DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR COMBAT COMMAND
LANGLEY AIR FORCE BASE, VIRGINIA

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NOV 16 2009

MEMORANDUM FOR ACC/JA

SUBJECT: Accident Investigation Board Report: MQ-1B, T/N 98-3047, 111 RS, 432 WG, Creech AFB, NV, 20 April 2009

I have reviewed the Accident Investigation Board Report regarding the MQ-1B, T/N 98-3047, that crashed south of Kabul Air Base, Afghanistan on 20 April 2009. The report prepared by Lt Col James W. Bruns complies with the requirements of AFI 51-503 and is approved.

WILLIAM J. REW
Lieutenant General, USAF
Vice Commander

Attachment:
Accident Investigation Board Report

EXECUTIVE SUMMARY

AIRCRAFT ACCIDENT INVESTIGATION
MQ-1B, "PREDATOR," T/N 98-3047
SOUTH OF KABUL AB, AFGHANISTAN
20 APRIL 2009

On 20 April 2009, at 1131Z (Zulu time), the mishap remotely piloted aircraft (MRPA), an MQ-1B Predator, tail number 98-3047, crashed 90 nautical miles south of Kabul Air Base (AB), Afghanistan. The Predator was an asset of the 432 Air Expeditionary Wing and was flown by the 111 Reconnaissance Squadron (Texas Air National Guard), Ellington Field, Texas.

After a six hour departure delay, the MRPA departed from Jalalabad Airfield, Afghanistan at 0214Z to fly a sortie in support of Operation ENDURING FREEDOM. At 1131Z, the MRPA lost its return link (RL). RL refers to the data transmission capability from the aircraft to the Ground Control Station (GCS) via the Predator communication systems. Attempts to reestablish the RL were unsuccessful. In addition, no further transponder signal was received. The transponder is a device on board the aircraft that sends out a transponder code, or "squawk code" which other aircraft and air traffic controllers can receive. This helps to both identify and locate the aircraft.

The MRPA did not execute its pre-planned emergency mission (EM) nor did it return to its forward operating base and was presumed crashed. The wreckage of the MRPA was located on 21 April 2009 downwind of its last recorded position. The exact time of the crash is unknown. There are no known injuries, deaths, or reported property damage. The MRPA was carrying one AGM-114P Hellfire missile. The mishap loss is valued at approximately $4.6 million.

The post-mishap investigation revealed no anomalies with regards to the MRPA at the time of the lost link. The preflight and launch was performed with no reported discrepancies. Flight crews, reported no anomalies with the operation of the MRPA in the hours of flight prior to the lost RL event.

The Accident Investigation Board President determined by clear and convincing evidence that the cause of the mishap was a catastrophic electrical system failure. The failure was most likely caused by a short circuit somewhere along the 28 volt power lines. Because of the physical and fire damage to the aircraft, there is no way to pinpoint where the failure occurred. However, a catastrophic electrical failure is considered the only plausible failure mode because only such a failure could account for the lost RL to the GCS, the inability of the aircraft to perform its pre-programmed EM, and the loss of the transponder signal. The loss of electrical power resulted in loss of control of the MRPA and the subsequent crash.

SUMMARY OF FACTS AND STATEMENT OF OPINION
MQ-1B, T/N 98-3047
20 APRIL 2009

TABLE OF CONTENTS

COMMONLY USED ACRONYMS AND ABBREVIATIONS

ACC	Air Combat Command
AEW	Air Expeditionary Wing
AGM	Air to Ground Missile
AIB	Aircraft Investigation Board
AFI	Air Force Instruction
ATO	Air Tasking Order
CL	Command Link
DAR	Dual Alternator Regulator
Det	Detachment
EM	Emergency Mission
FTU	Formal Training Unit
GCS	Ground Control Station
IMDS	Integrated Maintenance Data System
IR	Variable Aperture Infrared
ISR	Intelligence, Surveillance, and Reconnaissance
LL	Lost Link
LOS	Line of Sight
LRE	Launch and Recovery Element
LRGCS	Launch & Recovery Ground Control Station
MA	Mishap Aircraft
MC	Mishap Crew
MCE	Mission Control Element
MP	Mishap Pilot
MRPA	Mishap Remotely Piloted Aircraft
MSO	Mishap Sensor Operator
MTS	Multi-Spectral Targeting System
NM	Nautical Miles
PCM	Primary Control Module
PPSL	Predator Primary Satellite Link
RL	Return Link
ROZ	Restricted Operating Zone
RS	Reconnaissance Squadron
SATCOM	Satellite Communications
SCM	Secondary Control Module
SPMA	Sensor Processor Modem Assembly
T/N	Tail Number
TXANG	Texas Air National Guard
UAS	Unmanned Aircraft System
UAV	Unmanned Aerial Vehicle
Z	Greenwich Mean 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, PURPOSE AND CIRCUMSTANCES

