

EXECUTIVE SUMMARY

ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION

**MQ-1B, T/N 03-0111
CENTCOM AOR
18 SEPTEMBER 2012**

On 18 September 2012, at approximately 0926 Zulu (Z), the mishap remotely piloted aircraft (MRPA), an MQ-1B Predator, tail number 03-0111, operated by the 20th Reconnaissance Squadron (RS) at Whiteman Air Force Base (AFB), Missouri, crashed and was destroyed on impact in the Central Command Area of Responsibility. The 20th RS is assigned to the 432d Wing, Creech AFB, Nevada. At the time of the crash, the Mishap Crew (MC) was controlling the MRPA from Whiteman AFB. The MRPA was destroyed at an estimated loss of \$4.4 million. There were no casualties, and there was no reported damage to any property at the crash site other than the MRPA itself.

The MRPA took off from a forward operating base at 0102Z. Prior to the MC taking control of the MRPA, there was difficulty with the satellite data link that allows the MRPA to communicate with its crew. However, the issue was resolved by resetting the connection to the MRPA and the mission proceeded. At approximately 0919Z the primary navigation system began to diverge from the secondary navigation system by approximately .1 Nautical Mile (NM), to a maximum divergence of .25 NM. Normally, these systems record the same, or approximately the same, location for the MRPA. At 0921:53Z the MRPA satellite data link disconnected (known as a "lost link"). In response, the Mishap Pilot ran the appropriate checklist, but was unsuccessful in reestablishing a satellite link. At approximately 0926Z the MRPA impacted about 3.25 NM south-southwest from the point of "lost link."

The post mishap investigation revealed no anomalies with the Ground Control Station, MC, maintenance, or operations any time prior to the "lost link" at 0921:53Z. Prior to the "lost link," the satellite signal strength was normal and the MRPA was responsive. There was no evidence of negative maintenance trends or issues, and maintenance records showed no relevant discrepancies. The MC reported no anomalies with the operation of the MRPA immediately prior to the mishap. The MC followed all established checklist procedures and executed them in a timely manner. The only known anomaly was the navigation system divergence, there was no evidence to indicate this anomaly caused the mishap.

The Abbreviated Accident Investigation Board (AAIB) President could not determine any cause of, or factor that substantially contributed to, this mishap.

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-1B, T/N 03-0111
18 SEPTEMBER 2012

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COMMONLY USED ACRONYMS AND ABBREVIATIONS

12 AF	Twelfth Air Force	ISR	Intelligence, Surveillance and
20 RS	20th Reconnaissance Squadron		Reconnaissance
432 WG	432d Wing	KIAS	Knots Indicated Air Speed
AAIB	Abbreviated Accident	LA	Legal Advisor
	Investigation Board	LOS	Line of Sight
ACC	Air Combat Command	LRE	Launch and Recovery Element
AF	Air Force	Lt Col	Lieutenant Colonel
AFB	Air Force Base	MA	Mishap Aircraft
AFETS	Air Force Engineering and	Maj	Major
	Technical Services	MAJCOM	Major Command
AFI	Air Force Instruction	MC	Mishap Crew
AM	Aircraft Mechanic	MCC	Mission Crew Commander
AOR	Area of Operation	MIC	Mission Intel Coordinator
ATC	Air Traffic Control	MIC1	Mission Intel Coordinator1
AT	Avionics Technician	MIC2	Mission Intel Coordinator2
AT2	Avionics Technician2	MP	Mishap Pilot
ATO	Air Tasking Orders	MRPA	Mishap Remotely Piloted Aircraft
AWG	American Wire Gauge	MSL	Mean Sea Level
AWM2	Aircraft and Weapons Mechanic2	MSO	Mishap Sensor Operator
Capt	Captain	MTS	Multi-Spectrum Targeting System
CENTCOM	Central Command	MXSI	Maintenance Super Intendant
COMM	Communications Squadron	NM	Nautical Miles
CR	Communications Representative	Ops Tempo	Operations Tempo
DoD	Department of Defense	ORM	Operational Risk Management
ECS	Environmental Control System	PCM	Primary Control Module
EM	Emergency Mission	PPDM	Payload Power Distribution
EPS	Emergency Power System		Module
ES	Equipment Specialist	PR	Pre Flight
FLCS	Flight Control System	PPSL	Predator Primary Satellite Link
FS	Fighter Squadron	RPA	Remotely Piloted Aircraft
FSU	Flight Sensing Unit	RS	Reconnaissance Squadron
GA	General Atomics Aeronautical	SCM	Secondary Control Module
	Systems Inc.	SIB	Safety Investigation Board
GCS	Ground Control Station	SII	Special Interest Items
GPS	Global Positioning System	SPINS	Special Instructions
HQ	Headquarters	SPMA	Sensor Processor Modem Assembly
HUD	Heads up Display	T/N	Tail Number
IAW	In Accordance With	TO	Technical Order
IMIS	Integrated Maintenance	WFHQ	Warfighting Headquarters
	Information System	Z	Zulu
INS	Internal Navigation System		

