UNITED STATES AIR FORCE
ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

MQ-1B, T/N 99-3058

18TH RECONNAISSANCE SQUADRON
432D WING
CREECH AIR FORCE BASE, NEVADA

LOCATION: 53 NM Southwest of Jalalabad Air Base, Afghanistan

DATE OF ACCIDENT: 26 October 2012

BOARD PRESIDENT: Lt Col Ahren D. Heidt

CONDUCTED IAW AIR FORCE INSTRUCTION 51-503
Abbreviated Accident Investigation pursuant to Chapter 11

EXECUTIVE SUMMARY

ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION
MQ-1B, T/N 99-3058
53 NM SOUTHWEST OF JALALABAD AIR BASE, AFGHANISTAN
26 OCTOBER 2012

On 26 October 2012, at approximately 2222 hours Zulu time (Z), an MQ-1B remotely piloted aircraft, tail number 99-3058, impacted the ground 53 nautical miles southwest of Jalalabad Air Base (AB), Afghanistan, after completing a 20.4 hour surveillance mission. The mishap remotely piloted aircraft (MRPA) was forward deployed from the 432d Wing, Creech Air Force Base (AFB), Nevada (NV). The MRPA was operated by the 18th Reconnaissance Squadron, Creech AFB, NV. The MRPA and one air-to-ground Hellfire missile were destroyed on impact. The total damage to United States Government property was assessed to be $4,600,000.00. There were no injuries or damage to other government or civilian property.

On 26 October 2012, at 0159Z, after normal preflight checks, the MRPA taxied and departed Jalalabad AB, Afghanistan. Handover from the Launch and Recovery Element to the Mission Control Element (MCE) was uneventful. At approximately 2200Z, the MCE completed their assigned surveillance mission and steered towards Jalalabad AB to return to base. At 2206Z, the Mishap Crew, which consisted of the Mishap Pilot (MP) and the Mishap Sensor Operator, received a Variable Pitch Propeller (VPP) servo high temperature caution message on the heads down display. This message was the first indication of a VPP problem. Eventually, the VPP failed in a manner that only allowed movement to a lower propeller pitch angle. While attempting to resolve the problem, the MP momentarily commanded the propeller pitch to an angle that produced reverse thrust. The system would not accept commands to a higher propeller pitch angle. Next, the MP shut down the engine to increase the glide distance due to the reverse thrust. The resulting loss of forward thrust prevented the MRPA from returning back to base or reaching a suitable landing location. Finally, the MP was directed to crash the MRPA, with the Hellfire missile attached, into the terrain because it would not be able to reach Jalalabad AB and there were no Forward Operating Bases nearby. The MP did as directed causing the MRPA to impact the terrain at 2222Z.

The Abbreviated Accident Investigation Board (AAIB) President found by clear and convincing evidence the cause of the mishap was a combination of a mechanical failure of the VPP servo motor and unnecessary movements of the propeller pitch control lever by the MP. Furthermore, the AAIB President found by a preponderance of evidence that incorrect and insufficient checklist guidance, reinforced by incorrect simulator training, were substantially contributing factors to the mishap.