a. Authority

On 24 September 2009, Major General David E. Clary, Acting Vice Commander, Air Combat Command (ACC), appointed Lieutenant Colonel James Bruns to conduct an aircraft accident investigation of the 20 April 2009 crash of an MQ-1B Predator aircraft, tail number 98-3047, at a forward operating location south of Kabul AB, Afghanistan. The accident investigation was conducted at Nellis Air Force Base (AFB), Nevada (NV), from 24 September 2009 to 5 October 2009, pursuant to Chapter 11 of Air Force Instruction (AFI) 51-503, *Aerospace Accident Investigations*. Additional Board members were Captain Christopher Hickey, Legal Advisor, and Technical Sergeant Andrea Evans, Recorder. (Tab T-2)

b. Purpose

The purpose of this investigation is to provide a publicly releasable report of the facts and circumstances surrounding the mishap, to include a statement of opinion on the cause or causes of the mishap; to gather and preserve evidence for claims, litigation, disciplinary, and administrative actions; and for other purposes. This report is available for public dissemination under the Freedom of Information Act (5 United States Code (U.S.C.) § 552).

c. Circumstances

The accident board was convened to investigate the 20 April 2009 Class A mishap involving an MQ-1B Predator aircraft, tail number 98-3047, assigned to the 432 Air Expeditionary Wing (AEW) and flown by the Mishap Crew (MC) from the 111 Reconnaissance Squadron (RS), Texas Air National Guard (TXANG), Ellington Field, Texas (TX). The mishap remotely piloted aircraft (MRPA) was flown out of Jalalabad Airfield, Afghanistan in support of Operation ENDURING FREEDOM.

2. ACCIDENT SUMMARY

On 20 April 2009, at 1131Z (Zulu time), the MRPA, a converted Block 15 MQ-1B Predator, lost its return link (RL) with the Ground Control Station (GCS) nine hours and seventeen minutes after takeoff. (Tab B-3) RL refers to the data transmission capability from the aircraft to the GCS via the Predator communication systems. At the same time as the lost link event, the MRPA's transponder ceased operating. (Tabs V-2; Y-2) The transponder is a device on board the aircraft that sends out a transponder code, or "squawk code" which other aircraft and air traffic controllers can receive. This helps to both identify and locate the aircraft that is "squawking". Efforts by the MC to reestablish the RL were unsuccessful. Efforts by the controlling agency to pick up the transponder signal were also unsuccessful. Although programmed with an emergency mission (EM) in the event of an extended lost link occurrence, there is no indication that the MRPA initiated the EM, and it did not return to any intermediate

waypoints or to its forward deployed base. The EM is basically an autopilot program dynamically assigned by the MCE throughout the mission to safely transit the aircraft to a pre-established location where line of sight radar can then take control of the aircraft. The MRPA was presumed crashed and its wreckage was subsequently located downwind of its last recorded position. There are no known injuries, deaths, or reported property damage. The MRPA was carrying one AGM-114P Hellfire missile on its right wing. The aircraft loss is valued at $4,588,282.00. (Tab P-3)

3. BACKGROUND

a. Creech AFB, Nevada

The MRPA was assigned to the 432 AEW, Creech AFB, NV and operated by the 111 RS (TXANG), Ellington Field, TX. The 432 AEW is the first United States Air Force wing dedicated to unmanned aircraft systems. The 432 AEW reports to ACC, Twelfth Air Force, and consists of combat-ready Airmen who fly the MQ-1 Predator and MQ-9 Reaper aircraft to support American and Coalition war fighters. The 432 AEW conducts unmanned aircraft system (UAS) initial qualification training for aircrew, intelligence, weather, and maintenance personnel. The 432 AEW oversees operations of the 432 Operations Group (OG) and the 432 Maintenance Group (MXG).

