UNITED STATES AIR FORCE
ABBREVIATED ACCIDENT INVESTIGATION BOARD REPORT

MQ-1B, T/N 00-3072

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

LOCATION: Afghanistan

DATE OF ACCIDENT: 19 September 2010

BOARD PRESIDENT: Lieutenant Colonel Mark T. Fritzinger

Conducted pursuant to Chapter 11 of AFI 51-503.

EXECUTIVE SUMMARY

AIRCRAFT ACCIDENT INVESTIGATION
MQ-1B, T/N 00-3072, CREECH AIR FORCE BASE, NEVADA
19 SEPTEMBER 2010

On 19 September 2010, at 2018 Zulu (Z) time, the mishap remotely piloted aircraft (MRPA), a MQ-1B Predator, tail number 00-3072, crashed in uninhabited mountainous terrain approximately 20 miles south of Kabul, Afghanistan, approximately three hours after takeoff. Destruction of the MRPA, one hellfire missile, and two missile rails were assessed to be a financial loss of $3,800,278.00. No injuries, damage to other government, or damage to private property occurred as a result of the mishap.

After normal maintenance and pre-flight checks, the MRPA taxied and departed a Forward Operating Base (FOB) in Afghanistan at 1708Z. Approximately 8 minutes into the flight, the MRPA's turbo oil temperature rose above 285 degrees Fahrenheit (°F) and into the caution range. After accomplishing the applicable checklist procedures requiring activation of the cooling fan, the turbo oil temperature dropped below 285 °F and within normal operating limits. At 1755Z and nearing cruising altitude, the first Mission Control Element (MCE) crew turned off the cooling fan which resulted in the turbo oil temperature rising back into the caution range. At the same time, the oil quantity began a steady decrease until stabilizing at 65% one hour and 20 minutes into the flight. This frequently occurs in MQ-1Bs due to the design of the oil system and a condition called "oil foaming." After again turning on power to the cooling fan, the first MCE crew initiated the process of returning the MRPA to home station based on the high turbo oil temperature. Almost immediately following this decision, the crew reversed their course of action at 1820Z, when the turbo oil temperature dropped within normal limits, allowing them to continue the mission.

At 1900Z, the second MCE crew or mishap crew (MC) took control of the MRPA from the first crew and were briefed to monitor oil level indications. The MRPA operated at normal operating limits until 1953Z when the oil quantity rapidly declined until reaching 0% volume at 1956Z, causing an engine failure. As the oil quantity decreased below 60%, the MC immediately pointed the MRPA toward its home station. Soon after, the oil level reached 0% volume at 1956Z, causing an engine failure. At 2001Z, the engine momentarily restarted for two minutes prior to again failing and seizing for the remainder of the flight. The MRPA was beyond glide distance to a safe landing location and was subsequently crashed in a remote location. Within hours, U.S. military personnel made contact with the crash site, gathered sensitive equipment, and destroyed the remaining wreckage.

The Accident Investigation Board (AIB) President determined by clear and convincing evidence that the cause of the mishap was an oil system malfunction which caused a catastrophic oil leak and subsequent engine failure. The AIB President was not able to determine the cause of the oil system malfunction since the MRPA's engine was unsalvageable from the crash site.