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 9 November 2012, Lieutenant General William J. Rew, Vice Commander, Air Combat Command (ACC) appointed Lieutenant Colonel Daren S. Sorenson as the Abbreviated Accident Investigation Board (AAIB) President to conduct an aircraft accident investigation of the 18 September 2012 mishap of an MQ-1B Predator aircraft, tail number (T/N) 03-0111, that occurred in the Central Command (CENTCOM) Area of Responsibility (AOR) (Tab Y-3). The AAIB was conducted in accordance with Air Force Instruction (AFI) 51-503, *Aerospace Accident Investigations*, Chapter 11, at Nellis Air Force Base (AFB), Nevada, from 28 November 2012 through 14 December 2012. The following board members were also appointed: a Legal Advisor (LA) and a Recorder (Rec) (Tab Y-3).

b. Purpose

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

2. ACCIDENT SUMMARY

The Mishap Remotely Piloted Aircraft (MRPA), an MQ-1B Predator, T/N 03-0111, experienced a "lost link" on 18 September 2012 at approximately 0921:53 Zulu (Z) and impacted the ground at approximately 0926Z within the Central Command (CENTCOM) Area of Responsibility (AOR) (Tab DD-4 to 6). No injuries were reported and no other government or private property was damaged (Tab P-2). The aircraft was damaged beyond repair with a loss valued at \$4.4 million (Tab P-3). At the time of the mishap, the Mishap Crew (MC), was composed of the Mishap Pilot (MP) and the Mishap Sensor Operator (MSO) (Tab T-3, 25, 28). The Mission Crew Commander (MCC) also assisted in handling the mishap (Tab R-13). The MC operated the MRPA from the 20th Reconnaissance Squadron (RS) at Whiteman Air Force Base (AFB), Missouri (Tabs T-3, 28, R-2 to 3, 10 to 11, V-3.1, 6.1). The 20th RS is assigned to the 432d Wing (432 WG), Creech AFB, Nevada (Tab CC-15 to 17).

3. BACKGROUND

The MRPA was operated by the 20th RS. The 20th RS is a geographically separated unit of the 432 WG. The 432 WG has reporting responsibilities to the 12th Air Force, Air Combat Command and USAFCENT at Shaw AFB, South Carolina (Tabs CC-3 to 22).

a. Air Combat Command (ACC)

ACC is the primary force provider of combat airpower to America's warfighting commands. To support global implementation of national security strategy, ACC operates fighter, bomber, reconnaissance, battle-management, and electronic-combat aircraft. It also provides command and control, communications and intelligence systems, and conducts global information operations. 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. ACC numbered air forces provide the air component to U.S. Central, Southern, and Northern Commands. ACC also augments forces to U.S. European, Pacific and Strategic Command (Tab CC-3).



b. Twelfth Air Force (12 AF)

Headquarters (HQ) 12 AF is located at Davis-Monthan AFB, Tucson, Arizona (AZ). 12 AF is one of four numbered air forces assigned to ACC. The 12 AF mission is to provide combat ready forces to ACC, and train and equip 10 combat wings and one RED HORSE squadron. Additionally, 12 AF is responsible for the operational readiness of nineteen 12 AF-gained units in the Midwestern United States. (Tab CC-7).



c. 432d Wing (432 WG)