b. Ellington Field Joint Reserve Base, Houston, Texas

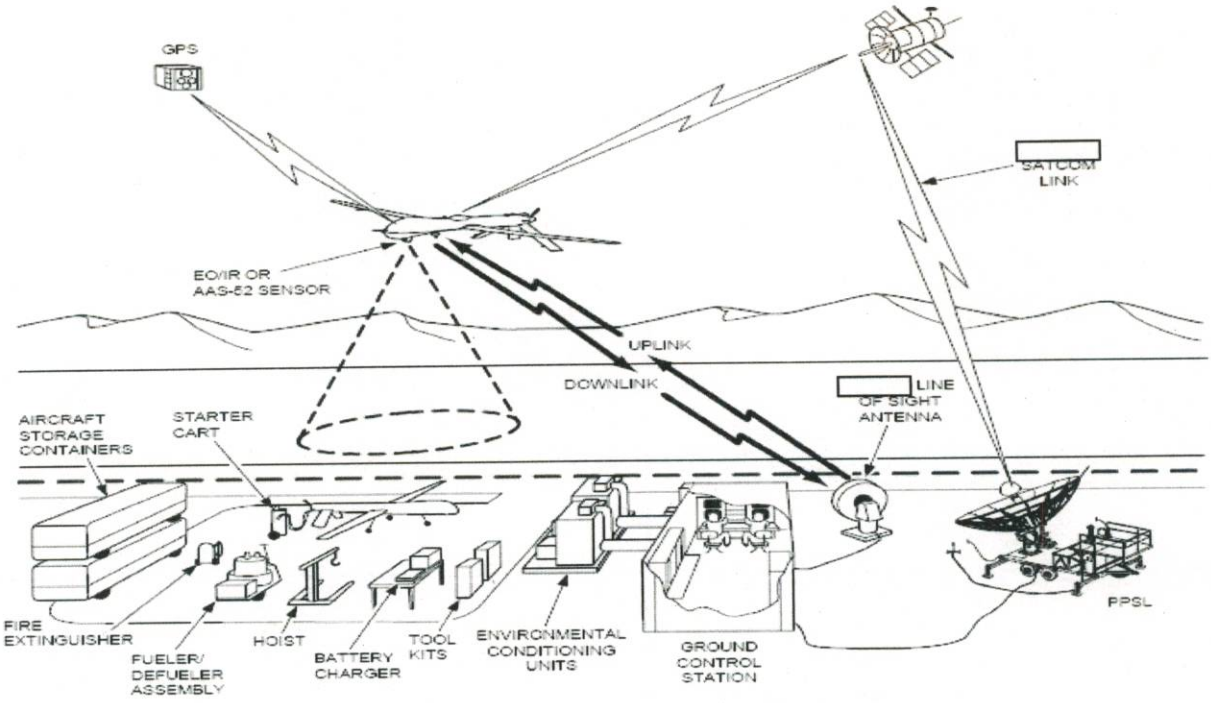
The 111 RS is an MQ-1 flying squadron attached to the147 Operations Group, 147 Reconnaissance Wing based at Ellington Field Joint Reserve Base, Houston, TX and is part of the Texas Air National Guard & 1st Air Force.

c. Predator System

The MQ-1B Predator aircraft is a medium-altitude, long endurance, unmanned aircraft system. Its primary mission is conducting armed reconnaissance and interdiction against critical perishable targets. When the MQ-1B is not actively pursuing its primary mission, it augments the MQ-9 Reaper as a Joint Forces Air Component Commander-owned theater asset for reconnaissance, surveillance and target acquisition in support of the Joint Forces Commander.

The MQ-1B Predator is a system, not just an aircraft. A fully operational system consists of four aircraft (with sensors), a GCS, a Predator Primary Satellite Link (PPSL), along with operations and maintenance crews for deployed 24-hour operations.