SUMMARY OF FACTS AND STATEMENT OF OPINION
MQ-1B, T/N 00-3072
19 SEPTEMBER 2010

TABLE OF CONTENTS

COMMONLY USED ACRONYMS AND ABBREVIATIONS

18 RS	18th Reconnaissance Squadron
432 WG	432d Wing
432 OG	432d Operations Group
ACC	Air Combat Command
AEW	Air Expeditionary Wing
AF	Air Force
AFB	Air Force Base
AFI	Air Force Instruction
AIB	Accident Investigation Board
ALT	Altitude
BFS	Battlespace Flight Services
EOD	Explosive Ordinance Disposal
FAE	Functional Area Expert
FOB	Forward Operating Base
GA ASI	General Atomics Aeronautical Systems, Incorporated
GCS	Ground Control Station
ISR	Intelligence, Surveillance, & Reconnaissance
LOS	Line of Sight
LRE	Launch and Recovery Element
MC	Mishap Crew
MCE	Mission Control Element
MP	Mishap Pilot
MRPA	Mishap Remotely Piloted Aircraft
MSL	Mean Sea Level
MSO	Mishap Sensor Operator
NV	Nevada
PPSL	Primary Predator Satellite Link
RPA	Remotely Piloted Aircraft
TCTO	Time Compliance Technical Order
T/N	Tail Number
T.O.	Technical Order
U.S.	United States
USAF	United States Air Force
WG	Wing
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, PURPOSE, AND CIRCUMSTANCES

a. Authority

On 27 October 2010, Lieutenant General William J. Rew, Vice Commander, Air Combat Command, United States Air Force (USAF), appointed Lieutenant Colonel Mark T. Fritzinger as the Accident Investigation Board (AIB) President to investigate the 19 September 2010 crash of an MQ-1B Predator, tail number (T/N) 00-3072, 20 miles south of Kabul, Afghanistan. An abbreviated AIB was conducted at Nellis AFB, NV, from 5 November 2010 through 23 November 2010, pursuant to Chapter 11 of Air Force Instruction (AFI) 51-503, *Aerospace Accident Investigations*. The Legal Advisor appointed to the AIB was Major Chad M. Jespersen, and the Recorder appointed to the AIB was Technical Sergeant Christopher Sheffield. Functional Area Experts (FAE) appointed to assist the AIB were Major Erik Jacobson (Pilot Advisor), Captain Suraj Ram (Medical Advisor), and Senior Master Sergeant Thomas W. Walsh, (Maintenance Advisor) (Tab Y-1).

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 preflight checks, the mishap remotely piloted aircraft (MRPA) taxied and departed from a Forward Operating Base (FOB) in Afghanistan, at approximately 1708 Zulu (Z). Approximately 2 hours and 45 minutes into the flight, the MRPA experienced a catastrophic oil leak, subsequently causing the engine to seize. The MRPA was beyond glide distance to a suitable landing location and thus, was crashed in a remote location 20 miles south of Kabul, Afghanistan. The MRPA was completely destroyed at an estimated cost of $3,800,278.00 (Tab P-1). There were no injuries or damage to personal property as a result of the mishap.

3. BACKGROUND

The MRPA was an asset of the 18 Reconnaissance Squadron (RS), 432 Wing (WG), Creech AFB, NV. The 432 WG has reporting responsibilities to Twelfth Air Force, Air Combat Command, and USAF Central Command at Shaw AFB, South Carolina (Tab DD-1).

a. 432d Wing

The 432 WG, also known as the 432 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. Additionally, the 432 WG conducts remotely piloted aircraft (RPA) initial qualification training for aircrew, intelligence, weather, and maintenance personnel. The 432 WG oversees operations of the 432d Operations Group (432 OG), 432d Maintenance Group, 11 RS, 15 RS, 17 RS, 18 RS, 30 RS, 42d Attack Squadron, 432d Aircraft Maintenance Squadron, 432d Maintenance Squadron, and the 432d Operations Support Squadron. The 432 WG is the Air Force's first RPA wing (Tab DD-1).

b. 18th Reconnaissance Squadron

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.

c. MQ-1B Predator System

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, not just an aircraft. This system consists of four aircraft systems (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 consists of 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), a day variable-aperture television camera, a variable aperture infrared camera (for low light/night), and other sensors, as required. The cameras produce full-motion video. The MQ-1B Predator also carries the Multi-Spectral Targeting System which integrates electro-optical, infrared, laser designator and laser illuminator into a single sensor package.

The MQ-1B Predator is manufactured by General Atomics Aeronautical Systems Inc (GA-ASI) headquartered in San Diego, California (Tab DD-1).

