air Force Base
AFE	Aircrew Flight Equipment
AFI	Air Force Instruction
AFTO	Air Force Technical Order
AGL	Above Ground Level
AOR	Area of Responsibility
AIB	Accident Investigation Board
ATC	Air Traffic Control
ATKS	Attack Squadron
CENTCOM	United States Central Command
COMACC	Commander, Air Combat Command
Comm	Communications
CSAR	Combat Search and Rescue
CT	Continuation Training
DoD	Department of Defense
DT	Dynamic Targeting
EP	Emergency Procedures
EPE	Emergency Procedures Evaluation
fpm	Foot/Feet Per Minute
ft	Foot/Feet
GA	General Atomics
GCS	Ground Control Station
GDT	Ground Data Terminal
HFACS	Human Factors Analysis & Classification System
IAW	In Accordance With
IFR	Instrument Flight Rules
IO	Investigating Officer
IOS	Intelligence Operations Supervisor
IP	Instructor Pilot
IR	Infrared
ISB	Interim Safety Board
ISR	Intelligence, Surveillance, Reconnaissance
KIAS	Knots Indicated Airspeed
L	Local Time
LR	Launch and Recovery
LRE	Launch and Recovery Element
MCC	Mission Commander
MCE	Mission Control Element
MFW	Multifunction Workstation
mIRC	Microsoft Internet Relay Chat
MIC	Mission Intelligence Coordinator
MIP	Mishap Instructor Pilot
MMCC	Mishap Mission Commander
MMCE	Mishap Mission Control Element
MP	Mishap Pilot
MQT	Mission Qualification Training
MR	Mission Ready
MRPA	Mishap Remotely Piloted Aircraft
MSO	Mishap Sensor Operator
MWS	Major Weapon System
NCO	Noncommissioned Officer
nm	Nautical Miles
ORM	Operational Risk Management
PIC	Pilot in Command
POC	Point of Contact
PPSL	Predator Primary SATCOM Link
PSO1	Pilot/Sensor Operator Position 1
RM	Risk Manager
RPA	Remotely Piloted Aircraft
SAR	Search and Rescue
SARM	Squadron Aviation Resource Manager
SATCOM	Satellite Communication
SIB	Safety Investigation Board
SIM	Simulator
SO	Sensor Operator
T/N	Tail Number
TV	Television
TX	Transition
UPT	Undergraduate Pilot Training
USAF	United States Air Force
VFR	Visual Flight Rules
VVI	Vertical Velocity Indictor
WG	Wing
WOC	Wing Operations Center
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 10 January 2017, Major General John K. McMullen, Vice Commander, Air Combat Command, appointed Lieutenant Colonel Thomas W. Hancock as the Abbreviated Accident Investigation Board (AAIB) President to investigate the 8 March 2016 accident involving an MQ-1B Predator aircraft (A/C), tail number (T/N) 07-3198 (Tab Y-3 to Y-4). An AAIB was conducted at Nellis Air Force Base (AFB), Nevada, from 11 January 2017 to 10 February 2017, pursuant to Air Force Instruction (AFI) 51-503, *Aerospace Accident Investigations*, Chapter 11 (Tab Y-3 to Y-4). A legal advisor and a recorder were also appointed to the AAIB (Tab Y-3 to Y-4).

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 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 8 March 2016, at approximately 1500 hours Zulu (Z), while conducting a combat support mission in the United States Central Command (CENTCOM) area of responsibility (AOR), the mishap remotely piloted aircraft (MRPA), an MQ-1B Predator, T/N 07-3198, forward deployed from the 432d Wing, Creech Air Force Base (AFB), Nevada, experienced a pilot sensor operator (PSO) 1 rack lock-up while simultaneously losing datalink (Tabs V-3.1, V-4.1, V-6.1, and DD-4).

The MRPA impacted the ground and was not recovered (Tab DD-4). At the time of the mishap, the MRPA was operated by the mishap mission control element (MMCE) from the 15th Attack Squadron (15 ATKS), Creech AFB, Nevada (Tabs K-3 to K-5 and V-3.1). The estimated cost of aircraft and munition damage is $4.216,800 (Tab P-2). There were no injuries or damage to other government or private property (Tab P-2).