The basic crew for the Predator is a pilot and sensor operator. They fly the aircraft from inside the GCS via a line-of-sight (LOS) data link or a satellite (SATCOM) data link for beyond LOS flight. The aircraft is equipped with a color nose camera (generally used by the pilot for flight control), a day variable-aperture TV camera, a variable-aperture infrared (IR) camera (for low light/night), and other sensors as the mission requires. The cameras produce full-motion video.



Predator Weapon System Configuration

The MQ-1B Predator carries the Multi-Spectral Targeting System (MTS) which integrates electro-optical, infrared, laser designator and laser illuminator into a single sensor package. The aircraft can employ two laser-guided Hellfire anti-tank missiles.

The system is composed of four major components, which can be deployed for worldwide operations. The Predator aircraft can be disassembled and loaded into a single container for transport. The GCS is transportable in a C-130 Hercules (or larger) transport aircraft or installed in a fixed facility. The Predator can operate on a 5,000 by 75 feet (1,524 meters by 23 meters), hard surface runway with clear LOS. The ground data terminal antenna provides LOS communications for takeoff and landing. The PPSL provides over-the-horizon communications for the aircraft.

An alternate method of employment, Remote Split Operations, employs a smaller version of the GCS called the Launch and Recovery GCS (LRGCS). This system conducts takeoff and landing operations at the forward deployed location while the continental United States based GCS conducts the mission via extended communication links.

d. Predator Command and Control

Predator command and control is designed so that a control station must be on the correct frequency and be configured with the specific aircraft identification codes in order to control a given aircraft.

If a Predator aircraft does not receive commands from the control station (via SATCOM or LOS data link), it is programmed to perform its lost link (LL) mission. The lost link mission is a pre-programmed set of commands that causes the aircraft to configure itself for the GCS to re-establish communications. If the lost link mission does not re-establish the command and control link, the aircraft is programmed to perform its emergency mission (EM). The EM is intended to safely navigate the aircraft to a pre-established landing area.

e. Loss of Data Link Contingency

There is always a set of EM data loaded into the onboard control system. This EM data is designed to bring the aircraft safely home in the event it loses contact with its GCS. The data consists of points that define a routing, and each leg of that routing also has an associated assigned altitude. EM data is updated repeatedly by the pilot on duty as weather and threat conditions change.

Regardless of whether an MQ-1B is being controlled using a LOS data link from the LRGCS or a SATCOM data link from the GCS, it receives a command link (CL), or uplink, and transmits a RL, or downlink. If the aircraft loses CL it will transition to a LL mission. The LL mission will cause the aircraft to fly to the first point loaded into the EM. The aircraft will then begin an orbit for a set amount of time. If the LL mission does not re-establish the CL by the end of the preset orbit delay, the aircraft will begin to fly its EM routing to a pre-established landing area.

4. SEQUENCE OF EVENTS

a. Mission

The mishap sortie was an intelligence, surveillance, and reconnaissance mission flown in support of Operation ENDURING FREEDOM and was authorized by an Air Tasking Order (ATO). The mishap pilot (MP) and mishap sensor operator (MSO) were assigned to the 111 RS (TXANG), Ellington Field, TX. The MRPA's mission profile consisted of a crew from the Launch and Recover Element (LRE) launching the aircraft and several crews from the Mission Control Element (MCE) performing the ATO assigned mission, including the MC. Another crew from the LRE would have landed the aircraft had the subject crash not occurred. The MC assumed control of the MRPA approximately 7.7 hours into the mission, at 1000Z. (Tabs K-8; V-2) The MC controlled the MRPA for one hour and thirty-one minutes until the lost link event occurred at 1131Z. Hand-off operations with the prior MCE crew was uneventful and the prior crew cited no abnormalities with the MRPA. (Tab V-1)

b. Planning

The MC performed mission planning prior to assuming control of the MRPA, including weather, geography, terrain and airspace constraints associated with this mission. (Tab V-2)

c. Preflight and Launch

The mission was delayed for approximately six hours. At 0214Z, an LRE crew performed the launch for a planned mission with no reported discrepancies.

