# UNITED STATES AIR FORCE
# AIRCRAFT ACCIDENT INVESTIGATION
# BOARD REPORT

**MQ-1B, T/N 01-3074**

**18th Reconnaissance Squadron**
**432d Air Expeditionary Wing**
**Creech Air Force Base, Nevada**

**LOCATION: Jalalabad Air Base, Afghanistan**

**DATE OF ACCIDENT: 1 May 2011**

**BOARD PRESIDENT: Lt Col Patrick McNutt**

**Conducted IAW Air Force Instruction 51-503**
**Abbreviated Accident Investigation pursuant to Chapter 11**

## EXECUTIVE SUMMARY

## AIRCRAFT ACCIDENT INVESTIGATION
## MQ-1B, T/N 01-3074, JALALABAD, AFGHANISTAN
## 1 MAY 2011

On 1 May 2011, at approximately 1650 zulu (Z) time, the mishap remotely piloted aircraft (MRPA), a MQ-1B Predator, tail number 01-3074, operated by the 18th Reconnaissance Squadron (RS) from Creech AFB, crashed 2 kilometers (KM) (direction unknown) outside a Forward Operating Base (FOB) after completing 18 hours of a tasked surveillance mission. The crash site was remote desert terrain close to the FOB, so US Army Soldiers were able to retrieve the salvageable MRPA. The MRPA was intact, but the wings were cut off by the Soldiers retrieving it in order to fit it on their vehicles and return it to their FOB. There were no injuries and there was no damage to other government or private property.

After normal maintenance and pre-flight checks, the MRPA taxied and departed from Jalalabad Air Base at approximately 2250Z on 30 Apr 2011. At 1500Z on 1 May 11, the mishap crew (MC) was working with ground forces in Afghanistan when they encountered weather that prevented them staying on station. The MC coordinated with air traffic control to work another operating area and encountered deteriorating weather conditions and severe clear icing on the MRPA. The MC altered course to get out of the weather and icing conditions. During this transit time the MC received numerous indications of maintenance anomalies (high turbo oil temperature, oil pressure and manifold pressure) for the MRPA. The MC attempted to alleviate the high turbo oil temperature by running the appropriate emergency checklists. The MC utilized the necessary emergency checklists but the high turbo oil temperature indications continued and the MRPA started an insidious descent rate of 200 to 400 feet per minute. The MRPA never maintained level flight again and crashed in a remote area of Afghanistan at approximately 1650Z.

The Accident Investigation Board (AIB) President determined by clear and convincing evidence that the cause of the mishap was due to prop thrust bearing failure. The failure of the prop thrust bearing contaminated the oil system with metal shavings and particulate that clogged the oil filter, resulting in a lack of adequate oil to the turbocharger and engine. Due to the lack of oil flowing through the system, the MRPA turbocharger eventually failed as well. The MRPA engine was unable to produce adequate thrust with a failed turbocharger and began to descend at a rate of 200 to 400 feet per minute. The MRPA engine developed oil pressure and manifold pressure (MAP) indications that were abnormal due to the oil system contamination. Eventually the MRPA engine experienced excessive heat damage and deterioration which caused a cylinder skirt to crack and destroyed connecting rod #2 further limiting the ability of the MRPA to maintain level flight. The MC realized the MRPA could not return to base or fly to an emergency divert, so the MC controlled the MRPA away from known populated areas. The MRPA crashed when it impacted the terrain. The estimated loss is valued at $2.02M.