3. BACKGROUND

a. Air Combat Command (ACC)

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 and Combat Air Forces lead agent, 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). Additionally, ACC develops strategy, doctrine, concepts, tactics, and procedures for air and space-power employment (Tab CC-3). The command provides conventional and information warfare forces to all unified commands to ensure air, space and information superiority for warfighters and national decision-makers (Tab CC-3). The command can also be called upon to assist national agencies with intelligence, surveillance and crisis response capabilities (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 United States European, Pacific, Africa-based and Strategic Commands (Tab CC-3).

b. Twelfth Air Force (12 AF)

12 AF, or Air Forces Southern, headquartered at Davis-Monthan AFB, Arizona, controls ACC's conventional fighter and bomber forces based in the western United States and also serves as the air component for United States Southern Command (Tab CC-5). In its numbered air force role, 12 AF is responsible for the combat readiness of ten active-duty wings and one direct reporting unit (Tab CC-5). These subordinate commands operate more than 800 aircraft with more than 64,000 uniformed and civilian Airmen (Tab CC-5). The command is also responsible for the operational readiness of gained wings and other units of the Air Force Reserve and Air National Guard (Tab CC-5).

c. 432d Wing (432 WG)

The 432 WG “Hunters” consists of combat-ready Airmen who fly remotely piloted aircraft (RPA) in direct support of the joint warfighter (Tab CC-13). The Hunters conduct RPA training for aircrew, intelligence, weather, and maintenance personnel (Tab CC-13). The 432 WG flies and maintains the MQ-1B Predator and MQ-9 Reaper RPAs to support United States total force components and combatant commanders (Tab CC-20).

d. 15th Attack Squadron (15 ATKS)

The 15 ATKS provides persistent intelligence, surveillance and reconnaissance and full motion video for real-time actionable intelligence and precision weapons employment in combat operations, using unmanned aircraft (Tab CC-17).

e. MQ-1B Predator

The MQ-1B Predator is an armed, multi-mission, medium-altitude, long-endurance RPA that is employed primarily as an intelligence-collection asset and secondarily against dynamic execution targets (Tab CC-20). 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-20). Predators can also perform the following missions and tasks: intelligence, surveillance, and reconnaissance, close air support, combat search and rescue, precision strike, buddy-lase, convoy/raid overwatch, route clearance, target development, and terminal air guidance (Tab CC-20). The MQ-1B's capabilities make it uniquely qualified to conduct irregular warfare operations in support of combatant commander objectives (Tab CC-20).

The Predator carries the Multi-spectral Targeting System, which integrates an infrared sensor, color/monochrome daylight TV camera, image-intensified TV camera, laser designator and laser illuminator (Tab CC-20). The full-motion video from each of the imaging sensors can be viewed as separate video streams or fused (Tab CC-20). The aircraft can employ two laser-guided Hellfire missiles that possess high accuracy, low-collateral damage anti-armor/anti-personnel engagement capabilities (Tab CC-20).

The aircraft is employed from a ground control station (GCS) via a line-of-sight datalink or a satellite datalink for beyond line-of-sight operations (Tab CC-20). The basic crew for the Predator is a rated pilot to control the aircraft and command the mission and an enlisted aircrew member to operate sensors and weapons inside the GCS (Tab CC-20).

4. SEQUENCE OF EVENTS

a. Mission

On 8 March 2016, the MRPA was authorized by an Air Tasking Order to conduct a combat support mission in the USCENTCOM AOR (Tab K-5).

b. Planning

On 8 March 2016, at around 0715Z, the MMCE consisting of the mishap pilot (MP) and mishap sensor operator (MSO) attended a mission brief within 15 ATKS (Tab V-3.1 and V-7.1). The briefing was standard with no risk factors noted (Tab V-7.1). Weather slides briefed at around 0715Z indicated thunderstorms in the AOR and it was decided to weather-delay missions (Tab V-3.1 and V-7.1). The MMCE remained on weather hold until around 1400Z when the operations supervisor sent the MMCE to the GCS for their mission. (Tabs F-2 to F-6 and V-3.1).

c. Preflight

Preflight checks and launch were conducted by a launch and recovery element (LRE) with no maintenance discrepancies (Tabs D-4 and V-8.1).