d. Summary of Accident

The MRPA departed at 0214Z from Jalalabad AB, Afghanistan. (Tab B-2) During the first seven hours of the mishap sortie, the MRPA flew as planned. At approximately 0930Z, the MRPA exited an assigned holding pattern and flew toward an area south of Kabul, Afghanistan. At 1000Z, the mishap crew (MC) took control of the MRPA from the prior MCE crew. Both the prior MCE pilot and the MP described the hand-off as "normal." (Tabs V-1; V-2) The MCE pilot briefed the MP on the weather conditions, which included some storms in the area and an incidence of icing on the camera lens. At turnover, there were no indications of any performance issues with the MRPA. (Tab V-1)

At the time of the hand-off, the MRPA was approximately 30-35 miles southwest of Jalalabad AB in transit to another area. The MC was in control of the MRPA for one hour and 31 minutes prior to the mishap. Until the lost RL, the MC testified there was no indication of any issue with the performance of the MRPA. (Tab V-2)

The MCE logger file data indicated all measured variables including the engine, power system flight computer, servos and link communications were all normal prior to the mishap. (Tab Y-2) There were six spikes in the system amperage but it was determined that those spikes correspond to payload power draws probably occurring when the MTS camera was periodically rotated by the MSO to check for icing. (Tab Y-2) The logger file data also indicated the MRPA had difficulty maintaining constant airspeed and altitude, and that the vertical speed indicator (VSI) and Normal Acceleration reported increasing fluctuation. (Tab Y-2) This data would be consistent with the MRPA flying in moderate to severe turbulence prior to the lost link.

During the mishap flight, the MC observed only a thin layer of cirrus clouds at flight level and moisture condensing on the camera lens. Neither the MP nor the MSO reported any severe weather, lightening or precipitation prior to the lost RL. (Tabs V-2; V-3)

At 1131Z, at an altitude of 19,074 feet, the MC received a loss of data advisory on the heads up display in the GCS. Upon receiving that advisory, the MC ran the checklist to reestablish the link. When the LL timer reached several minutes with no change, the MP contacted maintenance and began working with the wideband satellite communications contractor to continue efforts to restore the RL. (Tabs B-2; V-2) The Wing Operations Center (WOC) and 111 Flight Safety Office (FSO) were notified of the LL at 1135Z and 1230Z, respectively.

The MP also notified the controlling agency of the LL, the altitude of the MRPA, and the emergency mission routing. (Tab V-2) Subsequent efforts to regain link with the MRPA were unsuccessful. (Tab B-2) The controlling agency was unable to establish contact through either radar or the transponder code system. (Tab V-2) The MRPA did not execute its EM and never arrived at its pre-established location where line of sight radar can then take control of the aircraft.

e. Impact

The MA crashed at some unknown time after 1131Z, on 20 April 2009. The wreckage of the MRPA was subsequently located downwind of its last known position.

5. MAINTENANCE

a. Forms Documentation

Every USAF aircraft has a dedicated set of both written and electronic maintenance records used to record all flight and maintenance activity. Air Force Technical Order (AFTO) 781 forms collectively provides maintenance, inspection, servicing, configuration, status, and flight records for all USAF aircraft. The Integrated Maintenance Data System (IMDS) is a computer system used for maintenance management and trend analysis. All forms were documented in accordance with applicable requirements. (Tab D-16)

b. Inspections

All required inspections were accomplished, and none were overdue. (Tab D-13)

c. Maintenance Personnel and Supervision

No discrepancies in the training qualifications or documentation of maintenance practices were noted. Maintenance personnel and supervision were determined not to be relevant to this mishap.

d. Fuel, Hydraulic and Oil Inspection Analysis

The documented forms show correct levels of fluids in the aircraft at takeoff. (Tab D-15) Due to the post fire condition of the crashed MRPA, fuel and oil samples were not collected. There is no evidence to suggest petroleum, oils, or lubricants contributed to this mishap.

e. Unscheduled Maintenance

The maintenance repair history was pulled for the 90 days prior to the mishap and reveals a recurring history of issues with the MRPA regarding the Aircraft Electrical Power System. In the 90 day period, there were 13 discrepancies associated with the Aircraft Electrical Power System. Corrective actions included replacement of the Primary Control Module (PCM) twice,

replacement of the Secondary Control Module (SCM) twice and two replacements of the Sensor Processor Modem Assembly (SPMA), plus multiple other corrective actions. The MRPA's last flight prior to the mishap was on 8 April 2009 and landed with a NAV 2 Sensor fail and required the replacement of the PCM. The depot logs for the returned PCMs and SCMs were reviewed and in each case the depot was unable to duplicate the discrepancy or find anything malfunctioning on the components. There is no evidence that these maintenance issues, or the work performed accomplishing these maintenance procedures, caused or contributed to the loss of the MRPA. (Tab U-2)