The 432 WG, stationed at Creech AFB, NV, flies the MQ-1B Predator and MQ-9 Reaper remotely piloted aircraft (RPA) systems to provide real-time Intelligence Surveillance Reconnaissance (ISR), and precision attack against fixed and time-critical targets to support American and coalition forces worldwide. The 432 WG also conducts initial qualification training for aircrew, intelligence, weather, and maintenance personnel who will fly and support RPA systems. The wing's organization includes two groups, six RPA flying squadrons, an operation support squadron, and two maintenance squadrons (CC-11, 15, 17).



d. 20th Reconnaissance Squadron (20 RS)

The 20 RS provides combatant commanders with persistent ISR, full-motion video, and precision weapons employment. Its global operations support continuous MQ-1B Predator missions, providing actionable intelligence, strike, interdiction, close air support and special missions to deployed warfighters (Tab CC-15 to 17).



e. MQ-1B Predator

The MQ-1B Predator is an armed, multi-mission, medium-altitude, long endurance unmanned aerial system. The MQ-1B Predator's primary missions are close air support, air interdiction, and ISR. It acts as a Joint Forces Air Component Commander-owned theater asset for reconnaissance, surveillance and target acquisition in support of the Joint Forces Commander (Tab CC-17).

The operational system consists of four aircraft (with sensors and weapons), a Ground Control Station (GCS), a Predator Primary Satellite Link (PPSL), and spare equipment along with operations and maintenance crews for deployed 24-hour operations. A basic Predator crew consists of a rated pilot and a sensor operator. They fly the MQ-1B Predator from inside the GCS via a line-of-sight (LOS) radio data link and via a satellite data link for beyond LOS flight. A ground data terminal antenna provides LOS communications for takeoff and landing while the PPSL provides beyond LOS communications during the remainder of the mission (Tab CC-17).

The MQ-1B Predator is equipped with a color nose camera (generally used by the pilot for flight control), a day variable-aperture television camera, a variable aperture infrared camera (for low light/night), and other sensors as required. The cameras produce full-motion video. The MQ-1B Predator also carries the Multi-Spectral Targeting (MST) system, which integrates electro-optical infrared, laser designator and laser illuminator into a single sensor package. The aircraft can carry up to two laser-guided Hellfire missiles (Tab CC-17).

4. SEQUENCE OF EVENTS

a. Mission

The MC consisted of the MP and the MSO (Tab T-25, 28). The MC was assigned to the 20th RS, 432 WG, Creech AFB, Nevada (Tabs V-3.1, 6.1). At the time of the mishap, the MC was operating the MRPA from Whiteman AFB, Missouri (Tabs V-3.1, 6.1, CC-16). The mission was tasked via the daily Air Tasking Order (ATO) published by the Combined Air Operations Center, under the authority of the Coalition Forces Air Component Commander. The ATO is a classified document, but was reviewed by the Abbreviated Accident Investigation Board. The MRPA launched from a forward deployed location at 0102Z on 18 September 2012 (Tab AA-3 to 5). The MC was the third crew to pilot the MRPA on this mission (Tab R-10 to 13). Prior to the MC taking control of the MRPA, the Launch and Recovery Element (LRE) launched and then transferred control of the MRPA to Pilot1 (Tabs R-10 to 13, V-2.1). During the transfer from the LRE to Pilot1 there was difficulty with the return satellite data link from the MRPA, the radio link that allows the MRPA to communicate with its crew (Tabs R-14, V-2.1). The issue was resolved by resetting the Sensor Processor Modem Assembly (SPMA), the aircraft component that controls the satellite data link from the MRPA (Tabs R-14 to 15, V-2.1). After the SPMA reset, the mission proceeded without further incident (Tabs R-14 to 15, V-2.1). Pilot1 was in control of the MRPA for approximately 2 hours and then transferred control of the MRPA to the Pilot2 (Tab V-2.1). Pilot2 was in control of the MRPA for several hours until he transferred control of the MRPA to the MC at approximately 0700Z without incident (Tabs R-4 to 5, 10 to 13, V-4.1).