d. Summary of Accident

The MP and the MSO proceeded to their GCS at around 1400Z and gained control of the MRPA uneventfully at around 1415Z from the LRE (Tab V-3.1, V-6.1, and V-8.1). The MP was on a northwest heading with the airspeed hold and heading hold engaged while climbing to their assigned altitude and working area (Tabs V-3.1, V-6.1, and Z-3). Shortly after gaining the MRPA, the mishap instructor pilot (MIP) joined the MP and MSO in the GCS to conduct continuation training (CT) as an observer/instructor (Tab V-6.1). The addition of the MIP to the MMCE was not scheduled or prebriefed (Tab V-3.1). While discussing proper climb airspeed for the MQ-1B, the MP and MSO forgot to update their emergency mission waypoint and flew past it (Tab V-3.1). At that time, the MP attempted to update his emergency mission waypoint and the PSO1 stopped working and it was decided they had a PSO1 rack lock-up at around 1454Z (Tabs V-3.1, V-4.1, and DD-5). At that same time, the MSO reported he was receiving cautions that the MRPA had lost datalink (Tab V-3.1 and V-4.1; *see also* Figure 1). The two types of datalinks required to operate the aircraft are the command datalink and return datalink (Tab V-5.1). Command datalink sends inputs from the pilot and sensor operator (SO) to the aircraft and controls the MRPA (Tab V-5.1). Return datalink receives telemetry (digital instrument panel readout) and allows the MMCE to monitor or

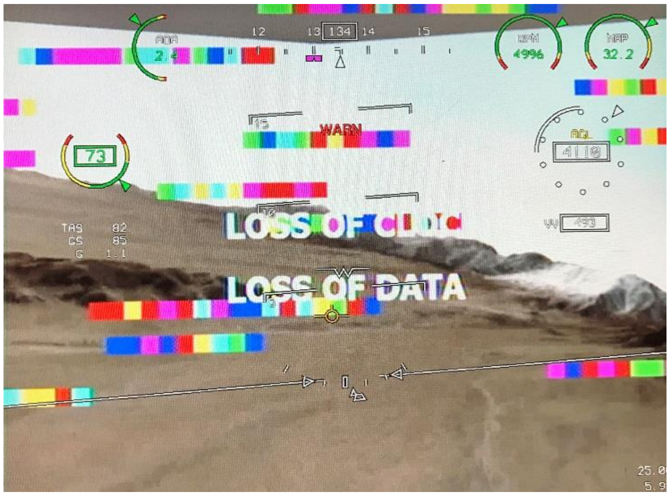

Figure 1. Lost Datalink Indicator: Main Screen (Tab Z-5)

view what the MRPA is actually doing via the main displays on the multifunction workstation (MFW) within the GCS (Tab V-5.1). At this point, both the command and the return datalink had been lost (Tab V-3.1 and V-4.1). The MMCE could not control or see what the MRPA was doing (Tab V-4.1). If the MMCE loses only the return datalink, the MRPA could still be commanded (good command datalink) without the MMCE being able to monitor what the MRPA was doing due to the lost return datalink (Tab V-5.1). The two separate emergency checklists the MMCE discussed executing were the PSO1 rack lock-up and the lost datalink checklists (Tabs V-3.1 and BB-18 to BB-25). The MP and MSO wanted to start with the PSO1 rack lock-up emergency procedure, believing regaining control of the MRPA was the most critical emergency (Tab V-3.1). However, with direction from the MIP, the MP and MSO decided to execute the lost datalink emergency procedure checklist first and communications maintenance was requested (Tab V-3.1, V-5.1, and V-6.1 to V-6.2). When the MMCE got to the first step in the lost datalink checklist, (disable command datalink) they were unable to do so due to PSO1's locked status (Tabs V-3.1 and BB-19). The MMCE then decided to execute the PSO1 rack lock-up emergency checklist which was successfully accomplished at around 1506Z (Tabs V-3.1, V-4.1, and DD-5).