6. AIRCRAFT AND AIRFRAME

a. Condition of Systems

Analysis of the information down linked to the GCS, the logger file data, indicates that immediately prior to the lost RL, at 1131Z, the aircraft and systems appeared to be operating within normal parameters for the mission. Post-accident inspection of the MRPA wreckage did not reveal a defect in any of the aircraft systems.

b. Functionality

Prior to the lost RL, the MRPA and the GCS appeared to be functioning normally and the MRPA was responding to the MP and MSO's commands. (Tabs V-2; Y-2)

c. Lost Link

There are many potential causes for LL events. Lost link is not uncommon and communication is usually reestablished without adverse consequence. There are two types of links that can be lost: command link (CL), information being sent from the flight crew to the aircraft, and return link (RL), information being sent from the aircraft to the flight crew. If CL is lost, the aircraft will transition to a LL profile and perform its programmed emergency mission. The EM is designed to fly the aircraft back to a point where acquisition of LRGCS LOS data link can occur so that the LRE can safely control the landing. If RL is lost, then the flight crew will manually terminate CL if RL is not reestablished. Once CL is terminated, the aircraft will transition to a LL profile and perform its programmed EM. Therefore, the aircraft should fly to a pre-established landing area safely regardless of whether CL or RL is lost. Discussions with operators and other technical experts indicate that the following factors can contribute to a lost link:

(1) **GCS failures.** Failure of power supplies or other components in the GCS can cause interruptions in CL transmission or RL reception.

(2) **Space Weather.** Potentially, satellite communications can be adversely affected by electromagnetic phenomena such as sunspots.

(3) **Atmospheric Weather.** Inclement weather such as thunderstorms could potentially cause LL due to extreme turbulence. Significant atmospheric moisture can also significantly attenuate radio frequency (RF) energy.

(4) **SATCOM jamming.** Deliberate jamming by hostile forces or inadvertent jamming by friendly forces of SATCOM frequencies could potentially cause lost lock.

(5) **Mutual Frequency Interference.** If several systems, including ground or air based systems, are operating in the same vicinity and are on the same or very similar frequencies mutual interference can occur.

(6) **Time Synchronization Failure.** The Predator system requires that the signals from the GCS and the aircraft be synchronized with respect to pulse timing. This is done by precision equipment on board the aircraft and in the GCS. In the GCS the Link Manager Assembly (LMA) performs this function and on the aircraft the SPMA performs this function.

(7) **Aircraft Attitude.** Bank angles greater than approximately twenty degrees may cause the onboard SATCOM antenna to lose its link.

(8) **Aircraft Component Failure.** Failure of various components onboard the aircraft could result in a LL. Some of these include the SATCOM antenna, the PCM, the SCM, the SPMA, and the alternator.

(9) **Catastrophic System Failure.** If the aircraft experienced a catastrophic event such as a shoot-down, flight into terrain or in-flight breakup, the links would be terminated.

In this aircraft mishap, the technical analysis of the logger file data from the MRPA prior to the LL suggests a catastrophic event caused the LL. Only a catastrophic electrical failure could account for the LL to the GCS, the inability of the aircraft to perform its pre-programmed EM, and the loss of the transponder signal. Although other potential LL causes such as atmospheric moisture, space weather or aircraft component failure cannot be verified or ruled out as a relevant factor in the LL, these events, if they occurred, would not have interfered with the MRPA's execution of its LL profile and safe return pursuant to its pre-programmed EM, or with the functionality of the MRPA's transponder.