# SUMMARY OF FACTS AND STATEMENT OF OPINION
# MQ-1B, T/N 01-3074 ACCIDENT
# 1 MAY 2011

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# COMMONLY USED ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AAIB | Abbreviated Accident Investigation Board |
| ACC | Air Combat Command |
| AEW | Air Expeditionary Wing |
| AF | Air Force |
| AFB | Air Force Base |
| AFI | Air Force Instruction |
| AIB | Accident Investigation Board |
| AoA | Angle of Attack |
| ATO | Air Tasking Order |
| AZ | Arizona |
| BFS | Battlespace Flight Services |
| C | Celsius |
| CONUS | Continental United States |
| Dash 1 | T.O. 1Q-1(M)B-1 Flight Manual |
| EGT | Exhaust Gas Temperature |
| FAE | Functional Area Expert |
| FDP | Flight Duty Period |
| FOB | Forward Operating Base |
| GA ASI | General Atomics Aeronautical Systems, Incorporated |
| GCS | Ground Control Station |
| HMMWV | High Mobility Multipurpose Wheeled Vehicle or "Humvee" |
| IAW | In Accordance With |
| IFE | In-flight Emergency |
| IP | Instructor Pilot |
| IPI | Initial Process Inspection |
| ISB | Interim Safety Board |
| ISR | Intelligence, Surveillance and Reconnaissance |
| KIAS | Knots Indicated Airspeed |
| kPa | Vapor Pressure |
| KM | Kilometers |
| L | Local Time |
| LA | Legal Advisor |
| LOS | Line of Sight |
| LR | Launch and Recovery |
| LRE | Launch and Recovery Element |
| MAJCOM | Major Command |
| MAP | Manifold Absolute Pressure |
| MCE | Mission Crew Element |
| MIC | Mission Intelligence Coordinator |
| mIRC | Mission Internet Relay Chat |
| MM | Maintenance Member |
| MMIC | Mishap Mission Intelligence Coordinator |
| MP | Mishap Pilot |
| MRPA | Mishap Remotely Piloted Aircraft |
| MSL | Mean Sea Level |
| MSO | Mishap Sensor Operator |
| MTS | Multi-spectral Targeting System |
| NV | Nevada |
| NM | Nautical Miles |
| OG | Operations Group |
| PCL | Point, Click, Loiter |
| PPSL | Predator Primary Satellite Link |
| PSI | Pounds per Square Inch |
| ROZ | Restricted Operating Zone |
| RPA | Remotely Piloted Aircraft |
| RPM | Revolutions per Minute |
| RS | Reconnaissance Squadron |
| SA | Situational Awareness |
| SAT | Satellite |
| SATCOM | Satellite Communications |
| SIB | Safety Investigation Board |
| SOC | Squadron Operations Center |
| SPMA | Sensor Processor Modem Assembly |
| SQ | Squadron |
| SU | Supported Unit |
| TCTO | Time Compliance Technical Order |
| T/N | Tail Number |
| T.O. | Technical Order |
| UAS | Unmanned Aerial System |
| US | United States |
| U.S.C. | United States Code |
| USAF | United States Air Force |
| VA | Virginia |
| VPP | Variable Pitch Propeller |
| WOC-D | Wing Operations Center-Director |
| WG | Wing |
| Z | Zulu Time |

The above list was compiled from the Summary of Facts, the Statement of Opinion, the Index of Tabs, and Witness Testimony (Tab R).

# SUMMARY OF FACTS

## 1. AUTHORITY, PURPOSE, AND CIRCUMSTANCES

### a. Authority

On 27 June 2011, Lt Gen William Rew, Vice Commander, Air Combat Command (ACC), United States Air Force (USAF), appointed Lieutenant Colonel Patrick McNutt as the Accident Investigation Board (AIB) President, an AIB Legal Advisor (LA), and AIB Recorder (Rec) (Tab Y-3), were also appointed to investigate the 1 May 2011 crash of a MQ-1B Predator, tail number (T/N) 01-3074, near Kandahar, Afghanistan. An abbreviated AIB (AAIB) pursuant to Chapter 11 of Air Force Instruction (AFI) 51-503, Aerospace Accident Investigations was conducted at Nellis Air Force Base (AFB), Nevada (NV), from 9 July through 5 August 2011. The Functional Area Expert (FAE) detailed to the AIB was AIB MM (Maintenance FAE) (Tab Y-4).