4. SEQUENCE OF EVENTS

a. Summary of Previous Mission

Previous to the mishap, elevated turbo oil temperatures were documented on MRPA flights on 7 September 2010, 15 September, and twice on 18 September (Tab T-1). The first instance of a possible problem occurred on 7 September where engine data conveyed a slightly elevated turbo oil temperature of approximately 250 degrees Fahrenheit (°F) when compared with historical data and GA-ASI analysis (Tab AA-1 and Tab FF-1). Since oil temperatures were within normal operating limits per technical order (T.O.) 1Q-1(M)B-1, the mission crew did not document any engine-related anomalies following the 22-hour mission (Tab BB-1). Post flight, the MRPA received scheduled maintenance, including a 60-hour inspection. This inspection for the oil system involved an oil and filter change, an oil pressure leak check, and a priming of the aircraft oil system. Maintenance did not observe any discrepancies during these procedures (Tab D-2).

Following the 7 September flight, the MRPA next flew on 15 September for 15.4 hours. During this flight, engine data showed a slightly elevated turbo oil temperature of 250 °F (Tab AA-4 and Tab FF-3). Once again, the MRPA landed with no discrepancies as all aircraft parameters were within normal operating limits.

The next two MRPA flights on 18 September began to highlight an oil system problem. On the first flight, the MRPA experienced an intermittent high turbo oil temperature with temperature spikes exceeding 300 °F (Tab AA-5 and Tab FF-3). This resulted in an early return to base for a total flight time of 4.2 hours (Tab BB-1). The corrective action for this discrepancy was to replace the turbo oil temperature sensor (Tab D-2). During the second flight on 18 September, the MRPA experienced high turbo oil temperature on its climb to altitude and subsequently returned to base for a total flight time of 0.4 hours (Tab AA-7 and Tab FF-13). Following this flight, the turbo assembly was replaced, requiring an in-flight operational check (Tab D-2). The next flight on 19 September resulted in the mishap.

b. Mission Planning

The mishap crew (MC) was assigned to the 18 RS, Creech AFB, and the MRPA was assigned to the 432 AEW based at a FOB in Afghanistan (Tabs V-3).

The MRPA launched from its FOB at 1708Z using LOS C-band transmitters then handed off at 1715Z to the Mission Control Element (MCE) via Ku Band satellite transmissions (Tab N-3).

The MC accomplished all preflight mission requirements and briefed in accordance with standard operating procedures. This was their second sortie of the day and the third crew to pilot the MRPA, including the Launch and Recovery Element (LRE) (Tab V-3). The MC assumed control of the MRPA approximately 1 hour and 52 minutes into the flight and continued to execute the mission (Tab N-1).

c. Preflight

The LRE conducted a normal preflight, launch, and handoff (Tab V-3).

d. Summary of Accident

Prior to the MCE handoff, the LRE did not notice any anomalies with the MRPA and did not pass on the requirement for an in-flight operational check to the MCE (Tab V-3). The first MCE crew to pilot the MRPA gained control at 1715Z and immediately began to notice a high turbo oil temperature climbing through approximately 5,000 feet mean sea level (MSL) (Tab EE-3). The temperature spiked at 292 °F then stabilized around 285 °F for the next 8 minutes before decreasing to 280 °F (Tab AA-8). After discussing the situation with the LRE and their maintenance personnel, the crew executed the Engine Overheat Checklist (Tab N-3 and Tab BB-4). In accordance with the checklist, the first MCE crew reduced power, turned on the cooling fan, and the turbo oil temperature subsequently stabilized within limits (Tab BB-4 and Tab N-3). At 1733Z, passing 10,200 feet MSL, the oil level began a steady decrease until 1815Z where it stabilized around 65 percent for the next 90 minutes (Tab AA-8). At 1753Z, the turbo oil temperature climbed again to around 292 °F causing the crew to initiate actions for handing the MRPA back to the LRE (Tab N-3 and Tab AA-8). Almost immediately after completing coordination for LRE handoff at 1823Z, the turbo oil temperature dropped well within limits to 250 °F, resulting in the crew's decision to continue the mission. The MRPA operated within normal limits for the remainder of the first MCE crew's sortie (Tab AA-8).