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b. Planning

On 18 September 2012, the MP arrived approximately two hours prior to his scheduled shift start time to go through normal pre-mission briefings (Tab V-6.1 to 6.2). The pre-mission briefings included a review of weather forecasts, operational notes, ATO, special instructions ("SPINS"), special interest items (SIIs), Operational Risk Management (ORM), and Flight Crew Information Files (FCIF) (Tabs R-3, V-3.1, 5.1, 6.1 to 6.2). The MC also attended a crew briefing with the MCC and the Mission Intelligence Coordinator (MIC) to review crew coordination details, weather, intelligence updates, mission flight plan, operational notes, and ingress/egress details (Tabs R-3, V-3.1, 5.1, 6.1 to 6.2).

c. Preflight

Preflight of the MRPA was performed by the LRE without incident (Tabs R-10 to 13, EE-9, 11, 13, 15, 17).

d. Summary of Accident Prior to the mishap, the MRPA was flying a pre-programmed mission in a repeating elliptical "loiter" pattern (Tabs DD-4 to 5, 15 to 16, J-2, R-4). The MRPA was operating on autopilot without any changes to its flight plan for approximately 2 hours prior to the mishap (Tabs DD-5, 15 to 16, J-2 to 3, R-4, V-6.1). The MP did not take direct control of the MRPA prior to the mishap (Tabs R-4, V-6.1). Just prior to the "lost link," the MRPA was flying at an altitude of 15,980 mean sea level (MSL) and an airspeed of 70 knots indicated air speed (KIAS) (Tabs DD-5, J-2 to 3). The MRPA was banked approximately 1 degree left, with a pitch angle of zero and a yaw rate of zero degrees/second (Tabs DD-5, J-2 to 3). Weather in the area was clear at the time of the mishap (Tabs DD-6, F-1 to 13). There were no abnormal readings, warnings, or potential failure indications prior to the mishap (Tabs DD-5, J-2 to 3, V-6.1 to 6.2).

At approximately 0919Z the primary navigation system, the LN-100G, which uses a combination of Global Positioning System (GPS) data and Internal Navigation System (INS) data, began to diverge from the secondary navigation system, the Novatel, which uses GPS data only (Tabs DD-5, 13, EE-19 to 20). The two systems diverged approximately .1 NM, with a maximum possible divergence of .25 NM (Tabs DD-5, 13, EE-19 to 20). Normally, these systems record the same, or approximately the same, location for the MRPA (Tabs DD-4 to 5, EE-19 to 20).

At 0921:48Z the MRPA return satellite data link, disconnected for approximately one second, recovered for approximately two seconds, and then dropped out permanently at 0921:53Z (Tabs DD-4 to 5, 21 to 23, J-2 to 3, R-5 to 6). This event is known as a "lost link" (Tabs R-5, 15 to 16, J-2). During the "lost link" the MC no longer received mission data from the MRPA, making it impossible to pilot the MRPA (Tabs R-6 to 7, 15 to 16, V-5.2, 6.2).

In response to the "lost link," the MP ran the Lost Ku-band Command/Return Data Link checklist, which directs the crew to disable/mute the satellite command link (Tab R-5 to 6, 16 to 17). Attempts to re-establish the return satellite link were unsuccessful (Tabs R-5 to 6, 16 to 17, DD-4 to 5, J-2 to 3). Local Air Traffic Control (ATC) reported a loss of radar contact with the MRPA at 0922Z (Tabs R-6, 16, V-3.1, 6.1). The MRPA's location is tracked by ATC via a transponder on the aircraft (Tab EE-19 to 20). At approximately 0932Z an attempt was made to locate the MRPA via satellite imagery, but was unsuccessful (Tab R-17).

In the event of a "lost link" the MRPA is automatically directed to execute an Emergency Mission (EM) (Tabs DD-7, V-3.1, 4.1, 6.1, EE-19 to 20). The MRPA's EM directed it to return to a designated location and await recovery however, this did not occur (Tabs DD-7, R-18).

e. Impact

The MRPA impacted the ground at approximately 4 minutes after going "lost link," 0926Z, on 18 September 2012 approximately 3.25 NM south-southwest from the point of "lost link" (Tab DD-4, 16).