### 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

After normal maintenance and pre-flight checks, the mishap remotely piloted aircraft (MRPA) taxied and departed from Jalalabad Air Base on 30 Apr 2011 at approximately 2250 zulu (Z) time to execute a surveillance mission. Approximately 18 hours into the flight at 1650Z, on 1 May 2011, the MRPA crashed in a remote region of Afghanistan. At the time of the accident the mishap crew (MC) consisted of a mishap pilot 1 (MP1), mishap pilot 2 (MP2), mishap sensor operator 1 (MSO1), mishap sensor operator 2 (MSO2) and mishap mission intelligence coordinator (MMIC).

## 3. BACKGROUND

The MRPA was an asset of the 18th Reconnaissance Squadron (RS). The 18th RS is a component of the 432d Wing (WG), based at Creech AFB, NV. The 432d WG is a component of 12th Air Force (AF) and USAF Southern Command, headquartered at Davis-Monthan AFB, Arizona (AZ). The 12th AF is a component of ACC, Headquartered at Langley AFB, Virginia (VA).

### a. Air Combat Command (ACC)


Air Combat Command is a major command of the United States Air Force and primary force provider of combat airpower to America's warfighting commands. Its mission is to organize, train, equip, and maintain 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 operates fighter, bomber, reconnaissance, battle-management, and electronic-control aircraft and provides command, control, communications, and intelligence systems and conducts global information operations. Over 67,000 active duty members, 13,500 civilians, and when mobilized, 50,000 Air National Guard and Reserve members compose ACC, and its units operate 1,800 aircraft (Tab CC 2-5).

### b. 12th Air Force (12th AF)


12th Air Force controls ACC's conventional forces in the western United States and has the warfighting responsibility for U.S. Southern Command as well as the U.S. Southern Air Forces. It manages all Air Force assets and personnel in the AFSOUTH AOR, which includes Central and South America. 12th Air Force has worked closely with nations in the Caribbean, Central and South America in the Global War on Terrorism by providing forces to OEF, OIF, and Operation NOBLE EAGLE, and it also has supported efforts to stem the flow of illegal drugs into the U.S. and neighboring countries. 12th Air Force directs 10 active duty wings and one direct reporting unit as well as 13 gained wings and other units of the Air National Guard and Reserve (Tab CC 6-8).

### c. 432d Wing


The 432d WG, also known as the 432d Air Expeditionary Wing (AEW) "Hunters" consists of combat-ready Airmen who fly the MQ-1B Predator and MQ-9 Reaper aircraft to support United States and Coalition warfighters. The 432d WG conducts remotely piloted aircraft (RPA) initial qualification training for aircrew, intelligence, weather, and maintenance personnel. The 432d WG oversees operations of the 432d Operations Group (OG), 432d Maintenance Group, 11th RS, 15th RS, 17th RS, 18th RS, 30th RS, 42d Attack Squadron, 432d Aircraft Maintenance Squadron (AMXS), 432d Maintenance Squadron, and the 432d Operations Support Squadron (Tab CC-10).

### d. 18th Reconnaissance Squadron

The 18th 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-11).

### e. MQ-1B Predator System

The MQ-1B Predator is a medium-altitude, long-endurance, RPA. The Predator's primary missions are close air support, air interdiction, and/or 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 14-15).

The MQ-1B Predator is a system, not just an aircraft. A fully 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 (Tab CC-14). The diagram below shows the typical system components of the MQ-1B Predator.

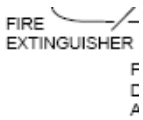


Diagram displaying typical system components of MQ-1B Predator

The basic crew for the Predator is a rated pilot to control the aircraft and command the mission and an enlisted aircrew member to operate sensors and weapons plus a mission coordinator, when required. The crew employs the aircraft from inside the GCS via a line-of-sight (LOS) data link or a satellite data link for beyond LOS operations (Tab CC-14).

The MQ-1B Predator carries the Multi-spectral Targeting System (MTS), which integrates an infrared sensor, a color/monochrome daylight TV camera, an image-intensified TV camera, a laser designator and a laser illuminator into a single package. The full motion video from each of the imaging sensors can be viewed as separate video streams or fused together. The aircraft can employ two laser-guided AGM-114 Hellfire missiles which possess a highly accurate, low collateral damage, and anti-armor and anti-personnel engagement capability (Tab CC-14).