SUMMARY OF FACTS AND STATEMENT OF OPINION

MQ-1B, T/N 99-3058
53 NM SOUTHWEST OF JALALABAD AIR BASE, AFGHANISTAN
26 OCTOBER 2012

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COMMONLY USED ACRONYMS AND ABBREVIATIONS

12 AF	Twelfth Air Force
18 RS	18th Reconnaissance Squadron
432 WG	432d Wing
AAIB	Abbreviated Accident Investigation Board
AB	Air Base
ACC	Air Combat Command
AF	Air Force
AFB	Air Force Base
AFI	Air Force Instruction
AFTO	Air Force Technical Order
AGM	Air to Ground Missile
AIB	Accident Investigation Board
amps	Amperes
BFS	Battlespace Flight Services
fpm	feet per minute
GA-ASI	General Atomics Aeronautical Systems, Inc.
GCS	Ground Control Station
IAW	In Accordance With
ISR	Intelligence, Surveillance, and Reconnaissance
LLC	Limited Liability Company
LOS	Line of Sight
Lt Col	Lieutenant Colonel
MAJCOM	Major Command
MC	Mishap Crew
MCE	Mission Control Element
MIC	Mission Intelligence Coordinator
mIRC	Multi-User Internet Relay Chat
MOS	Mishap Operations Supervisor
MP	Mishap Pilot
MRPA	Mishap Remotely Piloted Aircraft
MSFO	Mishap Safety Observer
MSO	Mishap Sensor Operator
MXP6	Maintenance Personnel 6
MXP8	Maintenance Personnel 8
nm	Nautical Miles
NV	Nevada
OJT	On-the-Job Training
Ops Sup	Operations Supervisor
PPSL	Predator Primary Satellite Link
RPA	Remotely Piloted Aircraft
RPM	Revolutions Per Minute
SIB	Safety Investigation Board
T/N	Tail Number
TDY	Temporary Duty
TO	Technical Order
U.S.	United States
U.S.C.	United States Code
VIT	Variable Information Table
VPP	Variable Pitch Propeller
VVI	Vertical Velocity Indicator
WOC	Wing Operations Center
Z	Zulu

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 28 December 2012, Lieutenant General William J. Rew, Vice Commander Air Combat Command (ACC) appointed Lieutenant Colonel Ahren D. Heidt to conduct an abbreviated aircraft accident investigation of the 26 October 2012 crash of an MQ-1B aircraft, tail number (T/N) 99-3058, 53 nautical miles (nm) southwest of Jalalabad Air Base (AB), Afghanistan. The abbreviated aircraft accident investigation was conducted in accordance with (IAW) Air Force Instruction (AFI) 51-503, *Aerospace Accident Investigations*, Chapter 11, at Nellis Air Force Base (AFB), Nevada (NV), from 7 January 2013 through 30 January 2013. A legal advisor and recorder were also appointed as members of the board (Tab Y-3 to Y-4). Functional area experts for the board included a pilot and a maintenance member (Tab Y-5).

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

On 26 October 2012, at approximately 2222 hours Zulu time (Z), the mishap remotely piloted aircraft (MRPA), an MQ-1B Predator, T/N 99-3058, assigned to the 432d Wing, Creech AFB, NV, impacted the ground approximately 53 nm southwest of Jalalabad AB, Afghanistan (Tabs AA-7, EE-3). The MRPA and one air-to-ground Hellfire missile (AGM-114) were destroyed upon impact with the loss valued at $4,600,000.00 (Tab P-4). There were no injuries or damage to other government or civilian property (Tab P-3).

3. BACKGROUND

The MRPA was an asset of the 432d Wing (432 WG), Creech AFB, NV (Tab EE-3). The 432 WG falls under the major command (MAJCOM) ACC and the numbered Air Force, Twelfth Air Force (12 AF) (Tab CC-7, CC-9). The Mishap Crew (MC), consisting of the Mishap Pilot (MP) and Mishap Sensor Operator (MSO), are assigned to the 18th Reconnaissance Squadron (18 RS), 432 WG, Creech AFB, NV (Tab K-8). Additionally, at the time of the mishap, the MRPA was forward deployed to Afghanistan and was maintained by Battlespace Flight Services (BFS), Limited Liability Company (LLC) (Tab V-4.1 to V-4.2).

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, control, communications, and intelligence systems, and conducts global information operations (Tab CC-3).

b. Twelfth Air Force (12 AF)

12 AF is responsible for the combat readiness of 10 active-duty wings and one direct reporting unit. The subordinate commands operate more than 818 aircraft with more than 65,000 uniformed and civilian Airmen. The command is also responsible for the operational readiness of 12 AF-gained wings and other units of the Air Force Reserve and Air National Guard (Tab CC-7).

