UNITED STATES AIR FORCE
ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION
BOARD REPORT

MQ-9A, T/N 12-4179

482d ATTACK SQUADRON
SHAW AIR FORCE BASE, SOUTH CAROLINA

432d WING
CREECH AIR FORCE BASE, NEVADA

LOCATION: UNDISCLOSED LOCATION IN AFGHANISTAN

DATE OF ACCIDENT: 28 OCTOBER 2020

BOARD PRESIDENT: COLONEL STEVEN G. SHEPAN

Abbreviated Accident Investigation, conducted pursuant to
Chapter 12 of Air Force Instruction 51-307

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR COMBAT COMMAND

AIR COMBAT COMMAND
1992 - 2022

OFFICE OF THE DEPUTY COMMANDER
205 DODD BOULEVARD, SUITE 203
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26 JAN 2022

ACTION OF THE CONVENING AUTHORITY

The report of the abbreviated accident investigation board conducted under the provisions of Air Force Instruction 51-307, *Aerospace and Ground Accident Investigations*, that investigated the 28 October 2020 mishap involving a MQ-9A, T/N 12-4179, operated by the 482d Attack Squadron, complies with applicable regulatory and statutory guidance, and on that basis it is approved.

RUSSELL L. MACK
Lieutenant General, USAF
Deputy Commander

EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION

MQ-9A, T/N 12-4179
UNDISCLOSED LOCATION IN AFGHANISTAN
28 OCTOBER 2020

On 28 October 2020 at 1944 Zulu time (z) an unmanned MQ-9A, tail number (T/N) 12-4179, crashed into a mountainous region in an undisclosed location in Afghanistan. The mishap aircraft (MA) was operated remotely by a Mission Control Element (MCE) which was comprised of the mishap pilot (MP) and mishap sensor operator (MSO). The MCE was assigned to the 482d Attack Squadron—a unit located at Shaw Air Force Base, South Carolina, but belonging to the 432d Wing at Creech Air Force Base, Nevada. The MA suffered heavy damage at impact about 118 nautical miles from the recovery location and was not recovered; instead, it was rendered unsalvageable by kinetic means a short time later. There was no reported damage to civilian property, no injuries, and no fatalities. The loss of government property was valued at $14,128,206.

Approximately 40 minutes before the crash, the MSO noticed a drop in oil level and alerted the MP. The MA lost 100 percent of its oil between 1903z and 1908z. The MCE declared an emergency, ran the requisite checklists, and notified the recovery location of their intent to return. Shortly after re-routing to the recovery location, the Combined Air Operations Center (CAOC) ordered the MCE to attempt to salvage the MA in the event of an emergency landing. At 1924z, the engine failed and the MCE identified an ad hoc landing site, but, in an effort to avoid a possible structure, crashed into a ridge at 1944z.

During the MA's previous sortie, two days prior, the pilot noticed a gradual drop in oil level, so he returned the MA to the recovery location. The Mishap Ground Crew (MGC) quickly diagnosed the source of the oil leak—two broken clamps and a small hole in the oil line. The primary maintenance technician assigned to repair the oil line (MGC 1) did not remove the associated components beforehand as required in the technical order (TO), which caused difficulty installing the replacement line.

The Abbreviated Accident Investigation Board (AAIB) President found, by a preponderance of the evidence, the oil leak, reducing the oil level to 0 percent, caused the engine to fail, preventing the MA from returning safely to the recovery location. Moreover, the AAIB President found, by a preponderance of the evidence, each of the following factors substantially contributed to the mishap: (1) MGC 1 failed to follow relevant TOs while replacing the oil line and clamps; and (2) the Mishap Flight Chief (MFC) directed MGC 1 to disregard TOs in an effort to expedite repair.