The MMCE completed the steps of the PSO1 rack lock-up emergency checklist which changes control from the PSO1 station to the PSO2 station (Tab V-3.1 to V-3.2 and V-5.1). The checklist did not then direct the MMCE to match PSO1 throttle settings on the PSO2 side before the swap was made (Tab BB-21 to BB-25). Once the MP pressed the button to swap control from PSO1 to PSO2, the MRPA established complete datalink (both command and return) for approximately 5 to 7 seconds (tabs V-3.2, V-5.1, V-6.2, and DD-6). During this brief time, the position of the MRPA was updated on the MP's heads up display showing it executing its emergency mission and on a south heading (Tabs V-3.1 to V-3.2, V-5.1, V-6.2, and Z-3). After 5 to 7 seconds, the MRPA lost datalink again (Tab DD-6). At about that same time, the MIP received a phone call from the Wing Operations Center (WOC) that the predator primary SATCOM Datalink (PPSL) station had muted their datalink (Tab V-6.2). Muting the datalink cuts off the command datalink to the aircraft, forcing it into its emergency mission (Tabs V-7.1 and DD-6). The MIP requested they un-mute the MRPA datalink and continued to trouble shoot the lost datalink emergency (Tab V-6.2). The MMCE incorrectly believed that the MRPA was safe and executing its emergency mission and return to base profile (Tabs V-3.2 and V-6.2). However, the MRPA actually had regained command datalink and began a turn away from its emergency mission profile back to the commanded northwest heading (Tabs V-3.1 and DD-6). The MMCE did not notice the change in heading because the MRPA still had no return datalink, thereby unknowingly resulting in the MRPA being "commanded in the blind" (Tab DD-5). Before a rack swap, console commands, such as throttle position, are independent of each other and will act according to whether the rack is a pilot configuration or sensor operator configuration (Tabs V-7.1 and BB-22). In this case, the PSO2 throttle, which is the zoom lever on a sensor operator configuration, was all the way back in the idle position and remained there after the PSO1 rack was swapped to PSO2 (Tab V-3.2 and V-7.1). This, when combined with the airspeed hold being engaged, forced the MRPA into a commanded descent to maintain commanded airspeed unbeknownst to the MMCE (Tabs V-3.2 and DD-5).

e. Impact

The last indication from Air Traffic Control (ATC) was at 1514Z on 8 March 2016 when the MRPA descended below radar coverage heading northwest (Tabs Z-3, DD-6, and DD-10). The MRPA was descending and most likely resulting in a ground impact at around 1521Z (Tabs Z-3 and DD-10). The time of 1521Z is consistent with the General Atomics (GA) analyzer lost return datalink energy (Tab DD-6 and DD-10).

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 review of the MRPA's maintenance documentation, recorded in the Air Force Technical Order (AFTO) 781 series revealed no relevant discrepancies (Tab D). AFTO Form 781H for 8 March 2016 revealed total MRPA airframe time of 16,799.8 hours (Tab D-4).

b. Inspections

All maintenance inspections were complied with (Tab D-11 to D-14).

c. Maintenance Procedures

Preflight inspections, servicing operations, and launch procedures were accomplished without incident (Tab D-11 to D-14).

d. Maintenance Personnel and Supervision

All preflight servicing and maintenance was correctly documented by properly trained, qualified, and supervised military and civilian maintenance personnel (Tab D-4 and D-7 to D-8).

e. Fuel, Hydraulic, and Oil Inspection Analyses

Maintenance documentation shows proper servicing and correct levels of fluids in the aircraft at takeoff (Tab D-5 to D-6). Post-accident fluid samples were not obtained from the MRPA because the aircraft was not recovered (Tab DD-4).

f. Unscheduled Maintenance

Maintenance documentation revealed no unscheduled maintenance (Tab D-12 to D-14).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

The MRPA was never recovered so an evaluation of its structures and systems was not done (Tab DD-4).

b. Evaluation and Analysis

According to the GA report, the lost return datalink was due to incorrect encryption keys on the PSO2 side (Tab DD-4 and DD-8). The incorrect encryption keys being loaded in the PSO2 rack potentially explains why the return datalink was lost (Tab DD-4 to DD-5). However, even if this is true, losing return datalink was such a common occurrence that it cannot realistically be considered a significant contributing factor to this mishap (Tab V-5.2). There is no other evidence, from any other source, that indicates the encryption keys played any role in this mishap.

7. WEATHER

a. Forecast Weather

Weather slides briefed during the mass brief at around 0715Z indicated moderate thunderstorms in the mission area (Tabs F-2 to F-6 and V-3.1). The WOC decided to place the MMCE on weather-hold until approximately 1400Z when the thunderstorms dissipated enough for safe mission execution (Tab V-3.1 and V-7.1). For the remainder of the mission, there is no evidence that suggests weather played a significant role in this mishap (Tab V-5.1, V-6.1, and V-7.1).

b. Observed Weather

After gaining the MRPA, the MP noted cloud layers at about 5,000 mean sea level (MSL) (Tab V-4.1). While, the MP was concerned about icing and turned on appropriate anti-icing systems, no other evidence suggests weather played a significant role in this mishap (Tab V-3.1, V-4.1, V-5.1, V-6.1, and V-7.1).

c. Operations

No evidence suggest that the MRPA was operated outside of its prescribed operational weather limitations.