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 force warfighter. The RPA systems provide real-time reconnaissance, surveillance, and precision attack against fixed and time-critical targets. The Hunters conduct RPA training for aircrew, intelligence, weather, and maintenance personnel (Tab CC-9).

d. 18th Reconnaissance Squadron (18 RS)

The 18 RS provides combatant commanders with persistent intelligence, surveillance, and reconnaissance (ISR), full-motion video, and precision weapons employment. Global operations architecture supports continuous MQ-1B Predator employment providing real-time actionable intelligence, strike, interdiction, close air support, and special missions to deployed war-fighters (Tab CC-10).

e. Battlespace Flight Services (BFS)

BFS provides organizational maintenance support for MQ-1 aircraft and systems to sustain the combat and training capability at tasked locations worldwide. The primary objective of BFS is to provide qualified management and supervisory personnel at the continental United States (U.S.) and outside continental U.S. locations, and a level of support for their personnel that allow them to accomplish their objective. Support includes aircraft maintenance, supply support, command, control, communications, computer, ISR systems, quality assurance, and an environmental, safety, and health program (Tab CC-13).

f. MQ-1B, Predator

The MQ-1B Predator aircraft is a medium-altitude, long endurance RPA. Its primary mission is interdiction and conducting armed reconnaissance against critical perishable targets. The MQ-1B Predator is a fully operational system, consisting of an aircraft (with sensors), a Ground Control Station (GCS), a Predator Primary Satellite Link (PPSL), and operations and maintenance personnel for deployed 24-hour operations. The basic crew for the MQ-1B Predator is one pilot and one 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. The aircraft is equipped with a color nose camera (generally used by the pilot for flight control), and other sensors, as required. The cameras produce full-motion video. The MQ-1B Predator also carries the Multispectral Targeting System, which integrates electro-optical, infrared, a laser designator, and a laser illuminator into a single sensor package (Tab CC-11 to CC-12).

4. SEQUENCE OF EVENTS

a. Mission

On 26 October 2012, the MRPA was performing a classified ISR and overwatch tasking out of Jalalabad AB, Afghanistan (Tabs V-1.1, AA-3).

b. Planning

The MC consisted of the MP and the MSO. On 26 October 2012, at approximately 1300-1330Z, the MP arrived at the 18 RS and performed administrative duties. At 1430Z, the MP attended a mass brief given by the Operations Supervisor (Ops Sup). The briefing covered weather, mission information, operations notes, and pertinent intelligence (Tab V-1.1). The MSO did not attend the mass briefing as he took a physical fitness test at 1600Z. The MSO returned to the 18 RS around 1700Z and performed no administrative actions other than signing in to fly (Tab V-2.1). The mission preparation, mass briefing, handover briefings, and crew briefing were adequate for the mission conducted (Tab V-1.1).

c. Preflight

The MSO stepped to the GCS around 1740Z and received a mission brief from the previous sensor operator prior to assuming sensor operator responsibility (Tab V-2.1). At approximately 1850Z, the MP stopped by mission support to get an update from the Ops Sup and Mission Intelligence Coordinator (MIC) on relevant intelligence, airspace, clearances, weather, mission, and any notes and changes from the morning mass brief. The MP then received another brief from the previous pilot covering the same topics, in addition to status of the aircraft and the GCS. The MP then swapped out the previous pilot and took control of the aircraft at 1900Z (Tab V-1.1 to V-1.2).

d. Summary of Accident

On 26 October 2012, the MRPA took off from Jalalabad AB, Afghanistan, at 0159Z (Tab AA-3). After an uneventful mission, the MC began the return to base at approximately 2200Z (Tab V-1.2). At 2202Z, the Variable Pitch Propeller (VPP) servo amperes (amps) climbed and stabilized at 1.4 and the VPP servo temperature began increasing simultaneously. At 2206Z, the MC received a VPP servo high temperature caution message on the heads down display. In an attempt to rectify the problem, the MC referenced the Technical Order (TO) 1Q-1(M)B-1 VPP Servo Overheat/Servo Failure checklist (Tab AA-3).

At 2208Z, the MP enabled manual control of the propeller pitch. As a result, the propeller pitch dropped to 10.75 degrees, the revolutions per minute (RPM) increased from 4,750 to 5,900 (the maximum RPM limit), the VPP servo amps dropped to zero, and the VPP servo temperature began decreasing. The MRPA began descending at approximately 250 feet per minute (fpm) (Tab AA-3).