SUMMARY OF FACTS AND STATEMENT OF OPINION

MQ-9A, T/N 12-4179
UNDISCLOSED LOCATION IN AFGHANISTAN
28 OCTOBER 2020

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ACRONYMS AND ABBREVIATIONS

15 AF	15th Air Force
432 WG	432d Wing
482 ATKS	482d Attack Squadron
AAIB	Abbreviated Accident Investigation Board
ACC	Air Combat Command
ADO	Acting Director of Operations
AFB	Air Force Base
AFE	Aircrew Flight Equipment
AFI	Air Force Instruction
AFMAN	Air Force Manual
ATC	Air Traffic Control
CAOC	Combined Air Operations Center
DAFI	Department of the Air Force Instruction
DO	Director of Operations
DoD	Department of Defense
ER	Exceptional Release
FAA	Federal Aviation Administration
HDD	Head Down Display
HFACS	Human Factors Analysis and Classification Factors
HUD	Head-Up Display
IMDS	Integrated Maintenance Data Systems
LRE	Launch and Recovery Element
MA	Mishap Aircraft
MAJCOM	Major Command
MCD	Magnetic Chip Detector
MCE	Mission Control Element
MFC	Mishap Flight Chief
MGC	Mishap Ground Crew
MGC 1	Primary Technician
MGC 2	Secondary Techincian
MP	Mishap Pilot
MPS	Mishap Production Supervisor
MQ-9A	Multi-roll Unmanned Version A
MSO	Mishap Sensor Operator
Ops Sup	Operations Supervisor
SAR	Search and Rescue
TCTO	Time Compliance Technical Order
TO	Technical Order
T/N	Tail Number
VIT	Variable Information Tables
z	Zulu

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 24 June 2021, the Air Combat Command (ACC) Deputy Commander, appointed Colonel Steven G. Shepan as President of the Abbreviated Aircraft Investigation Board (AAIB) for the mishap that occurred on 28 October 2020 involving an MQ-9A at an undisclosed location in Afghanistan (Tab Y-3 to Y-4). Other board members included a Major Legal Advisor and a Staff Sergeant Recorder (Tab Y-3 to Y-4). On 27 July 2020, a Master Sergeant Recorder was appointed to the board (Tab Y-7). The AAIB conducted its investigation in accordance with Air Force Instruction (AFI) 51-307, *Aerospace and Ground Accident Investigations*, Chapter 12, at Shaw Air Force Base (AFB), South Carolina from 9 July 2021 to 23 August 2021 (Tab Y-3 to Y-4). On 12 July 2021, two Subject Matter Experts, a Captain MQ-9A Pilot and a Master Sergeant MQ-9A Maintenance Crew Chief, were detailed to advise the board (Tab Y-5 to Y-6).

b. Purpose

In accordance with AFI 51-307, *Aerospace and Ground Accident Investigations*, this AAIB conducted a legal investigation to inquire into all the facts and circumstances surrounding this Air Force aerospace accident, prepare a publicly-releasable report, and obtain and preserve all available evidence for use in litigation, claims, disciplinary action, and adverse administrative action. This investigation was an abbreviated accident investigation, conducted pursuant to Chapter 12 of AFI 51-307.

2. ACCIDENT SUMMARY

On 28 October 2020, at 1944 Zulu time (z), an unmanned MQ-9A, tail number (T/N) 12-4179, crashed into an unpopulated, mountainous region of an undisclosed location in Afghanistan (Tab EE-3 to EE-4). The mishap aircraft (MA) was operated remotely by a Mission Control Element (MCE) which was comprised of the mishap pilot (MP) and mishap sensor operator (MSO) (Tab EE-3). The MCE was assigned to the 482d Attack Squadron (482 ATKS)—which was located at Shaw AFB, South Carolina, but belonged to the 432d Wing at Creech AFB, Nevada (Tab CC-18 to CC-20, EE-3). The MA suffered heavy damage at impact about 118 nautical miles from the recovery location and was not recovered; instead it was rendered unsalvageable by kinetic means a short time later (Tab EE-4). There was no reported damage to civilian property, no injuries, and no fatalities (Tab DD-3). The loss of government property was valued at $14,128,206 (Tab DD-3).

About 40 minutes before the crash, around 1903z, the MSO noticed a significant drop in oil level, and he alerted the MP (Tabs V-2.5, Z-20, and EE-3). The MP and MSO scanned the aircraft but there were no visual indications of an oil leak (Tabs V-2.5 and EE-3). Within 5 minutes (between 1903z and 1908z) the oil level dropped from 100 percent to 0 percent (Tab EE-3). Together, the MCE reported the problem to the Operations Supervisor (Ops Sup) in the squadron operations cell, declared an emergency, ran the requisite checklists, and notified the recovery location of their intent to return (Tabs V-2.5 to V-2.6, V-3.10 to V-3.12, V-11.3, and EE-3 to EE-4). Shortly after

re-routing to the recovery location, the MCE received orders from the CAOC to attempt to salvage the MA in the event of an emergency landing (Tab V-1.5 and V-5.6). Then, at 1924z, the engine failed due to oil starvation, so the MP controlled the glide of the MA to optimize range and began the process of selecting a flat, unpopulated area where the MA might be recovered (Tab EE-3). As the MA lost altitude, the MCE and its supporting staff identified an ad hoc landing site and configured the MA for landing by lowering the landing gear at 1943z (Tabs V-3.10 and EE-4). As they approached, the safety observer directed the MP to change course because he observed what appeared to be a man-made structure in their trajectory (Tab V-3.5, V-7.6). Accordingly, the MP turned the MA in the opposite direction and was unable to avoid a ridge, resulting in a crash at 1944z (Tabs V-2.5 to V-2.6, V-3.10, and EE-3 to EE-4).