8. CREW QUALIFICATIONS

a. Mishap Pilot

The MP was current and had been qualified in the MQ-1B since 3 December 2015 (Tab G-3). The MP had a total flight time of 74.1 hours in the MQ-1B (Tab G-6). The MP's flight time during the 90 days before the mishap was as follows (Tab G-7):

	Hours	Sorties
Last 30 Days	34.4	12
Last 60 Days	34.4	12
Last 90 Days	34.4	12

b. Mishap Sensor Operator

The MSO was current and had been qualified in the MQ-1B since 15 October 2015 (Tab G-14). The MSO had a total flight time of 198.7 hours in the MQ-1B (Tab G-17). The MSO's flight time during the 90 days before the mishap was as follows (Tab G-18):

	Hours	Sorties
Last 30 Days	58.5	15
Last 60 Days	109.7	30
Last 90 Days	132.4	36

c. Mishap Instructor Pilot

The MIP was current and had been qualified in the MQ-1B since 26 March 2012 (Tab G-33). The MIP had a total flight time of 1006.2 hours in the MQ-1B (Tab G-35). The MIP's flight time during the 90 days before the mishap was as follows (Tab G-36):

	Hours	Sorties
Last 30 Days	5.4	4
Last 60 Days	16.6	11
Last 90 Days	24.5	16

9. MEDICAL

a. Qualifications

At the time of the mishap, MMCE crewmembers were fully medically qualified for flight duty (Tab EE-3 to EE-5).

b. Health

There is no evidence to suggest the health of the MMCE crewmembers contributed to the mishap.

c. Toxicology

The medical clinic at Nellis AFB, Nevada, collected blood and urine samples from the MMCE after the mishap (Tab EE-6 to EE-8). All toxicology testing resulted in negative findings (Tab EE-6 to EE-8).

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 are required to have proper crew rest prior to performing in-flight duties, defined as a minimum of 12-hours non-duty time before the designated flight duty period begins (Tab BB-

7). The MMCE met crew rest requirements (Tab V-3.2, V-4.1, and V-6.3). There is no evidence to suggest crew rest and crew duty time were factors in the mishap.

10. OPERATIONS AND SUPERVISION

a. Operations

On the day of the mishap, it was a normal duty day for the MMCE who were on a 2300 to 0800 local time (L) schedule, also known as mid-shift (Tab V- 3.1). There were no significant issues reported and the operations tempo was considered normal by the MP and MSO (Tab V-3.2, V-4.1, and V-6.3). There is no evidence to suggest operations tempo contributed to the mishap.

b. Supervision

On the day of the mishap, the MMCE received their daily mass briefing as they came on shift around 2315L/0715Z. (Tab V-3.1). The MMCE conducted their standard mission briefing (Tab V-3.1 and V-7.1). The MMCE was current on their go/no-go requirements and their operational risk management (ORM) was signed off by the squadron aviation resource management (SARM) and MCC (Tab K-3 to K-5 and K-7).

It was common practice in the squadron for instructor pilots to perform continuation training (CT) by observing missions in a GCS (Tab V-3.1 and V-6.1). Sometimes, these CT events would be unscheduled (Tab V-3.1 to V-3.2 and V-6.3). Here, the MP had just completed his mission qualification training and believed the MIP would be testing his general knowledge, which made the MP anxious (Tab V-3.1). However, before that actually happened, the compound emergency occurred (Tab V-3.1). Because of the MP/MIP dynamic when the emergency began, the MP was unsure of whether full command to handle the emergency remained with the MP or had been assumed by the MIP (Tab V-3.1 to V-3.2). Given the low experience levels of the MP and MSO, this led to a stressful situation where the MP believed the responsibility of safely recovering the MRPA had transferred to the MIP (Tab V-3.2). While the MP remained the pilot in command, his lack of experience led him to trust the MIP to direct the proper course of action (Tab V-3.2). The MIP, however, was under the impression he was to be hands-off and that the MP was in complete control of the emergency (Tab V-6.3). The MIP also stated that he believed the MP and MSO were pleased he was helping them during this emergency (Tab V-6.3).