At 2209Z, the MP verified that the propeller pitch lever was set for 57.5 percent. The MSO then read step six of the checklist which directs aircrew to set the propeller pitch lever to zero amps to correct for an overheat by matching the propeller pitch lever to a frozen VPP servo's current position. In response, the MP stated, "…set for zero amps, and we have zero amps right now. I think that may have been erroneous." He then enabled automatic control of the propeller pitch which caused the pitch to move to 20 degrees then immediately back down to 18.5 degrees. The RPMs stabilized at approximately 4500. The VPP servo amps increased and stabilized at 1.4 and the VPP servo temperature began rising (Tab AA-4).

At 2210Z, the MP noticed the rising VPP servo temperature and therefore enabled manual control of the propeller pitch. The VPP servo amps immediately returned to zero and the temperature began to decrease while the propeller pitch stayed at 18.5 degrees. The MP verbalized that the propeller pitch was stuck at approximately 18 degrees (Tab AA-4).

At 2211Z, the MP stated that everything had returned to normal and he just needed to add power and level off. The MP increased the throttle to 100 percent but the RPMs only increased to approximately 4,600 and the MRPA maintained a slow descent of approximately 300 fpm (Tab AA-4).

At 2213Z, the MP moved the propeller pitch lever from 57.5 percent down to 45 percent, which caused the propeller pitch to reduce to 12.15 degrees. Then the MP increased the propeller pitch lever back to 60 percent; however, the propeller pitch continued to reduce to 10.5 degrees. The RPMs correspondingly increased to 5,900 and the descent rate increased to 450 fpm (Tab AA-4).

At 2214Z, the MP increased the propeller pitch lever to 85 percent, but the propeller pitch did not change. The MP then decreased the propeller pitch lever to 35 percent and the pitch decreased to 7.0 degrees (Tab AA-4). The MP further decreased the propeller pitch lever to 30 percent and the propeller pitch decreased to 5.0 degrees. The descent rate increased to approximately 800 fpm and the MSO announced they were in a rapid descent. The MP then increased the propeller pitch lever to 100 percent, but the propeller pitch did not change (Tab AA-5).

At 2215Z, the MP decreased the propeller pitch lever to zero percent and the propeller pitch decreased to negative three degrees. The MP increased the propeller pitch lever to 100 percent with no change in propeller pitch. The MRPA descended through 16,500 feet and the descent rate increased to 1,200 fpm (Tab AA-5).

The MP cycled the propeller pitch lever two more times from 100 percent to zero percent over the next 40 seconds while the propeller pitch remained at negative three degrees. The MP verbalized the propeller pitch was stuck at negative three degrees and executed the VPP Rack Bridge Bearing Failure checklist (Tab AA-5). IAW the checklist, the MP turned off the engine and the descent rate decreased from 1,200 to approximately 800 fpm (Tab AA-6).

The MP determined the MRPA would not make it back to Jalalabad AB and verified with the mission intelligence coordinator that there were no Forward Operating Bases nearby. The Wing Operations Center Director instructed the MP, via the Ops Sup, to drive the MRPA "controlled hard" into the ground as close to Jalalabad AB as possible with the missile on the aircraft. The MP did as directed, accelerating the MRPA to a final airspeed of 100 knots at impact (Tab AA-6 to AA-7).

e. Impact

The MRPA impacted the terrain at approximately 2222Z on 26 October 2012, approximately 53 nm southwest of Jalalabad AB, Afghanistan (Tab AA-7). The MRPA and one AGM-114 Hellfire missile were destroyed on impact. There were no injuries or damage to other government or civilian property. The total damage to U.S. Government property was assessed to be $4,600,000.00 (Tab P-3 to P-4).