7. WEATHER

The AIB reviewed the reported weather conditions and interviewed the MC and prior MCE pilot regarding observed weather conditions. This review included weather prior to and after the LL at 1131Z. The Forecaster in the Loop (FITL) map reported hazardous weather to include isolated thunderstorms, hail, severe turbulence, icing, heavy precipitation, lightening and wind shear in the general area of the MRPA flight path. (Tab F-4) However, it appears the MRPA was at all times outside the depicted hazardous weather zone. In addition, both the MP and MSO testified transitioning only through light cloud cover during the mishap flight. (Tabs V-2; V-3)

The MSO did report moisture condensing on the MTS camera lens which was cleared by turning the camera to the rear for brief periods. Atmospheric moisture can contribute to a LL event. However, because the LL mission and EM mission are pre-programmed into the aircraft, atmospheric moisture would not have interfered with the MRPA's execution of its LL mission and safe return pursuant to its pre-programmed EM.

The MCE logger file data also indicated the MRPA had difficulty maintaining constant airspeed and altitude, and that the VSI showed increasing fluctuation as did Normal Acceleration. (Tab Y-2) This data would be consistent with the MRSP flying in moderate to severe turbulence prior to the lost link. Turbulence can contribute to a LL event, causing a short term LL condition because of rapid movements. However, the link is normally reestablished fairly quickly once the aircraft steadies. The turbulence was not considered abnormal for the area and would not have caused the transponder to quit functioning.

The prior MCE pilot reported icing on the MTS camera while in a holding pattern near Jalalabad AB. (Tab V-1) However, that icing area would have been at least two hours from the mishap location. The MSO also testified to checking for the presence of ice formation in approximately 10 minute intervals during the mishap flight and never observed icing. (Tab V-3)

Space weather, or environmental factors in space beyond the earth's atmosphere, were not considered. However, because the LL mission and EM mission are pre-programmed into the aircraft, space weather would not have interfered with the MRPA's execution of its LL mission and safe return pursuant to its pre-programmed EM.

8. CREW QUALIFICATIONS

Crew qualifications were reviewed by the AIB and found to be in order. There is no evidence to suggest crew qualifications were relevant to the mishap.

a. Mishap Pilot

The MP is a senior pilot experienced in the MQ-1B with over 1,300 hours unmanned aerial vehicle (UAV) piloting time and had completed 493 MQ-1B sorties prior to the mishap flight. (Tab G-3)

b. Mishap Sensor Operator

The MSO was also qualified and current on the MQ-1B. The MSO had over 1,000 hours as a sensor operator. (Tab G-5)

9. MEDICAL

Medical records show the MP and MSO were medically qualified to perform their duties. Post mishap toxicology reports were negative for alcohol or drug use. (Tabs W-4; W-5) There is no evidence that medical histories, health or lifestyles of the MC were relevant to the mishap.

Based on the testimony of the MP and MSO and a review of their duty records leading up to the mishap flight, crew rest was within regulation and not relevant to this accident. (Tabs G-3; G-5; V-2; V-3)

10. OPERATIONS AND SUPERVISION

Operations and supervision were appropriate and not found to be relevant to the mishap.

11. HUMAN FACTORS

Human factors are perceived crew or maintainer complacency, overconfidence, under-motivation or over-motivation to succeed, distraction, disruption, pressure, channelized attention, uncharacteristic mistake, or other degradation that may have led to the mishap. There is no evidence that human factors were relevant to this mishap.

12. GOVERNING DIRECTIVES AND PUBLICATIONS

1. AFI 11-2MQ-1, Volume 1, MQ-1 Crew Training, 4 May 2007
2. AFI 11-2MQ-1, Volume 2, MQ-1 Crew Evaluation Criteria, 28 November 2008
3. AFI 11-2MQ-1, Volume 3, MQ-1 Operations Procedures, 29 November 2007
4. AFI 11-202, Volume 3, General Flight Rules, 5 April 2006
5. AFI 11-401, Flight Operations Aviation Management, 7 March 2007, incorporating Change 1, 13 August 2007
6. AFI 11-418, Operations Supervision, 21 October 2005
7. AFI 51-503, Aerospace Accident Investigations, 16 July 2004, incorporating through Change 2, 11 February 2008
8. AFI 21-101, Maintenance Management of Aircraft, 29 June 2006.

NOTICE: The AFIs listed above are available digitally on the AF Departmental Publishing Office internet site at: **http://www.e-publishing.af.mil.**

13. NEWS MEDIA INVOLVEMENT

There was no apparent media interest regarding this accident.