11. HUMAN FACTORS ANALYSIS

The AAIB considered all human factors as prescribed in the Department of Defense Human Factors Analysis and Classification System (DoD HFACS) Version 7.0 to determine those human factors that directly related to the mishap (Tab BB-3 to BB-5).

a. Unintentional Operation of Equipment (DoD HFACS AE11)

Unintended operation of equipment is a factor when an individual’s movements inadvertently activate or deactivate equipment, controls, or switches when there is no intent to operate the controls or device. This action may be noticed or unnoticed by the individual (Tab BB-4).

When the MP and MSO executed the PSO1 rack swap checklist, they unintentionally left the PSO2 side throttle position in idle (Tabs V-3.2 and DD-5). Before the rack swap, the PSO2 throttle is the MSO's sensor zoom lever (Tab V-7.1). The PSO2 throttle was all the way back in the idle position and remained there after the PSO1 rack was swapped to PSO2 (Tab V-3.2). This, when combined with the airspeed hold engaged, forced the MRPA into a descent until it impacted the ground (Tab DD-10). The MMCE incorrectly believed that the MRPA was safe and executing its emergency mission and return to base profile (Tab V-3.2 and V-4.1). However, the MRPA actually had regained command datalink and began a turn away from its emergency mission profile back to the commanded northwest heading (Tabs V-3.1 and DD-6). The MMCE did not notice the change in heading because the MRPA still had no return datalink, thereby allowing the MRPA to be "commanded in the blind" and continued its descent with no effort towards recovery (Tab DD-5 to DD-6).

b. Provided Inadequate Procedural Guidance or Publication (DoD HFACS OP003)

Provided inadequate procedural guidance or publication is a factor when written direction, checklists, graphic depictions, tables, charts or other published guidance is inadequate, misleading or inappropriate (Tab BB-5).

The MMCE executed two emergency procedure checklists during the course of this mishap (Tab V-3.1 and V-6.2). When the MRPA lost datalink and experienced a PSO1 rack lock at the same time, the MMCE was not sure which checklist to begin with and neither checklist gave them any written guidance on the compound emergency (Tabs V-3.1, V-6.2, and BB-18 to BB-25). Once the MMCE decided to begin the lost datalink emergency checklist, the MMCE realized they could not accomplish the first step (disable command datalink), due to the PSO1 rack lock-up (Tabs V-3.1 and BB-21 to BB-25). This forced them to discontinue the lost datalink emergency checklist, which would have directed them to mute the MRPA (Tabs V-3.1 and BB-20). A more directive checklist would have led the MMCE to mute the MRPA and force it into its emergency mission (Tab V-3.2)

Similarly, the PSO1 rack lock-up emergency checklist lacked clarity and did not direct the MMCE to match mission settings, (such as throttle position) in order to ensure the aircraft was muted before executing the rack swap to PSO2 (Tab BB-21 to BB-25).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

(1) AFI 51-503, *Aerospace Accident Investigations*, 14 April 2015
(2) AFI 51-503, Aerospace Accident Investigations, Air Combat Command *Supplement*, 28 January 2016
(3) AFI 11-2MQ-1&9, Volume 1, *MQ-1&9, Aircrew Training*, 23 April 2015
(4) AFI 11-2MQ-1&9, Volume 3, MQ-1 AND MQ-9, Operations Procedures, 28 August 2015
(5) AFI 11-22, Volume 3, *General Flight Rules*, 7 November 2014
(6) AFI 91-204, Safety Investigations and Reports, 12 February 2014, Corrective Actions

Applied 10 April 2014, Attachment 6, *DoD Human Factors Analysis and Classification System*, Version 7.0
(7) 15th Reconnaissance Squadron, *Squadron Standards*, 6 November 2015

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.

b. Other Directives and Publications Relevant to the Mishap

(1) T.O. 1Q-1(M)B-1, Flight Manual – USAF Series MQ-1B System, 11 February 2016

c. Known or Suspected Deviations from Directives or Publications

There is no evidence to suggest that any directive or publication deviations occurred during this mishap.