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

The Air Force Technical Order (AFTO) 781 series forms for the MRPA were documented IAW applicable maintenance guidance. The forms indicated no outstanding issues that would have prevented the MRPA from flying on 26 October 2012 (Tab D-3 to D-12). There was one minor documentation discrepancy in the AFTO 781 Form A; specifically, a member of the crew annotated the servo adjustment in the same block as the maintenance of the VPP replacement

(Tab D-12, U-9). IAW with BFS's customs and practices, all rigs and adjustments must be written up in separate blocks on the AFTO 781 Form (Tab V-4.2). There is no evidence that this documentation error was a factor in the mishap. Furthermore, there were no recurring maintenance problems documented in the AFTO 781 Forms (Tab U-9).

b. Inspections

All maintenance inspections were completed and documented IAW applicable regulations and TOs. On 25 October 2012, the maintenance crew performed a 60-hour inspection on the aircraft (Tabs D-4 to D-11, V-4.1).

A 60-hour inspection is completed after every 60 hours of RPA flight time (Tab V-4.1). It is an inspection of the aircraft's oil cooler supply line, engine coolant line, magnetic plug, and turbocharger. In addition, during the inspection, the aircraft's air filter is cleaned and the oil filter is changed (Tabs D-7 to D-8, V-4.1). The 60-hour inspection was completed by Maintenance Personnel 8 (MXP8), a civilian contractor (Tab V-4.1). Nothing out of the ordinary was discovered during the 60-hour inspection (Tabs U-9, V-4.1).

c. Maintenance Procedures

The VPP assembly is replaced every 720 hours of RPA flight time (Tab V-3.1). Maintenance Personnel 6 (MXP6), a civilian contractor, replaced the MRPA VPP assembly on 25 October 2012. The old VPP was removed and the new one was installed without any issue or deviation from technical data (Tab V-3.1, D-3 to D-12).

Additionally, the VPP servo is also replaced every 720 hours of flight time. This VPP servo was originally installed on a different aircraft and remained until the 720 hours of flight time was reached. The VPP servo was sent back to General Atomics Aeronautical Systems, Incorporated (GA-ASI) for a rebuild. It was then installed on the MRPA and had 562 hours prior to the incident. There was no specific maintenance performed on it and it had roughly 158 flight hours remaining before it was due to be changed (Tab U-10).

All proper tools and equipment were provided to complete the task required for removal, install, rigging, and operational checking of the VPP assembly (Tab U-5 to U-8).

d. Maintenance Personnel and Supervision

BFS maintained the MRPA at Jalalabad AB, Afghanistan (Tab V-4.1). A review of the Air Force (AF) Forms 623 and AF Forms 797 for the maintenance crew, including MXP6 and MXP8 who performed the VPP assembly removal and installation and the 60-hour inspection, showed they were trained, experienced, and certified to complete their tasks (Tab U-226 to U-268, U-312 to U-355). Additionally, MXP6 and MXP8 received adequate supervision while performing these services (Tab U-3 to U-4).

e. Fuel, Hydraulic and Oil Inspection Analyses

The MRPA was refueled prior to the mishap by MXP6 and MXP8 (Tab D-5). The aircraft oil was changed and inspected by a maintenance crew prior to mishap and nothing out of ordinary

was reported (Tab D-3 to D-12). The MQ-1B is not equipped with a hydraulic system. Additionally, no hardware or fluid was recovered from the MRPA (Tab U- 9).

f. Unscheduled Maintenance

Not applicable.

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

The MRPA was intentionally flown into a mountainside. It was destroyed on impact, and no aircraft parts were recovered. Consequently, the actual condition of the systems could not be determined (Tab DD-4).

b. Evaluation and Analysis

Due to the damage to the aircraft, no parts were recoverable or able to be sent for examination and testing by engineers (Tab DD-4). Therefore, data logger files were relied upon heavily for accident analysis. While T/N 99-3058 was airborne, it constantly transmitted the status of aircraft systems to the GCS, where the flight data was recorded against a time stamp (in seconds) that began at aircraft preflight when the aircrew powers on the recorders (Tab AA-7).

Data log analysis showed the VPP servo motor failed in a manner that only allowed one direction of movement due to reduced torque ability. Only propeller movements to lower pitch angles, aided by aerodynamic loading, were able to be achieved. The servo appeared to be unable to drive the propeller to higher pitch angles; however, it was able to maintain various pitch angles until additional commands were made (Tab DD-12 to DD-13).