During the MA's previous sortie, two days prior to the mishap, the MA experienced an in-flight incident due to a drop in oil level (Tabs V-5.5 and EE-3). During that flight the pilot noticed the oil level at 0900z was between 95-100 percent, but had dropped to 66 percent by 1005z (Tabs V-5.5, Z-17). The pilot did not declare an in-flight emergency due to oil levels still being in operational range, but immediately decided to return the MA to the recovery location and landed safely (Tabs V-5.5 to V-5.7 and EE-3). The Mishap Ground Crew (MGC) technicians diagnosed the reason for the oil leak—broken oil hose clamps and a small hole in the -8 oil line (Tabs D-99 and V-8.10 to V-8.11). To repair the oil line, the Technical Order (TO) required the MGC to remove certain component parts beforehand to allow sufficient space to accomplish the repair work; however, the MGC's primary maintenance techincian (MGC 1) assigned to the repair did not remove these components because the Mishap Flight Chief (MFC) told him not to (Tabs D-92 and V-8.3). Because MGC 1 did not remove the required components, the workspace was significantly reduced which complicated MGC 1's ability to replace the -8 oil line (Tab V-8.7). Specifically, the limited workspace made it difficult to maneuver his hands and tools in the confined area (Tab V-8.7).

3. BACKGROUND

a. Air Combat Command (ACC)

ACC, headquartered at Joint Base Langley-Eustis, Virginia, is one of ten major commands (MAJCOMs) in the United States Air Force (Tab CC-13). For more than seven decades, ACC has served as the primary provider of air combat forces to America's warfighting commanders. ACC organizes, trains, and equips Airmen who fight in and from multiple domains to control the air, space, and cyberspace (Tab CC-13). As the lead command for fighter, command and control, intelligence, surveillance and reconnaissance, personnel recovery, persistent attack and reconnaissance, electronic warfare, and cyber operations, ACC is responsible for providing combat air, space, and cyber power and the combat support that assures mission success to America's warfighting commands (Tab CC-13).

b. Fifteenth Air Force (15 AF)

15 AF, headquartered at Shaw Air Force Base, South Carolina, is a Numbered Air Force under ACC. 15 AF trains Airmen to deliver combat airpower worldwide and provides a light, lean, and

agile Air Force, Joint, or Combined Task Force Headquarters (Tab CC-17). 15 AF is responsible for ensuring the agile combat support capabilities of 13 wings and 3 direct reporting units, preparing Airmen for the dynamic requirements of air, space, and cyberspace of the future (Tab CC-17). These units encompass about 600 aircraft and more than 45,000 active duty and civilian members (Tab CC-17). 15 AF is also responsible for the operational readiness of 16 National Guard and Air Force Reserve Units (Tab CC-17).

c. 432d Wing (432 WG)

The 432 WG employs remotely piloted aircraft in combat air patrols to support combatant commander needs and deploys combat support forces worldwide (Tab CC-7). This mission includes combat command and control, tactics development, intelligence support, weather support and standardization and evaluation oversight for Air Combat Command, U.S. Air Forces Central Command, Air Force Material Command, the Air National Guard, Air Force Reserve Command and Royal Air Force remotely piloted aircraft units (Tab CC-7).

c. 482d Attack Squadron (482 ATKS)

The 482 ATKS is a United States Air Force unit, stationed at Shaw AFB, South Carolina (Tab CC-20). It is an operational squadron of the 25th Attack Group—which is a unit assigned to the 432 WG—and it operates the MQ-9A unmanned aerial vehicle (Tab CC-20). The 482 ATKS supports the 432 WG as professional combat leaders by employing the MQ-9A to produce persistent attack and reconaissance to support our national objectives (Tab CC-22).

d. MQ-9A

The MQ-9A is an armed, multi-mission, medium-altitude, long-endurance remotely piloted aircraft that is employed primarily against dynamic execution targets and secondarily as an intelligence collection asset (Tab CC-3 to CC-4). Given its significant loiter time, wide-range sensors, multi-mode communications suite, and precision weapons—it provides a unique capability to perform strike, coordination, and reconnaissance against high-value, fleeting, and time-sensitive targets (Tab CC-3 to CC-4). Reapers can also perform the following missions and tasks: intelligence, surveillance, reconnaissance, close air support, combat search and rescue, precision strike, "buddy-lase," convoy/raid overwatch, and target development (Tab CC-3 to CC-4). The MQ-9A's capabilities make it uniquely qualified to conduct irregular warfare operations in support of combatant commander objectives (Tab CC-3 to CC-4).

e. Amentum

Amentum is a private defense contractor that acquired DynCorp International, a provider of sophisticated aviation, logistics, training, intelligence and operational solutions (Tab CC-23). Amentum delivers enhanced capabilities including a full suite of logistics/aviation services and solutions to support critical needs anywhere, anytime (Tab CC-24). Specifically, Amentum provides maintenance services to various Air Force MAJCOMs, including ACC (Tab CC-28).