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

All maintenance forms for the MRPA were documented in accordance with Technical Order (T.O.) 00-20-1 (Tabs D-2 to 15, EE-5, 9, 11, 17). At the time of the mishap, the MRPA had 11382.1 total flight hours (Tab D-2). There were no discrepancies in the AFTO Form 781As prior to the mishap with no indications of recurring maintenance problems (Tab D-2 to 15).

b. Inspections

The aircraft inspections were documented and up to date (Tab D-2 to 15). The last major inspection performed on the aircraft was a 150-hour airframe inspection on 9 September 2012, 9 days prior to the mishap (Tabs D-2, EE-9). No evidence suggests the 150-hour airframe inspection had anything to do with the mishap (Tab EE-9, 17). Following the mishap, an impound and inspection of the GCS, the system with which the MC piloted the MRPA, was performed (Tab D-12 to 15). No discrepancies or anomalies were found (Tab D-12 to 15).

c. Maintenance Procedures

All proper maintenance procedures were followed and no documentation errors were found (Tabs D-2 to 15, EE-9, 11, 13, 15, 17). Maintenance was completed by civilian contractors working for Battlespace Flight Services (Tab EE-9, 11, 13, 15, 17). One possible cause of the mishap proposed by General Atomics (GA), the MRPA manufacturer, speculated that excessive

force and/or mishandling of the W160 power cable during routine Primary Control Module (PCM) maintenance (Tabs DD-12, EE-19 to 20) could have been causal. However, there is no direct evidence to support this theory, maintenance personnel report that no maintenance involving or handling the W160 power cable occurred within the recent timeframe of the mishap (Tab EE-9, 11, 13, 15, 17).

d. Maintenance Personnel and Supervision

Maintenance personnel and supervision for the MRPA were not relevant to the mishap.

e. Fuel, Hydraulic and Oil Inspection Analyses

Due to the MRPA destruction on impact, there were no post flight fuel or oil samples available (Tab DD-4 to 9). There is no evidence to suggest petroleum, oils or lubricants contributed to the mishap. There is no evidence to suggest fuel was a factor in the mishap.

f. Unscheduled Maintenance

There is no evidence that any maintenance action contributed to this mishap.

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS.

a. Structures and Systems

A review of the maintenance records, forms, and data logs for the MRPA revealed no evidence of anomalies or malfunctions that would contribute to the mishap (Tabs D-2 to 16, J-2 to 3, DD-5 to 6, EE-9, 11, 13, 15, 17). The MRPA wreckage was located after the mishap but only a few components were recovered from the crash location (Tabs Q-2 to 3, DD-4, 8 to 9). The recovered components were delivered to the manufacturer, GA, for analysis (Tabs Q-2 to 3, DD-8 to 9). Analyzed components included one Wing Control Module, one alternator, a piece of structural housing, and a navigation component (Tab DD-8 to 9). Analysis of the recovered parts revealed no evidence of contributing factors to the mishap (Tab DD-8 to 9). Of note, no power cables were recovered for analysis (Tab DD-8 to 9).

b. Evaluation and Analysis

GA analyzed the recovered wreckage and the data log files from the MRPA (Tabs J-2 to 3, DD-8 to 9). The GA report concluded there were no indications in the data logs of anomalous performance or failure of any subsystem or component that would have resulted in a "lost link" condition and loss of the aircraft (Tabs J-2 to 3, DD-8 to 13, EE-19 to 20). A separate analysis done by Air Force Engineering and Technical Services (AFETS) supports GA's data log analysis (Tab EE-5). In a case of a "lost link," the MRPA is automatically directed to execute an EM, which would have instructed the MRPA to fly to a designated location and await recovery (Tabs DD-4, J-3, R-18, V-3.1, 4.1, 5.1, 6.1). GA concluded that the most likely cause of this mishap was a catastrophic power failure (Tab DD-12 to 13). GA asserts that a catastrophic power failure would account for the "lost link," failure of the MRPA to execute its EM, and the abrupt crash of the aircraft (Tabs J-2 to 3, DD-12 to 13, EE-19 to 20). GA opined that the most likely cause of

the catastrophic power failure was a failure of one of the PCM power cables, either the W160 or the W164 (Tabs J-2 to 3, DD-12 to 13). However, without the recovery of these power cables for analysis, it is impossible for GA to confirm this theory (Tab DD-4).