At 1900Z, the second MCE crew or mishap crew (MC) assumed control of the MRPA (Tab N-3). The first crew briefed the MC regarding the need to watch the slightly depressed oil quantity but it was unclear whether the mishap pilot (MP) was briefed on the previous high turbo oil temperature (Tab V-3). At 1924Z, the MC noticed the oil level momentarily decrease below 60%, then recover above and stabilize within limits until 1953Z (Tab N-3 and Tab AA-8). At that moment, the oil quantity dropped below 60% and steadily decreased until reaching 0% at 1956Z, subsequently causing engine failure (Tab AA-8). During this oil quantity decrease, the MC pointed the MRPA toward its launch location and declared an in-flight emergency to controlling agencies (Tab N-2 and Tab EE-1). At 2001Z, the engine momentarily restarted and ran for 2 minutes, before it seized for the remainder of the flight (Tab AA-5 and Tab FF-1). Without power, the MC followed engine failure procedures and established the best rate of glide toward home field. As the MQ-1B was beyond glide distance from a suitable landing site, the MC was instructed to crash the MRPA in a remote location (Tab V-3-3).

e. Impact

At 2018Z, the MRPA impacted uninhabited mountainous terrain approximately 20 miles south of Kabul, Afghanistan. In order to maximize the destruction, the MC accelerated the MRPA to 101 knots prior to impacting terrain at 6,710 feet MSL. The resulting impact and fire destroyed a majority of the MRPA including the attached AGM-114 missile. An Explosive Ordnance Disposal (EOD) team arrived at the accident site on 20 September 2010 at 0129Z, secured critical components and destroyed remaining debris via two controlled detonations (Tab EE-3). Engine components critical to this investigation were destroyed and unavailable for analysis.

The cost for the MRPA is estimated at $3,800,278.00 including the AGM-114 missile and missile rails (Tab P-3).

f. Life Support Equipment, Egress and Survival

Not applicable.

g. Search and Rescue

Not applicable.

h. Recovery of Remains

Not applicable.

5. MAINTENANCE

a. Forms Documentation

Maintenance forms from 16 September to 18 September 2010 were reviewed for accuracy and compliance. In the aircraft maintenance community, maintenance records are assumed to reflect exactly what maintenance was performed. If a maintenance procedure is not documented, it was assumed not accomplished. Some discrepancies were noted. Specifically, on the aircraft forms dated 18 September 2010, an engine operational check was documented as accomplished, yet no T.O. reference was included in the corrective action block specific to it being completed (Tabs D-14 and U-3). Additionally, an in-flight operational check was not properly annotated on the relevant maintenance document following the sortie in accordance with T.O. guidance (Tab U-1). Maintenance records showed two open discrepancies on the day of the mishap. The first discrepancy was associated with a Time Compliance Technical Order (TCTO) and not relevant to the mishap. The second open discrepancy stated, "IFOC (in-flight operational check) due on turbo oil temp sensor (Tab D-17)." An in-flight operational check requires pilots to verify the maintenance corrective action fixed the discrepancy in question.

Delayed discrepancies are those maintenance discrepancies identified as requiring correction at a future date. There were no delayed discrepancies in the aircraft maintenance forms.

b. Inspections

All scheduled inspections were accomplished within scheduled time limits, and there were no overdue aircraft TCTOs.