//SIGNED//

10 FEBRUARY 2017

THOMAS W. HANCOCK, LT COL, USAF
President, Accident Investigation Board

STATEMENT OF OPINION

MQ-1B Predator, T/N 07-3198
USCENTCOM AOR
8 MARCH 2016

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 8 March 2016, at approximately 1500 hours Zulu (Z), while conducting a combat support mission in the United States Central Command (USCENTCOM) area of responsibility (AOR), the mishap remotely piloted aircraft (MRPA), an MQ-1B Predator, tail number (T/N) 07-3198, forward deployed from the 432d Wing, Creech Air Force Base (AFB), Nevada, experienced a pilot sensor operator (PSO) 1 rack lock-up while simultaneously losing datalink. The MRPA impacted the ground and was not recovered. At the time of the mishap, the MRPA was operated by the mishap mission control element (MMCE) from the 15th Attack Squadron (15 ATKS), Creech AFB, Nevada. The estimated cost of aircraft and munition damage is $4.216,800. There were no injuries or damage to other government or private property.

I find by a preponderance of the evidence that the cause of the mishap was that the MRPA lost return datalink and did not provide the MMCE with any reasonably discernable indication that command datalink was still transmitting; which, when combined with the PSO2 throttle position being in idle and the airspeed hold engaged, led to a commanded descent and eventual ground impact.

I developed my opinion by analyzing factual data from historical records, flight data logs, manufacturer reports, maintenance records, witness testimony, Air Force directives and guidance, and Air Force Technical Orders.

2. CAUSE

I find by a preponderance of the evidence that the cause of the mishap was that the MRPA lost return datalink and did not provide the MMCE with any reasonably discernable indication that command datalink was still transmitting; which, when combined with the PSO2 throttle position being in idle and the airspeed hold engaged, led to a commanded descent and eventual ground impact.

a. Command Datalink Transmitting With No Return Datalink

The rack lock-up on PSO1 was caused by a software anomaly that can occur following any number of specific sequence of operator selections on the heads up display. The PSO1 rack lock-up happened at the exact time the mishap pilot (MP) was attempting to update his emergency mission waypoint. Simultaneously, the MMCE lost datalink with the MRPA. The two types of datalinks required to operate the aircraft are the command datalink and return datalink. Command datalink sends inputs from the pilot and sensor operator (SO) to the aircraft and controls the MRPA. Return datalink receives telemetry (digital instrument panel readout) and allows the MMCE to monitor or view what the MRPA is actually doing via the main displays on the multifunction workstation (MFW) within the ground control station (GCS). If the MMCE loses only the return datalink, as was the case in this mishap, the MRPA could still be commanded (good command datalink) without the MMCE being able to monitor what the MRPA was doing due to lost return datalink. After the MMCE executed the rack swap to PSO2, both command and return datalinks were briefly re-established, but the return datalink was lost approximately 5 seconds later. The MMCE believed the MRPA had lost both command and return datalink and was executing its emergency mission. In reality, the MRPA regained command datalink, allowing the MRPA to be "commanded in the blind," flying according to the MP's commands. This was unknown to the MP, since there was no return datalink indicating he was still in control of the MRPA. With the throttle set at idle on the PSO2 MFW, and airspeed hold on, the MRPA started a descent until it impacted the ground.

According to the GA report, the lost return datalink was due to incorrect encryption keys on the PSO2 side. The incorrect encryption keys loaded in the PSO2 rack potentially explains why the return datalink was lost. However, losing return datalink happened so frequently, that it cannot be realistically be considered a significant contributing factor to this mishap. There is no other evidence from any other source that indicates the encryption keys played any role in the mishap. The only evidence regarding encryption keys is the GA report that explains that they are most likely reason the MMCE lost return datalink.