7. WEATHER

a. Forecast Weather

The forecast for the area in which the MRPA was operating at the time of the mishap was winds from approximately 230 to 250 degrees at 15 to 18 knots and clear skies (Tabs F-2 to 12, S-2, R-5, V-4.1, 5.2, 6.2).

b. Observed Weather

The weather at the time of the incident was clear skies with no restrictions. These conditions were normal for this area of operation (Tabs R-5, V-4.1, 5.2, 6.2).

c. Space Environment

Space weather was analyzed and determined not to be a factor (Tab F-13).

d. Operations

Not applicable.

8. CREW QUALIFICATIONS

a. Mishap Pilot

The MP is an instructor pilot and has been a qualified MQ-1B pilot since 14 November 2011 (Tab G-3). At the time of the mishap, the MP had a total flight time of 2,431.1 hours, with 1045.3 hours in the MQ-1B. The MP was previously qualified as a C-130E navigator.

Recent flight time is as follows (Tabs G-3 to 16, V-6.1):

	Hours	Sorties
Last 30 Days	24.7	11
Last 60 Days	36.9	26
Last 90 Days	66.1	35

b. Mishap Sensor Operator

The MSO has been a qualified MQ-1B sensor operator since 24 April 2012 (Tab G-17). At the time of the mishap, the MSO had a total flight time of 248.6 hours, solely in the MQ-1B.

Recent flight time is as follows (Tab G-19 to 24):

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	Hours	Sorties
Last 30 Days	74.9	19
Last 60 Days	137.3	34
Last 90 Days	208.0	54

There is no evidence to suggest crew qualifications were a factor in this mishap.

9. MEDICAL

a. Qualifications

The MP and the MSO were medically qualified for flight duties at the time of the mishap (Tab T-3, 25).

b. Health

No evidence exists to indicate that any medical condition of the MC contributed to the mishap (Tab T-3 to 25).

c. Pathology

Blood and urine samples from directly involved personnel were collected immediately after the mishap. There is no evidence that toxicological factors were relevant in the mishap (Tab EE-29).

d. Lifestyle

No lifestyle factors were found to be relevant to the mishap.

e. Crew Rest and Crew Duty Time

In accordance with Chapter 9 of AFI 11-202 V3, *General Flight Rules*, dated 22 October 2010, crew rest consists of a 12-hour period between duty periods (Tab BB-3 to 5). Crew rest is defined as non-duty time to be utilized by the aircrew to ensure adequate rest before performing flight or flight related duties (Tab BB-3 to 5). During this time, aircrew members require a minimum of 10 hours of continuous restful activities, which includes an opportunity for at least eight hours of uninterrupted sleep (Tab BB-3 to 5). The MC complied with crew rest requirements in accordance with AFI 11-202 (Tabs R-14, T-3 to 25). The MP reported some fatigue related to recently starting the "graveyard shift," but discounted fatigue playing any role in the mishap (Tabs R-7, V-6.1 to 6.2).

10. OPERATIONS AND SUPERVISION

a. Operations

At the time of the mishap, 20 RS had an operating schedule of 6 days on, 3 days off for its mission crews with 6-hour daily flying time (Tab V-5.1 to 5.2, 6.2). Both the MCC and MP

stated that operations tempo was moderate and that mission crews were not overworked (Tab V-5.1 to 5.2, 6.2).

b. Supervision

On 18 September 2012, the MP arrived approximately two hours prior to his scheduled shift start time to go through normal pre-mission briefings (Tab V-6.1 to 6.2). The pre-mission briefings included a review of weather forecasts, operation notes, ATO, special "SPINS," SIIs, ORM, and FCIF (Tabs R-3, V-3.1, 5.1, 6.1 to 6.2). The MC also attended a crew briefing with the MCC and the MIC to review crew coordination details, weather, intelligence updates, mission flight plan, operational notes, and ingress/egress details (Tabs R-3, V-3.1, 5.1, 6.1 to 6.2). There is no evidence to suggest that any supervision factors contributed to this mishap.

11. HUMAN FACTORS

A human factor is any environmental or individual physical or psychological factor a human being experiences that contributes to or influences his performance during a task. There is no evidence to suggest that any human factors contributed to this mishap.