The system can be deployed for worldwide operations. The Predator aircraft can be disassembled and loaded into a container for travel. The GCS and PPSL are transportable in a C-130 Hercules (or larger) transport aircraft. The Predator can operate on a 5,000 by 75 foot (1,524 meters by 23 meters) hard surface runway with clear line-of-sight to the ground data terminal antenna. The antenna provides line-of-sight communications for takeoff and landing.

The PPSL provides over-the-horizon communications for the aircraft and sensors (Tab CC-14). An alternate method of employment, Remote Split Operations, employs a GCS for takeoff and landing operations at the forward operating location while the Continental United States (CONUS) based crew executes the mission via beyond-line-of-sight links (Tab CC-14).

The aircraft has an ARC-210 radio, an APX-100 IFF/SIF with Mode 4, and an upgraded turbocharged engine. The latest upgrades, which enhance maintenance and performance, include notched tails, split engine cowlings, braided steel hoses and improved engine blocks (Tab CC-15).

# 4. SEQUENCE OF EVENTS

## a. Mission

The mishap sortie was an ISR mission flown in support of Operation ENDURING FREEDOM and was authorized by an Air Tasking Order (ATO). The MC consisted of MP1, MP2, MSO1, MSO2 and the MMIC, all were assigned to the 18th RS, 432d WG, Creech AFB, NV (Tab R-3, R-13, R-40, R-53). 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. MP1 assumed control of the MRPA at 1330Z. At 1500Z MP2 arrived for the crew swap, but due to bad weather and a declared in-flight emergency (IFE) the pilot swap was not accomplished till approximately 1600Z. MP1 stayed on to assist MP2 with running the check lists, assisting with eliminating the icing problems the MRPA was experiencing, assisting with the Falcon View problems and assisting the high turbo oil check temperature indicator. The MRPA was already experiencing bad weather, which occurred approximately 15 hours into the mission, when MP1 swapped into the seat. On the day of the mishap the MP1 was the "break pilot." MP1's job was to give all the RPA pilot's an hour to an hour and a half break. MP1 was completing his last cycle of RPA pilot breaks, when MP1 swapped into the RPA GCS which became the MRPA. The IFE was declared by MP1 and occurred approximately 16 hours into the mission, at which time MSO1 had already been flying for his entire shift. At this time MSO1 was preparing to swap seats with MSO2. This swapped occurred at approximately 1600Z (Tab R-9). MP2 and MSO2 controlled the MRPA for approximately fifty minutes until the crash occurred at 1650Z (Tab R 11-12). Hand-off operations with the prior MCE crew were uneventful and the LRE crew cited no abnormalities with the MRPA (Tabs R-65, R-67). All ground ops and procedures went normally and all performance checks were within technical order parameters. (Tab R-65)

## b. Planning

The MC planned the mishap sortie in accordance with Squadron Operating Procedures. The MC attended a mass briefing prior to assuming control of the MRPA, including weather, geography, terrain and airspace constraints associated with this mission.

### c. Preflight and Launch

The mission was not delayed and launched at its scheduled launch time. The LRE crew taxied and performed the launch without incident (Tab R-65).