b. Throttle Position in Idle

When the MP and mishap sensor operator (MSO) executed the PSO1 rack swap checklist, they unintentionally left the PSO2 throttle lever in the idle position. Before a rack swap, the PSO2 throttle lever is the MSO's sensor-zoom lever. In this case, the PSO2 throttle was all the way back in the idle position and remained there after the PSO1 rack was swapped to PSO2. This, when combined with the airspeed hold being engaged, forced the MRPA into a descent until it impacted the ground. The MMCE incorrectly believed that the MRPA was safely executing its emergency mission and return to base profile. The only time the MMCE could monitor the position of the MRPA was for about 5 to 7 seconds following the rack swap to PSO2, when all datalink returned. After those 5 to 7 seconds, the signal was briefly muted and terminated all datalink to the MRPA. When the signal was un-muted, the return datalink was not regained. Because of this, the MMCE assumed command link was lost as well, and that the MRPA was continuing on its emergency mission. However, the MRPA actually had regained command datalink and began to turn away from its emergency mission profile back to the northwest heading as commanded by the heading hold. The MMCE did not notice the change in heading because the MRPA still had no return datalink, thereby unknowingly resulting in the MRPA to be "commanded in the blind," or flown with no visual cues or telemetry. When the airspeed hold is engaged, the aircraft will climb or descend as necessary, based on the throttle position, in order to maintain airspeed. In this instance, the throttle was set to idle, thus requiring a descent by the MRPA in order to maintain the indicated airspeed. With no return link or other indicators, the MMCE was unaware that the MRPA was in a constant descent, which led to ground impact.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

I find by a preponderance of the evidence that there were two factors which substantially contributing to the mishap: (a) existing emergency checklists (lost datalink, PSO1 rack lock) did not provide sufficient or clear guidance; and (b) the unscheduled presence of the mishap instructor pilot (MIP) which increased confusion.

a. Existing Emergency Checklists Did Not Provide Sufficient or Clear Guidance

The MMCE executed two emergency procedure checklists during the course of this mishap. Both the lost datalink and PSO1 rack lock-up checklists are poorly written and did not properly direct the MMCE to mute the MRPA or match throttle settings once the rack was swapped. When the MRPA lost datalink and experienced a PSO1 rack lock at the same time, the MMCE was not sure which checklist to begin, and neither checklist gave them any written guidance on how to properly handle this type of compound emergency. Once the MMCE decided to begin the lost datalink emergency checklist, the MMCE realized they could not accomplish the first step (disable command datalink), due to the PSO1 lock-up. This forced them to discontinue the lost datalink checklist, which would have required them to mute the MRPA. Had the checklist stated this more clearly, the MMCE most likely would have muted the MRPA, thereby forcing it into its emergency mission and increased the chances of recovery.

Similarly, the PSO1 rack lock-up emergency checklist is not clear and does not explain how to match settings (such as throttle position). It also does not direct the crew to ensure the aircraft is muted before executing a rack swap to PSO2. Had the checklist directed the MMCE to match throttle settings and ensure the aircraft was muted, the MRPA may not have followed command inputs and started a descent. The checklist is confusing to the point that more experienced pilots, when experiencing a PSO1 rack lock-up, know to mute the aircraft first and either reset the PSO1 rack or step to a spare GCS. This practice is not in accordance with the checklist, yet is clearly a better procedure.

b. The Un-scheduled MIP's Presence Increased Confusion

It was common practice at the time of the mishap for instructor pilots to perform continuation training (CT) by observing missions in a GCS. Sometimes, these CT events would be unscheduled. Here, the MP had just completed his mission qualification training and believed the MIP would be testing his general knowledge, which made the MP anxious. However, before that actually happened, the compound emergency occurred. Because of the MP/MIP dynamic when the emergency began, the MP was unsure of whether full command to handle the emergency remained with the MP or had been assumed by the MIP. Given the low experience levels of the MP and MSO, this led to a stressful situation where the MP believed the responsibility of safely recovering the MRPA had transferred to the MIP. While the MP remained the pilot in command, his lack of experience led him to trust the MIP to direct the proper course of action. The MIP, however, was under the impression he was to be hands-off and that the MP was in complete control of the emergency, leading to more confusion in the GCS. This confusion led to a breakdown in communication that, without, would have likely allowed the MMCE to better assess the situation and increased the likelihood of recovering the MRPA.

4. CONCLUSION

I find by a preponderance of the evidence that the cause of the mishap was that the MRPA lost return datalink and did not provide the MMCE with any reasonably discernable indication that command datalink was still transmitting; which, when combined with the PSO2 throttle position being in idle and the airspeed hold engaged, led to a commanded descent and eventual ground impact. I also find by a preponderance of the evidence the following factors substantially contributed to the mishap: (a) existing emergency checklists (lost datalink, PSO1 rack lock) did not provide sufficient or clear guidance; and (b) the unscheduled presence of the MIP which increased confusion.

//SIGNED//

10 FEBRUARY 2017

THOMAS W. HANCOCK, LT COL, USAF
President, Accident Investigation Board

INDEX OF TABS