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publicly Available Directives and Publications Relevant to the Mishap

- (1) AFI 11-202, Volume 3, *Flying Operations-General Flight Rules*, 22 October 2010*
- (2) AFI 11-202, Volume 3, *Flying Operations-General Flight Rules, ACC Supplement*, 28 November 2012*
- (3) T.O. 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures*, 1 September 2010

NOTICE: *All directives and publications listed above are available digitally on the AF Departmental Publishing Office internet site at: <http://www.e-publishing.af.mil>.

b. Other Directives and Publications Relevant to the Mishap

Non-Applicable.

c. Known or Suspected Deviations from Directives or Publications

There were no known deviations relevant to this mishap.

13. ADDITIONAL AREAS OF CONCERN

The GA report and follow-on interviews identified the W160 power cable, which leads from the Front Bay Junction Board to the PCM, as the most likely single point of failure that could have caused a catastrophic power loss to the MRPA (Tabs DD-4, 12, EE-19 to 20). A failure in this

cable would cause a "lost link" to occur, power loss to both the PCM and transponder, and loss of control of the aircraft (Tabs DD-4, 12, EE-19 to 20).

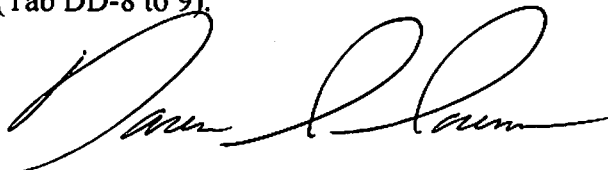
The W160 cable contains splices that convert nine #22 American Wire Gauge (AWG) wires carrying power into #10 AWG wires (Tabs DD-10, 12 to 13, E-19 to 20). A separate power cable, the W320 cable, carries power to the Secondary Control Module (SCM) and contains similar splices (Tab EE-19 to 20). Both of these power cables are single points of failure to critical systems on board the MQ-1B (Tabs DD-10, 12 to 13, E-19 to 20).

Through the course of this investigation, the AAIB discovered from expert interviews that the splices in both of these cables have failed in the past (Tab EE-19 to 20).

The W320 was determined to have been causal in a previous mishap and as a result, improvements were made to the W320 cable (Tab EE-19 to 20). However, the AAIB was unable to verify if all original W320 cables, part number UPA76465-1, in the MQ-1B fleet have been replaced by the newer W320 cable, part number UPA78085-1 (Tab EE-19 to 20). According to GA representatives, the W320 cable is only being replaced through attrition (Tab EE-19 to 20).

In a separate case, a W160 power cable was returned to GA for troubleshooting (Tab EE-19 to 20). Analysis showed this W160 cable had failed splices similar to what had previously been seen in the W320 cable (Tab EE-19 to 20). In this particular cable, eight of the nine splices had failed and only the single remaining wire was providing power to the PCM (Tab EE-19 to 20). Had the remaining wire failed during flight, it would have resulted in a catastrophic power failure and loss of the aircraft (Tab EE-19 to 20).

The W160 power cable in the MRPA was not recovered. Therefore, the AAIB is not able to determine if it was causal in this mishap (Tab DD-8 to 9).



DAREN S. SORENSON, Lt Col, USAF
President, Abbreviated Accident Investigation Board

14 December 2012

STATEMENT OF OPINION

**MQ-1B, T/N 03-0111
CENTCOM AOR
18 September 2012**

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

1. OPINION SUMMARY

I find there is not sufficient evidence to determine the cause of this mishap. I find no evidence to suggest that the Mishap Remotely Piloted Aircraft (MRPA) was lost due to weather, maintenance discrepancies, a navigational/flight control failure, the Ground Control Station (GCS) or Mishap Crew (MC) performance.

At 0921:53 Zulu (Z), the GCS stopped receiving satellite data transmissions from the MRPA. This is commonly known as a "lost link." At approximately the same time, civilian Air Traffic Control (ATC) stopped receiving location data from the MRPA's transponder. The MC followed the appropriate procedures in a timely manner to attempt to regain the communication link with the MRPA. For unknown reasons, the GCS was unable to reestablish the satellite data link with the MRPA. The MRPA was unable to execute the Emergency Mission (EM) profile and return to base. At approximately 0926Z, the MRPA crashed and the aircraft's wreckage was found in the general vicinity of its last known position. The MRPA appeared to have suffered a catastrophic loss of power and crashed approximately four minutes after it lost data link with the GCS.