### d. Summary of Accident

The MRPA departed from Jalalabad AB, Afghanistan at 2250Z on 30 Apr 11. During the first 16 hours of the mishap sortie, several crews, including the MC, executed the surveillance mission and experienced no abnormalities or problems. At approximately 1325Z on 1 May 2011, the MC asked for an alternate tasking, because the weather was too bad for them to get over the objective or be mission effective. It took approximately an hour to get the new tasking. At approximately 1425Z MSO1 swapped seats with MSO2 and MP1 asked for an altitude of 22,000 MSL. The requested altitude of 22,000 MSL was not allowed due to other air traffic in the area. MP1 was authorized to ascend to an altitude of 21,500 MSL. At this altitude the MC got an icing warning and the MRPA began to lose altitude. The MC began running the appropriate icing checklist (Tabs R-4, R-42). It was also at this time MP2 arrived for the pilot swap. Because MP1 was dealing with the icing and running the icing check list it was decided they would not do the pilot swap at that time. The pilot swap eventually occurred approximately an hour later at 1600Z. After running the icing checklist the MC attempted to get out of the bad weather. They finally found a hole and were able to escape the bad weather. Shortly after they ran the icing checklist and got out of the bad weather the "turbo oil temperature high" warning indicator went on. At this time MP2 was not in the seat yet and was backing up MP1 by running various checklists. Also, at this time their "Falcon View" crashed (Tab R-8). The MC began running checklists for the turbo oil high temperature warning. MP1 turned on the engine cooling fan and the temperature started to come down. The temperature fluctuated for a while and stabilized in the medium (yellow) zone, and the turbo oil temperature high warning cleared, but the altitude was still slowly dropping. The MC were trying different things, including turning the MRPA autopilot off, hand flying the MRPA, and changing airspeeds, but the MRPA still wouldn't hold altitude. After cycling through the checklists a couple times the MC called for an instructor pilot (IP) to assist them (Tab R-15). The MC ultimately got out of the icing and the ice was melting, but they were still losing altitude. The IP was there helping run Falcon View and air traffic control (ATC) was giving them block altitudes, because there were certain areas they couldn't go. At some point while the check lists were being run and the MC were encountering weather, icing and warning indicator problems MP1 declared an emergency. At approximately, 16,000 MSL, at 1600Z, when they were out of the icing MP1 and MP2 did the seat swap. MP1 stayed to assist MP2 as backup. MP2 determined they could not make it back to Jalalabad Air Base, because they were continuing to lose altitude and would not be able to make it over the mountains. MP1 asked the IP for suggestions. They determined they had enough gas to make it to Kandahar Air Base. They did an immediate turn and began the divert to Kandahar (Tab R-16). At that time the MRPA was below 14,000 MSL and heading towards 13,000 MSL. MP2 updated the emergency mission with the new airfield. The turbo oil high temperature warning

kept coming back on. MP2 would put the fan on and until the oil temperature would cool and he would turn the fan off. But when the turbocharger cooled down the "Low Coolant Oil" indicator would come on. The mechanical problems for the MRPA were getting worse, and the MRPA was still losing altitude. MP2 saw one indication that the turbocharger was getting really hot, up to 450 degrees Celsius (C) (Tab R-16). Consequently, he decided to leave the fan on despite the checklist warning of overheating and the checklist item to reduce electrical load. As the MRPA descended the outside air temperature rose to 5 then 15 degrees C (Tab R-8), which was helping with the icing problem, but not the engine performance problem. MP2 was trying counter measures, including trying to keep the MRPA at stall speed plus five knots, but nothing helped. MC determined at this point the turbocharger must have failed. The turbocharger oil was high, RPMs were at their maximum, but the MRPA wasn't getting any power. MC was pressing towards Kandahar. They were about 115 miles from Kandahar when they observed terrain features going by quickly and realized they were very low to the ground. MP2 asked the IP if he should put the landing gear down. The IP said no to keep the landing gear up (Tab R-17). At that point the MRPA hit the ground. When the MRPA crashed the throttle was at 90-95% and the RPMs were at the limit for normal operating. Airspeed at impact was approximately 62 knots (Tab R-17).

### e. Impact

The MRPA crashed at approximately 1650Z, on 1 May 2011. The wreckage of the MRPA was located at the crash site, which was approximately 2 kilometers (KM) outside the unnamed Forward Operating Base (FOB). The MRPA was recovered by US Army Soldiers. Upon locating the MRPA the Soldiers had to cut off its wings in order to transport the MRPA back to the unnamed FOB on their High Mobility Multipurpose Wheeled Vehicle (HMMWV) or "Humvee".

### f. Life Support Equipment, Egress and Survival

Not applicable.

### g. Search and Rescue (SAR)

Not applicable.

### h. Recovery of Remains

Not applicable.