GA-ASI performed several tests to determine possible failure modes that would have produced results similar to what the data loggers indicated. One of the tests was specifically designed to determine if a failed VPP servo motor (motor with a dead spot) would have been able to move a loaded propeller to a lower pitch angle (Tab DD-8).

Thorough testing conducted by GA-ASI indicated a failure of the VPP servo motor was most likely a factor. Specifically, it was likely the VPP servo motor experienced a loss of torque due to either a damaged connection or a failure of the brushes within the electrical servo motor. Tests confirmed that a VPP motor experiencing this failure would be unable to move the propeller to a higher pitch angle due to aerodynamic loads during flight. However, VPP servo movement to a lower propeller pitch angle would be uninhibited when assisted by the same aerodynamic loads (Tabs DD-9, DD-12 to DD-14).

7. WEATHER

a. Forecast Weather

High pressure was forecast over the region with no convective development, turbulence, cloud cover, precipitation, or icing. Visibility was unlimited (Tab W-3).

b. Observed Weather

Weather in the operating area was not significant (Tab V-1.1). An Aircraft Mishap Weather Report accomplished by the 432d Weather Operation Center assessed that weather did not have an impact on the mishap sortie (Tab W-3).

c. Operations

Operations were conducted within their prescribed operational weather limitations (Tab V-1.1).

8. CREW QUALIFICATIONS.

a. Mishap Pilot

The MP was an instructor with a total flight time of 1,288.6 hours including 85.7 hours of instructor time (Tabs G-4, V-1.1). Additionally, the MP was an experienced Launch and Recovery Pilot (Tabs G-17, V-1.1).

Recent flight time is as follows (Tab G-5):

	Hours	Sorties
Last 30 Days	36.9	14
Last 60 Days	100.5	38
Last 90 Days	134.5	51

b. Mishap Sensor Operator

The MSO was qualified in the MQ-1B on 19 July 2012 and had a total flight time of 142.1 hours at the time of the mishap (G-9, G-10).

Recent flight time is as follows (Tab G-5):

	Hours	Sorties
Last 30 Days	59.0	20
Last 60 Days	114.3	39
Last 90 Days	125.5	47

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

9. MEDICAL

a. Qualifications

At the time of the mishap, MP and MSO had current flight physicals, no known illnesses or injuries, and were medically qualified to perform flying duties (Tab FF-3 to FF-4).

b. Health

Both members' Preventative Health Assessments and flight physicals were current. Neither member had been issued a certificate restricting flight duties or "Duties Not Including Flying." There were no pending or expired medical waivers. The members had no medical conditions that were factors in the mishap. Neither the MP nor the MSO were taking any medication other than those that were previously recommended, ground tested, approved, and prescribed by licensed medical providers. There is no evidence that medication was a factor in the mishap (Tab FF-3 to FF-4).

c. Toxicology

Blood and urine samples of the MP and MSO were collected at Creech AFB, NV. The samples were tested for the presence of ethanol, and drugs of abuse (amphetamine, barbiturates, benzodiazepines, cannabinoids, cocaine, opiates, and phencyclidine). All toxicology testing resulted in negative findings for ethanol and drugs of abuse (Tab FF-3 to FF-4).

d. Lifestyle

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

e. Crew Rest and Crew Duty Time

AFI 11-202, Volume 3, *Flying Operations-General Flight Rules,* Chapter 9, 22 October 2010, requires pilots to have proper "crew rest" prior to performing in-flight duties and adhere to proper duty time requirements. No crew rest or crew duty time requirements were violated nor found to be a factor in the mishap (Tab FF-3 to FF-4).

10. OPERATIONS AND SUPERVISION

a. Operations

The operations tempo was normal (Tab V-2.1). All individuals involved in the mission including the MC were experienced and qualified to perform the mission (Tab V-1.1, V-2.1, V-3.1, V-4.1). There is no evidence that operational tempo was a factor in the mishap.

b. Supervision

All members involved in the mission received adequate oversight from supervision (Tab V-2.1, V-4.2). There is no evidence supervision was a factor in the mishap.