c. Maintenance Procedures

On 18 September 2010, the MRPA returned from a mission after only 4.2 hours of flight time. In the maintenance forms aircrew wrote, "Turbo oil temp high (285-321 °F) possible sensor. No other abnormal temperatures." Maintenance replaced the relevant sensor and signed off "op ck

good," in accordance with T.O. 1Q-1(M)B-2-72JG-20-1 #72-23-19-004 (Tab D-17). The MRPA received a thru-flight inspection and required an in-flight operational check to assess the high turbo oil temperature condition. The MRPA launched again on 18 September for another mission and for accomplishment of the in-flight operational check. The aircrew returned the MRPA to base after approximately 20 minutes stating, "Turbo oil temp hi (285-293 °F) on climb out. Cooling fan reduced temp by approx 5 degrees." The result of the in-flight operational check was not properly documented on the maintenance forms as required (Tab D-17 and Tab U-3). Maintenance personnel removed and replaced the turbo with a new turbo, serial number 00240, in accordance with T.O. 1QM0 B-2-72JG-40-1, 72 4105004. The removed turbo was sent to GA-ASI for analysis following the mishap. Maintenance personnel completed a successful engine run and operational check in accordance with technical data as evidenced by their annotation, "ops chk good." The MRPA completed a pre-flight inspection on 18 September at 1730 prior to the mishap flight (Tab D-11).

There was a 60-hour inspection accomplished on the MRPA on 8-9 September that had no bearing on the mishap. No other maintenance procedures were relevant to this mishap.

d. Maintenance Personnel and Supervision

The training records for the maintenance personnel who performed relevant maintenance on the MRPA show they were properly qualified on the maintenance tasks performed. There is no evidence to suggest that qualifications or supervision of personnel were a factor in the mishap.

e. Fuel, Hydraulic and Oil Inspection Analysis

There is no evidence to suggest fuel contributed to the mishap (Tab J-3). Analysis of oil and other lubricants could not be accomplished as the MRPA was destroyed upon impact.

f. Unscheduled Maintenance

There were no unscheduled maintenance actions on the MRPA.

6. AIRCRAFT AND AIRFRAME

a. Condition of Systems

The MRPA was destroyed upon impact.

b. Functionality of Equipment

The GCS was inspected subsequent to the mishap and determined to have been functioning properly at the time of the mishap (Tab J-6).

c. Testing

Following the mishap, the previously removed turbo for maintenance on 18 September 2010 was sent to GA-ASI for analysis. Results of the analysis found the turbo to be fully operational. Not enough residual oil could be gathered during its disassembly to determine if foreign matter existed within the oil system.

7. WEATHER

The weather was insignificant and not a factor to the mishap (Tab F).

8. CREW QUALIFICATIONS

a. Mishap Pilot

(1) Training

The MP received his initial qualification in the MQ-1B on 23 December 2009.

(2) Experience

The MP's total flight time is 5602.3 hours, which includes 485.9 hours in the MQ-1B. Prior to flying the MQ-1B, the MP was a C-130, C-141, and T-33 pilot (Tab G-1.1).

The MP's flight time during the 90 days before the mishap is as follows:

MP	Hours	Sorties
Last 30 days	18.3	6
Last 60 days	57.8	19
Last 90 days	118.2	32

b. Mishap Sensor Operator

(1) Training

The mishap sensor operator (MSO) received his initial qualification in the MQ-1B on 4 May 2010 (Tab G-1.4).

(2) Experience

The MSO's total flight time is 277.6 hours, all in the MQ-1B (Tab G-1.4.2).

The MSO's flight time during the 90 days before the mishap is as follows:

MP	Hours	Sorties
Last 30 days	46.7	8
Last 60 days	86.4	17
Last 90 days	183.6	36

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

9. MEDICAL

a. Qualifications

At the time of the mishap, the MP was fully qualified for flight duties with a current flight physical, AF form 1042 (Medical Recommendation for Flying or Special Operational Duty), and approved medical waiver.

b. Health

The full military medical record of the MP revealed that he was in good health for his age. There is no evidence to suggest that the health of the MP was relevant to the mishap (Tab CC-3).

c. Pathology

A review of the toxicology report revealed no evidence of impairment to the MP that contributed to the mishap (Tab CC-3).

d. Lifestyle

A review of the medical record shows no evidence that lifestyle factors, including unusual habits, behavior or stress, contributed to the mishap.

e. Crew Rest and Crew Duty Time

Air Force Instructions require pilots have proper "crew rest," as defined in AFI 11-202, Volume 3, *General Flight Rules*, 22 October 2010, prior to performing in-flight duties. AFI 11-202, Volume 3 defines normal crew rest as a minimum 12-hour non-duty period before the designated flight duty period 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 8 hours of uninterrupted sleep.