## 5. MAINTENANCE

### a. Forms Documentation

All forms were documented in accordance with (IAW) Technical Order (T.O.) 00-20-1. There were no open discrepancies noted on the aircraft maintenance forms. Forms documentation was not relevant to the mishap.

### b. Inspections

All scheduled inspections were accomplished within scheduled time limits, and there were no overdue aircraft Time Compliance Technical Orders (TCTO). The next scheduled inspection for the MRPA was the 180 day launcher cleaning and lubrication which was due in 1 day (Tab D-43).

### c. Maintenance Procedures

On 22 April 2011, engine E3209 was replace with engine E3519 and was installed in the MRPA IAW T.O. 1Q-1(M)B-2-72-00-2 (Tab D-2, D-28). Engine E3519 was last overhauled 10 April 2011, 21 days prior to the mishap (Tab D-2). In process inspections (IPI) and Quality Assurance (QA) inspections were completed IAW T.O. 1Q-1(M)B-2-61JG-00-1. On 30 April 2011, the batteries were topped off IAW T.O. 1Q-1(M)B-2-12JG-10-1 (Tab D-50). There was one minor documentation error on 30 April 2011 for the most current 781 H (Tab D-39) and was determined not relevant to the mishap.

### d. Maintenance Personnel and Supervision

MQ-1B Predator aircraft maintenance services at Jalalabad, Afghanistan are performed exclusively by Battlespace Flight Services (BFS) employees. There is no evidence in the training records for the BFS personnel who performed maintenance on the MRPA in the days prior to the mishap to indicate they were not properly qualified on the maintenance tasks performed. Maintenance personnel and supervision for the MRPA were not relevant to the mishap.

### e. Fuel, Hydraulic and Oil Inspection Analysis

There is no evidence to suggest fuel was a factor in the mishap. The MQ-1B does not have a hydraulic system. The MRPA was serviced with commercial 1 quart oil containers and no oil lot existed to draw post mishap oil samples of the oil used for the MRPA servicing. As is standard procedure, there are no pre-flight oil samples taken.

Due to the MRPA being recovered and returned to Creech AFB for post-mishap analysis, oil samples were available. There is no evidence to suggest petroleum, oils or lubricant pre-flight contamination contributed to the mishap.

The MRPA oil sample analysis was conducted post-mishap and showed high levels of aluminum. The high aluminum content is consistent with an engine part failure contaminating the oil system during the sortie (Tab J-11).

### f. Unscheduled Maintenance

There were no unscheduled maintenance actions on the MRPA relevant to the mishap.

## 6. AIRCRAFT AND AIRFRAME

### a. Condition of Systems

The MRPA was damaged on impact with terrain. The MRPA was recovered by US Army Soldiers and returned to Creech AFB, NV. The MRPA is repairable and will return to service (Tab P-2).

### b. Testing

There were no system tests other than post mishap component testing completed.

### c. Functionality of Equipment

The MRPA experienced a prop thrust bearing failure that caused an oil system malfunction eventually leading to a catastrophic engine failure. When the prop thrust bearing failed, metal shavings and particulate clogged the oil filter drastically reducing oil flow for the entire engine. There is no indication of oil system contamination prior to this sortie.

The MRPA turbocharger overheated due to a lack of oil (Tab J-2) while flying at 22,000 MSL. The MC received a turbo oil temperature high warning which is indicative of a reduction of oil to the turbocharger. The reduction of oil flow due to the failed prop thrust bearing caused the turbocharger to fail in-flight. When the MRPAs turbocharger failed the MRPA began to descend at a rate of 200 - 400 feet per minute. The MC ran all pertinent checklists for the turbo oil temperature high warning, but the warning light persisted due to the failed turbocharger.

The MRPA engine experienced excessive heat damage and deterioration due to the clogged oil

filter and resultant oil starvation. The MRPA engine experienced a catastrophic failure when a cylinder skirt cracked and destroyed connecting rod #2. The MRPA engine failure is a direct result of the failed prop thrust bearing contaminating the oil system.