11. HUMAN FACTORS

AFI 91-204, *Safety Investigations and Reports,* 24 September 2008, Attachment 5, contains the Department of Defense Human Factors Analysis and Classification System, which lists potential human factors that can play a role in aircraft mishaps. The following human factors were relevant to this mishap:

a. AE201 Risk Assessment – During Operation

Risk Assessment – During Operation is a factor when the individual fails to adequately evaluate the risks associated with a particular course of action. This faulty evaluation leads to inappropriate decision and a subsequent unsafe situation. This failure occurs in real-time when formal risk-assessment procedures are not possible (Tab BB-4).

Although the aircrew checklist has no notes, warnings, or cautions concerning unnecessary movements of the propeller pitch lever outside of a regime acceptable for sustained flight, the narrative section of the checklist discusses intermittent and permanently frozen VPP servo failures (Tab AA-9).

b. OP003 Procedural Guidance/Publications

Procedural Guidance/Publications is a factor when written direction, checklists, graphic depictions, tables, charts or other published guidance is inadequate, misleading or inappropriate and this creates an unsafe situation (Tab BB-5 to BB-6).

The narrative section of the TO 1Q-1(M)B-1 Propeller Servo Overheat/Servo Failure checklist addresses several possible symptoms of a failing VPP servo. The checklist itself has no notes, warnings, or cautions concerning unnecessary movements of the propeller pitch lever outside of a regime acceptable for sustained flight (Tab AA-9). Additionally, the checklist assumes an overheating VPP servo will continuously attempt to move to match the commanded propeller pitch setting. In reality, when the propeller pitch lever is adjusted, the VPP servo will only attempt to move for three seconds (Tab AA-8 to AA-9).

c. OP004 Organizational Training Issues/Programs

Organizational Training Issues/Programs are a factor when one-time or initial training programs, upgrade programs, transition programs, or other training conducted outside the local unit is inadequate or unavailable, thus creating an unsafe situation (Tab BB-6).

In the MQ-1B simulator, an overheating VPP servo continues to draw current indefinitely and the servo heats up as a result. To stop the current and resulting overheating of the servo, crews are taught to manually move the propeller pitch lever to match the failed position of the VPP servo. Unlike the simulator, the aircraft VPP servo will only attempt to move for three seconds (Tab AA-8).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

(1) AFI 51-503, *Aerospace Accident Investigations*, 26 May 2010
(2) AFI 91-204, *Safety Investigations and Reports,* 24 September 2008

*All AFIs are available digitally at: http://www.e-publishing.af.mil.

b. Other Directives and Publications Relevant to the Mishap

(1) TO 1Q-1(M)B-2-61GS-00-1, *Technical Manual, Propeller, MQ-1B Remotely Piloted Aircraft*, 31 January 2011
(2) TO 1Q-1(M)B-2-61JG-00-1, *Job Guide, Propeller, MQ-1B Remotely Piloted Aircraft*, 31 January 2011
(3) TO 1Q-1(M)B-1, *Flight Manual, USAF Series MQ-1B System*, 13 December 2010
(4) TO 1Q-1(M)B-1CL-1, *Flight Crew Checklist, USAF Series MQ-1B System*, 13 December 2012

c. Known or Suspected Deviations from Directives or Publications

Not applicable.

13. ADDITIONAL AREAS OF CONCERN

Not applicable.

30 January 2013

AHREN D. HEIDT, Lt Col, USAF
President, Abbreviated Accident Investigation Board

STATEMENT OF OPINION

MQ-1B, T/N 99-3058
53 NM SOUTHWEST OF JALALABAD AIR BASE, AFGHANISTAN
26 OCTOBER 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

On 26 October 2012, at approximately 2222 hours Zulu time, an MQ-1B remotely piloted aircraft, tail number 99-3058, impacted the ground 53 nautical miles southwest of Jalalabad Air Base, Afghanistan, after completing a 20.4 hour surveillance mission. The mishap remotely piloted aircraft (MRPA) was forward deployed from the 432d Wing, Creech Air Force Base (AFB), Nevada (NV). The MRPA was operated by the 18th Reconnaissance Squadron, Creech AFB, NV. The MRPA and one air-to-ground Hellfire missile were destroyed on impact. The total damage to United States Government property was assessed to be $4,600,000.00. There were no injuries or damage to other government or civilian property.