A review of the duty cycles of the MP and MSO leading up to the mishap indicated that they had adequate crew rest. The MP and MSO complied with the crew rest and duty day requirements on the day of the mishap. None of the crew indicated they suffered from stress, pressure, fatigue or lack of rest prior to or during the mishap sortie. There is no evidence to suggest fatigue was a factor in this mishap (Tab K-3).

10. OPERATIONS AND SUPERVISION

The operations tempo was high for the 18 RS at the time of the mishap. Squadron members fill normal deployment rotations in support of OPERATION NEW DAWN. The 18 RS utilizes three separate 8-hour shifts per day, enabling continuous MQ-1B operations 365 days a year. There were no issues with supervision in the 18 RS at the time of the mishap. There is no evidence to suggest that operations tempo or supervision were a factor in the 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. Air Force Instruction (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, 7 March 2007, incorporating Change 2, 18 May 2009
6. AFI 11-418, Operations Supervision, 21 October 2005, incorporating Change 1, 20 March 2007
7. T.O. 1Q-1(M)B-1, Flight Manual USAF Series MQ-1B and RQ-1B Systems, 1 November 2003, incorporating Change 13, 8 April 2009
8. T.O. 1Q-1(M)B-1CL-1, Flight Checklist USAF Series MQ-1B and RQ-1B Systems, 1 November 2003, incorporating Change 15, 8 April 2009

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
3. 1Q-1(M)B-2-72JG-20-1, MQ-1B Job Guide, Engine Reciprocating, Ignition, Indicating and Starting 8 June 2010
4. TCTO T.O. 1Q-1B-1073 Modification of Oil Reservoir Dipstick (P/N UPA41115) With New Full Level Mark 06 August 2010

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

c. Known or Suspected Deviations from Directives or Publications

There are no known or suspected deviations from directives or publications by the MC or maintenance members.

13. NEWS MEDIA INVOLVEMENT

There is no media involvement at the time of this report.

14. ADDITIONAL AREAS OF CONCERN

None.

6 January 2011

MARK T. FRITZINGER, Lt Col, USAF
President, Accident Investigation Board

STATEMENT OF OPINION

MQ-1B, T/N 00-3072, ACCIDENT
19 SEPTEMBER 2010

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 an oil system malfunction resulted in a complete loss of engine oil and the subsequent engine failure as the cause for the mishap. Based on digital aircraft engine data, a catastrophic oil leak occurred as the engine oil level rapidly depleted from 65 percent to zero within 5 minutes. Concurrently, the engine speed decreased until eventually seizing, signifying its total loss of oil. Since the mishap remotely piloted aircraft (MRPA) was completely destroyed and unavailable for analysis, the exact cause of the oil system malfunction is unknown.

2. DISCUSSION OF OPINION

Without the MRPA's engine, evidence to support my conclusion was based primarily on recorded engine data from the mishap flight, engine data from its previous four flights, witness testimony, and a General Atomics Aeronautical Systems Inc (GA-ASI) report relating to the mishap.

Review of engine data prior to the mishap flight identified discrepancies with the MRPA's oil system. The first instance of a possible problem occurred on 7 September 2010 where engine data conveyed a slightly elevated turbo oil temperature of approximately 250 degrees Fahrenheit (°F). GA-ASI considered this higher than normal based on historical data, however, technical order (T.O.) 1Q-1(M)-1 states normal turbo oil temperature is anything less than 285 °F with the maximum being 300 °F. Since within limits, the mission crew did not document any engine-related anomalies following the 22-hour mission. Post flight, the MRPA received numerous scheduled maintenance including a 60-hour inspection. Inspection of the oil system involved an oil and filter change, an oil pressure leak check, and a priming of the aircraft oil system. Maintenance did not notice any discrepancies during these procedures.