### d. Post Mishap Component Testing

The recovered MRPA engine was torn down for post mishap analysis and the oil system was analyzed for any abnormalities. The prop thrust bearing showed extensive damage during the inspection. The failed prop thrust bearing began to disintegrate and eventually contaminated the oil system. The turbocharger and engine both experienced excessive heat damage and deterioration and failed in flight as a result of a lack of oil due to the prop thrust bearing failure. The oil system inspection identified a high aluminum content, metal shavings and particulate in the oil and oil filter that restricted oil flow throughout the engine which led to the failure of the MRPA engine.

## 7. WEATHER

The MC dealt with adverse weather conditions during the sortie to include icing conditions. The MC handled the weather appropriately during the sortie. Weather was within operational limits, and there was no evidence to suggest weather was a factor in the mishap (Tab F 2-15).

## 8. CREW QUALIFICATIONS

### a. Mishap Pilot 1

#### (1) Training

The MP1 has been a qualified MQ-1B pilot since 12 May 2010.

#### (2) Experience

At the time of the mishap, the MP1's total flight time is 5158.0 hours, which includes 363.5 hours in the MQ-1B (Tab G-2). The MP's flight time during the 90 days before the mishap is as follows (Tab G-3):

| | Hours | Sorties |
|---|---|---|
| 30 Days | 29.3 | 10 |
| 60 Days | 69.5 | 25 |
| 90 Days | 92 | 34 |

### b. Mishap Pilot 2

**(1) Training**

The MP2 has been a qualified MQ-1B pilot since 28 June 2005.

**(2) Experience**

At the time of the mishap, the MP2's total flight time is 5707.6 hours, which includes 653.2 hours in the MQ-1B (Tab G-2). The MP2's flight time during the 90 days before the mishap is as follows (Tab G-3):

| | Hours | Sorties |
|---|---|---|
| 30 Days | 49.8 | 13 |
| 60 Days | 104.8 | 31 |
| 90 Days | 124.9 | 39 |

**c. Mishap Sensor Operator 1**

**(1) Training**

The MSO1 has been a qualified MQ-1B sensor operator since 19 Apr 10 (Tab AA-4).

**(2) Experience**

The MSO1's total MQ-1B flight time is 637.4 hours (Tab G-9).
The MSO1's flight time during the 90 days before the mishap is as follows (Tab G-10):

| | Hours | Sorties |
|---|---|---|
| 30 Days | 72.6 | 21 |
| 60 Days | 160.7 | 46 |
| 90 Days | 214.7 | 67 |

**d. Mishap Sensor Operator 2**

**(1) Training**

The MSO2 has been a qualified MQ-1B sensor operator since 16 September 2008 (Tab AA-4).

**(2) Experience**

The MSO2's total MQ-1B flight time is 1030.3 hours (Tab G-9).
The MSO2's flight time during the 90 days before the mishap is as follows (Tab G-10):

| | Hours | Sorties |
|---|---|---|
| 30 Days | 50.4 | 15 |
| 60 Days | 59.2 | 18 |
| 90 Days | 83.7 | 51 |

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

## 9. MEDICAL

### a. Qualifications

At the time of the mishap, all personnel were fully medically qualified for flight duty without medical restrictions or waivers.

### b. Health

The 72-hour histories and the 14-day histories for the MC revealed no significant health concerns. There is no evidence to suggest that the health of the MC were relevant to the mishap.

### c. Toxicology

Immediately following the mishap, commanders directed toxicology testing for all personnel involved in the maintenance, launch and flight of the MRPA. All toxicology testing was normal and not a factor in this mishap.

### d. Lifestyle

There is no evidence that unusual habits, behavior or stress on the part of the MC or maintenance crew members contributed to this accident. The 72-hour and 14-day histories revealed no evidence that suggests lifestyle factors, including unusual habits, behavior or stress contributed to the mishap.