I find by clear and convincing evidence the cause of the mishap was a combination of a mechanical failure of the Variable Pitch Propeller (VPP) servo motor and unnecessary movements of the propeller pitch control lever by the Mishap Pilot (MP). The VPP servo motor failed in a manner that only allowed movement to a lower propeller pitch angle. The MP momentarily commanded the propeller pitch to an angle that produced reverse thrust and the system would not accept commands to a higher pitch angle. The resulting loss of forward thrust prevented the MRPA from reaching a suitable landing location; therefore, the MP deliberately crashed it into the terrain. Furthermore, I find by a preponderance of evidence that incorrect and insufficient checklist guidance, reinforced by incorrect simulator training, were substantially contributing factors to the mishap.

2. CAUSES

a. Failure of the VPP Servo Motor

The VPP servo motor demonstrated multiple signs of impending failure to include increasing temperature and an inability to move the propeller to the commanded pitch angles. After inconsistent movements to both a lower and higher pitch angle, the VPP servo motor failure progressed to a point where it would only allow movement to a lower propeller pitch angle.

Thorough testing by technicians at General Atomics Aeronautical Systems, Incorporated of possible failure modes concluded that the VPP servo motor experienced a loss of torque due to either a damaged connection or a failure of the brushes within the electrical servo motor.

b. Risk Assessment During Operation

Although the aircrew checklist has no notes, warnings, or cautions concerning unnecessary movements of the propeller pitch lever outside of a regime acceptable for sustained flight, the narrative section of the checklist discusses intermittent and permanently frozen VPP servo failures. The MP did not adequately assess the risk associated with manually commanding a potentially failing or failed servo outside of the normal operating envelope.

The movement of the propeller pitch lever by the MP combined with the VPP servo motor failure resulted in a propeller pitch angle that produced reverse thrust. The system would not accept commands to a higher propeller pitch angle and the resulting loss of forward thrust prevented the MRPA from reaching a suitable landing location.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

a. Technical Order Checklist Guidance

The narrative section of the Technical Order (TO) 1Q-1(M)B-1 Propeller Servo Overheat/Servo Failure checklist addresses several possible symptoms of a failing VPP servo. The checklist itself has no notes, warnings, or cautions concerning unnecessary movements of the propeller pitch lever outside of a region acceptable for sustained flight.

Additionally, the Propeller Servo Overheat/Servo Failure checklist assumes an overheating VPP servo will continuously attempt to move to match the commanded propeller pitch setting. In reality, when the propeller pitch lever is adjusted, the VPP servo will only attempt to move for three seconds. The checklist directs unnecessary movements of the propeller pitch lever that may result in a failing VPP servo freezing at a pitch angle unsuitable for sustained flight.

The Propeller Servo Overheat/Servo Failure checklist was insufficient and incorrect for the VPP servo failure experienced during the mishap.

b. Training Issues

In the MQ-1B simulator, an overheating VPP servo continues to draw current indefinitely and the servo heats up as a result. To stop the current and resulting overheating of the servo, aircrew are taught to manually move the propeller pitch lever to match the failed position of the VPP servo. Unlike the simulator, the aircraft VPP servo will only attempt to move for three seconds. Aircrew have incorrectly been trained in the MQ-1B simulator that an overheating VPP servo will continuously attempt to move to match the commanded propeller pitch setting.

Based on checklist guidance and simulator training, the MP assessed that the aircraft was not responding to the propeller pitch lever. This assessment caused the MP to troubleshoot the propeller pitch lever by moving it back and forth with increasing displacement.

4. CONCLUSION

All evidence is consistent with a combination of a mechanical failure of the VPP servo motor and unnecessary movements of the propeller pitch control lever by the MP. The VPP servo motor failed in a manner that only allowed movement to a lower propeller pitch angle. The MP momentarily commanded the propeller pitch to an angle that produced reverse thrust and the system would not accept commands to a higher pitch angle. The resulting loss of forward thrust prevented the MRPA from reaching a suitable landing location; therefore, the MP deliberately crashed it into the terrain.

30 January 2013

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