Following the 7 September flight, the MRPA next flew on 15 September for 15.4 hours. During this flight, engine data showed a slightly elevated turbo oil temperature of 250 °F. Once again, the MRPA landed with no discrepancies as all aircraft parameters were within normal operating limits.

The next two MRPA flights on 18 September began to highlight an oil system problem. The first flight experienced an intermittent high turbo oil temperature with temperature spikes exceeding 300 °F. This resulted in an early return to base for a total flight time of 4.2 hours. The ensuing aircrew documentation stated, "Turbo oil temp high (285 – 321 °F) possible sensor. No other abnormal temperatures." Maintenance corrective action included replacing a loose turbo oil temperature sensor. The second flight on 18 September experienced high turbo oil temperature on its climb to altitude and subsequently returned to base for a total flight time of .4 hours. The aircrew documented, "Turbo oil temp hi (285 – 293 °F) on climbout, cooling fan reduced temps by approx 5 degrees." Following this discrepancy, maintenance replaced the turbo assembly, requiring an in-flight operational check. Since the mishap, the replaced turbo was sent to GA-ASI for analysis, but found it to be fully functional. Not enough oil was retrieved from the assembly to accomplish a proper oil analysis.

Finally, the MRPA on 19 September experienced issues similar to its previous two flights. Prior to this flight, the mission crews were unaware of the in-flight operations check required for its previous high turbo oil temperatures. On the climb to cruising altitude and just after Launch and Recovery Element (LRE) handoff to the Mission Control Element (MCE), the first MCE crew noticed a high turbo oil temperature fluctuating between 280 to 292 °F. The expanded T.O. 1Q-1(M)B-1 was referenced since the T.O. 1Q-1(M)B-1CL-1, flight checklist, does not provide direction for a high turbo oil temperature condition. In accordance with T.O. 1Q-1(M)B-1, the first MCE crew executed the Engine Overheat Checklist requiring a throttle reduction and the activation of the engine cooling fan. After accomplishing these procedures, the turbo oil temperature decreased approximately 5 °F, hovering around the high end of normal operating limits. After passing 10,200 feet mean sea level (MSL), the oil quantity level began to decrease slowly from 100% to approximately 65% over the next hour where it stabilized until just prior to the mishap. According to witness testimony, although the oil quantity was slightly lower than typically seen, a moderate decrease below 100% is common during climb and cruising altitude for the MQ-1B. T.O. 1Q-1(M)B-1 does not require crew action until the oil level decreases below 60%. The crew experienced another climb in temperature above 285 °F after turning off the cooling fan nearing their cruising altitude of 18,500 feet MSL, prompting the crew to return the MRPA to home station. Shortly prior to handoff back to the LRE for an early recovery, the turbo oil temperature dropped to 250 °F, well within normal operating limits. After consultations with the LRE and maintenance personnel at the MRPA's home station, the crew elected to continue the mission. The MRPA operated normally through change out with the mishap crew (MC) 1 hour and 52 minutes into the flight.

At handoff, the first MCE crew briefed the second MCE crew (same as MC) regarding the need to watch the slightly depressed oil quantity. The initially high turbo oil temperatures were briefed to the mishap sensor operator (MSO) but it is unknown whether the mishap pilot (MP) received this information. The MC executed their briefed mission until approximately 50 minutes into their flight when the oil quantity level decreased below 60%. The MC immediately executed the correct flight manual procedure and began to steer the MRPA toward home station. However, within 5 minutes the oil level fell to zero, resulting in engine failure.

Based on engine data from the mishap, all engine parameters showed normal, other than the turbo oil temperature and the oil quantity level. Considering otherwise normal engine parameters and a fully operational turbo, an unknown oil system malfunction resulted in a catastrophic oil leak and subsequent engine seizure. Without power and beyond glide distance to a suitable landing site, the MRPA was crashed into an uninhabited area of Afghanistan.

6 January 2011

MARK T. FRITZINGER, Lt Col, USAF
President, Accident Investigation Board