### e. Crew Rest and Crew Duty Time

AFI require pilots have proper "crew rest," as defined in AFI 11-202, Volume 3, General Flight Rules, 22 Oct 10, prior to performing in-flight duties. AFI 11-202 defines normal crew rest as a minimum 12-hour non-duty period before the designated flight duty period (FDP) begins. During this time, an aircrew member may participate in meals, transportation or rest as long as he or she has the opportunity for at least eight hours of uninterrupted sleep. A review of the duty

cycles of the MC leading up to the mishap indicated that they had adequate crew rest. The MC complied with the crew rest and duty day requirements on the day of the mishap. None of the MC indicated they suffered from stress, pressure, fatigue or lack of rest prior to or during the mishap sortie. There is no evidence to suggest that fatigue was a factor in this mishap.

## 10. OPERATIONS AND SUPERVISION

Operations tempo and operations supervision was investigated and found not a factor in 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. Primary Operations Directives and Publications

1. AFI 11-2MQ-1, Volume 1, MQ-1 Aircrew Training, 21 January 2010
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, 22 October 2010
5. AFI 11-401, Aviation Management, 10 December 2010
6. AFI 11-418, Operations Supervision, 21 October 2005, incorporating Change 1, 20 March 2007
7. T.O. 1Q-1(M)B-1, USAF Series MQ-1B and RQ-1B Systems, 1 December 2010
8. T.O. 1Q-1(M)B-1CL-1, USAF Series MQ-1B and RQ-1B Systems Flight Checklist, 1 December 2010

### b. Maintenance Directives and Publications

1. AFI 21-101, Aircraft and Equipment Maintenance Management, 26 July 2010
2. T.O. 00-20-1, Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures, 1 September 2010, ACC SUP 1, 14 December 2007
3. 1Q-1(M)B-6, MQ-1B Technical Manual, Aircraft Scheduled Inspection and Maintenance Requirements, 21 January 2010, Change 1, 28 April 2011
4. 1Q-1(M)B-2-72JG-00-1, MQ-1B Job Guide, Engine Reciprocating, General – Volume I, 10 June 2010

# STATEMENT OF OPINION

**MQ-1B, T/N 01-3074, ACCIDENT**
**1 May 2011**

*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 due to a prop thrust bearing failure (Tab S 16, S 25-28). The failure of the prop thrust bearing contaminated the oil system with metal shavings and particulate that clogged the oil filter (Tab S 20-22, S 30-31), resulting in a lack of adequate oil to the turbocharger and engine. Due to the lack of oil flowing through the oil system, the MRPA turbocharger failed (Tab S 17-19). The MRPA engine was unable to produce adequate thrust with a failed turbocharger and began to descend at a rate of 200 to 400 feet per minute. The MRPA engine developed abnormal oil pressure and manifold pressure (MAP) indications that were due to the oil system contamination. Eventually the MRPA engine experienced excessive heat damage and deterioration which caused a cylinder skirt to crack and destroyed connecting rod #2 (Tab S 32-35) further limiting the ability of the MRPA to maintain level flight. The MC realized the MRPA could not return to base or fly to an emergency divert, so the MC controlled the MRPA away from known populated areas. The MRPA crashed when it impacted the terrain.

## 2. DISCUSSION OF OPINION

Evidence shows that the MRPA experienced a prop thrust bearing failure (Tab S 16, S 25-28) that caused an oil system malfunction (Tab S 20-22, S 30-31) eventually leading to a catastrophic engine failure (Tab S 32-35). When the prop thrust bearing failed, metal shavings and particulate clogged the oil filter drastically reducing oil flow for the entire engine. There is no indication of oil system contamination prior to this sortie.

The MRPA turbocharger overheated due to a lack of oil while flying at 22,000 MSL. The MC received a turbo oil temperature high warning which is indicative of a reduction of oil to the turbocharger. The reduction of oil flow due to the failed prop thrust bearing caused the turbocharger to fail in-flight. The MRPA engine was unable to produce adequate thrust with a failed turbocharger and began to descend at a rate of 200 to 400 feet per minute. The MC ran all pertinent checklists for the turbo oil temperature high warning, but the warning light persisted due to the failed turbocharger.