14. ADDITIONAL AREAS OF CONCERN

There are no additional areas of concern.

3 October 2009

JAMES W. BRUNS, Lt Col, USAF
President, Accident Investigation Board

STATEMENT OF OPINION
MQ-1B, T/N 98-3047
20 APRIL 2009

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

1. OPINION SUMMARY

I find by clear and convincing evidence that the cause of the mishap was a catastrophic electrical system failure. The failure was most likely caused by a short circuit somewhere along the 28 volt power lines. This circuit is referred to as the 28V Bus and encompasses the lines that run from the alternators to the front bay power junction board, rear bay network junction board, and the Dual Alternator Regulator (DAR). Because of the physical and fire damage to the aircraft, there is no way to pinpoint exactly where the failure occurred. Since the aircraft lost its return datalink to the Ground Control Station (GCS), the aircraft didn't perform its pre-programmed emergency mission, and the transponder stopped transmitting a signal, only a failure that could affect all systems is considered logical and plausible. A review of the performance data showed no indications of degradation or anomalous readings thus eliminating many other mishap scenarios. The mishap crew (MC) diligently scanned the wings checking for icing conditions because of the cloudy conditions. No visual indications of icing were noted nor were there any "ice detected" faults logged by the system thus eliminating weather as a contributory factor.

2. DISCUSSION OF OPINION

a. Background

On 20 April 2009, after an approximately 6 hour launch delay, the mishap remotely piloted vehicle (MRPA) departed at 0214Z (Zulu Time) from Jalalabad Airfield, Afghanistan. At 1131Z, just over 9 hours into flight, as the MRPA was flying straight and level, the MC received a notification on the heads-up display of a "lost-link" condition between the MRPA and the GCS. The MC waited a short time as "lost-link" conditions are not uncommon and then proceeded to run the applicable checklists. A technician from the wideband satellite communications contractor verified the satellite and relays were functioning correctly and a request was made to the controlling agencies to search for an active squawk from the MRPA's transponder. The relays were working properly and a transponder signal could not be found. The MC continued to monitor the pre-programmed emergency route, but the MRPA failed to reach any of the planned points. The "link" was never reestablished and the MRPA was considered a complete loss after about 30 minutes. The aircraft wreckage was found the next day, downwind of the location that "lost link" occurred.

b. Analysis

Only a catastrophic aircraft electrical system failure could cause a complete and sudden loss of aircraft performance information. Individual short circuits or component failures would result in at least some discrepancy data reported through the link. A short circuit somewhere along the 28V Bus would cause a voltage drop severe enough to shut down all components connected to the Bus. This drop and the subsequent shut down of components could all happen in less than a second, resulting in no indication of failure from one sampling of the aircraft performance data to complete failure. Although a failure of the Primary Control Module (PCM) could make the aircraft unresponsive to inputs, the circuit would fail in a "closed" condition and the transponder would still generate a signal. The MQ-1B is equipped with backup batteries designed to provide power for a limited time for typical failures in the electrical system or engine failures, resulting in no power being produced. The batteries provide enough power for some flight maneuvers, maintaining command links and providing power to the transponder. However, a catastrophic failure in the 28V Bus would likely overpower the ability of the batteries to provide power.

After evaluating the MRPA history over the 90 days prior to the incident, it appears to have a higher than average amount of discrepancies (13) in the electrical system and "lost link" events. In that period, the PCM, Secondary Control Module, and Sensor Processor Modem Assembly were each removed and replaced two times in addition to other component and cable replacements. The PCM was changed following the MRPA's last flight and this flight. The post-mishap evidence appears to support that the PCM was properly installed and was not a contributing factor. There is no evidence that these previous discrepancies were linked to this electrical failure; however, there may have been a growing problem within the 28V Bus masqueraded by perceived failure of the other components. Depot return logs show the returned PCMs and SCMs as could-not-duplicate (CND), no repair action needed.

I arrived at my opinion by examining the GA-ASI Test Report, witness testimony, consulting with subject matter experts, data logger information from the mishap flight and applicable technical data. All evidence points to a catastrophic electrical failure caused by a short circuit within the 28V Bus as the most probable cause of the mishap.

3 October 2009

JAMES W. BRUNS, Lt Col, USAF
President, Accident Investigation Board