2. CAUSE

Even though the crash site of the MRPA was located, only a few items of wreckage were recovered. Parts of the MRPA that were vital to determining the cause of the mishap were not recovered. This lack of physical evidence limited the Abbreviated Accident Investigation Board's (AAIB) ability to determine the exact cause of the mishap. However, even without all of the wreckage, there is sufficient evidence to rule out some of the possible causes for this mishap. These conclusions are based upon a combination of witness statements, review of maintenance records, consultation with expert advisors, results of technical analysis, weather data, and examination and review of other relevant documents. I reviewed the personnel records of all individuals directly involved in the mishap, the maintenance records and forms of the MRPA and conducted a technical analysis of the recorded data received from the MRPA prior to the loss of link.

This investigation revealed no anomalies with the GCS, the MC, maintenance, or operations any time prior to the "lost link" at 0921:53Z. Prior to the "lost link," the satellite signal strength was

normal and the MRPA was responsive. There was no evidence of negative maintenance trends or issues, and maintenance records showed no relevant discrepancies. The MC reported no anomalies with the operation of the MRPA immediately prior to the mishap. The MC followed all established checklist procedures and executed them in a timely manner. The MC was not causal to the lost link or the MRPA's failure to return to its recovery base.

Weather in the area and along the planned and emergency routes was clear. The MRPA had been operating in the same location for approximately six hours prior to the mishap. Weather was not causal to the loss of the MRPA.

The GCS for this mission was impounded and closely examined and found to be in normal working condition. It was released and returned to service without further incident. The GCS was not causal to the mishap.

The investigation did reveal one anomaly with the LN-100G navigational unit that could not be explained. In the final minutes of data recorded just before the "lost link" with the MRPA, the LN-100G began to drift and the accuracy of its present position became degraded. After an analysis of recorded data from both navigational sensors, the drift was approximately .1 Nautical Miles (NM) from that of reported position of the secondary navigational unit, with a maximum possible drift of .25 NM. This drift was not significant enough to cause a fault message to be displayed or for the autopilot to switch to the secondary navigational unit. No maintenance faults were recorded from the LN-100G prior to data link termination and, other than the degraded accuracy being reported at the time of the mishap, the LN-100G appeared to be operating normally. Even if the LN-100G had failed completely and caused a "lost link" to occur, the MRPA should have still been able to fly its EM. Therefore, I determined the anomaly with the LN-100G drift was not causal to the mishap.

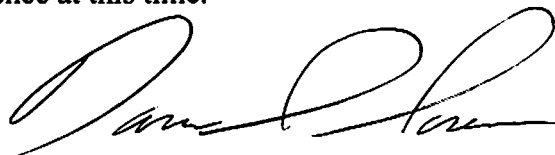
After interviewing expert witnesses, I determined that a "lost link" with an MQ-1B is rare, but not an uncommon occurrence. Usually, the satellite data link with an MQ-1B is re-established within a few seconds to a couple of minutes. But even in a situation where the link could not be regained, the MRPA should have been able to fly the EM profile and return to the recovery base and allow a safe landing by the Launch and Recovery Element (LRE) crew. Such a recovery would normally be monitored by civilian ATC, as they would continue to receive position information from the aircraft's transponder. However, ATC reported that it stopped receiving the MRPA's transponder code at approximately the same minute the satellite data link stopped.

The MQ-1B does have a history of catastrophic Primary Control Module (PCM) failure, which would have resulted in an immediate loss of satellite data link and loss of aircraft control. However, even with a PCM failure of this nature, the MRPA's transponder would have continued to operate and would have been observed by ATC until the MRPA crashed.

Given the evidence available, it is possible there was a catastrophic power loss at 0921:53Z which rendered the MRPA un-flyable causing the MRPA to crash approximately four minutes later. In a recreation of the MQ-1Bs flight profile in a simulator, I verified both the time elapsed and impact location of the MRPA were plausible based on the flight termination profile the flight

controls would have commanded had such an event occurred. There is not enough evidence, however, for me to conclude this was a contributing cause by a preponderance of the evidence.

Due to the lack of physical evidence available, the actual cause of the power loss cannot be determined by clear and convincing evidence at this time.



14 December 2012

DAREN S. SORENSON, Lt Col, USAF
President, Abbreviated Accident Investigation Board

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