4. SEQUENCE OF EVENTS

a. Mission

Before the mishap on 28 October 2020, the crew conducted support for an intelligence, surveillance, and reconnaissance mission at an undisclosed location in Afghanistan (Tab V-3.10).

b. Planning

Prior to assuming command of the MA, the MP received a mission brief from the outgoing pilot (Tab V-3.10). The MP verified the respective personnel completed both exceptional releases (ER), i.e. clearing the asset for flight (Tab U-13). The shift's weather brief showed nothing significant in the target area (Tab W-3).

c. Preflight

The Mishap Production Superintendent (MPS) performed the ER for the MA (Tab D-98). The outgoing pilot, who gave the MP the mission brief, also signed the ER for the Ground Control Station—the place where the MCE controlled the MA—prior to the MA launching (Tab D-99).

d. Summary of Accident

During the previous sortie flown on 26 October 2020, a separate MCE piloting the MA noticed an oil level issue (Tabs Z-17 and V-5.5). Specifically, during the hourly operations check, between 0900z and 1000z, the pilot of that sortie noticed the oil level drop to 66 percent (Tabs Z-17 and V-5.5). The MA was between 50 and 60 miles from the recovery location when the MCE elected to return (Tab V-5.5 to V-5.7). At 1030z, that MCE handed off the MA to the Launch and Recovery Element (LRE), the crew responsible for takeoff and landing of the MQ-9A, with the oil level around 44 percent (Tabs V-5.7 and Z-17). The LRE crew working with the maintenance personnel documented the oil level issue stating it landed with 14 percent remaining (Tab D-94)

During the mishap sortie two days later, the MP performed a crew change, i.e. replaced the outgoing pilot midflight (Tab V-3.10). During the transition, the outgoing pilot briefed the MP on the status of the MA, explaining it was operating normally (Tab V-3.10). Over an hour later, around 1856z, the MSO performed a crew change (Tab V-2.4 and V-11.6). The outgoing sensor operator did not note any issues with the MA either, but stayed in the MCE to take care of some administrative work (Tab V-2.7 and V-11.6). About 5 minutes after the MSO took his place in the cockpit, he noticed the oil level dropping rapidly (Tab V-2.4 to V-2.5). The MSO told the MP

about the oil issue and the MCE chose to return to the recovery location immediately (Tab V-2.5). The MP and MSO scanned the aircraft but there were no visual indications of an oil leak (Tabs V-2.5 and EE-3). After running the Low Oil Level Checklist, the MCE prepared for an engine failure (Tab V-2.5). During this time, the outgoing sensor operator left to inform the Ops Sup about the emergency; who, in turn, directed an oncoming shift's instructor pilot to be the safety observer (Tab V-1.5 and V-11.6). The Acting Director of Operations (ADO) had access to a terrain mapping program called Zeus which offered better fidelity than the Heads Up Display (HUD), so the Mishap Safety Operator coordinated with the ADO over the clear communication system to see if there were any good spots to put the aircraft down (Tab V-7.5 and V-11.8). The Director of Operations (DO) had contact with the CAOC who ordered the MCE to attempt to salvage the MA in the event of an emergency landing (Tabs V-1.5 and V-5.6). Approximately 158 nautical miles from the recovery location at 1924z, the engine failed due to oil starvation giving the MCE the warning "Engine Out: Detected" in the HUD (Tab EE-3 to EE-4). The MCE ran the appropriate checklists and the MP controlled the glide of the MA to optimize range and begin the process of selecting a flat, unpopulated area where the MA might be recovered (Tabs V-2.5 to V-2.6, V-3.10, and EE-4).

e. Impact

As the MA lost altitude, the MCE and its supporting staff identified an ad hoc landing site and the MCE configured the MA for landing by lowering the landing gear at 1943z (Tabs V-3.10 and EE-4). During the final two minutes of flight the safety observer directed the MP to change course because he observed what appeared to be a man-made structure in their trajectory (Tab V-3.5 and V-7.6). Accordingly, the MP turned the MA in the opposite direction and was unable to avoid a ridge resulting in a crash around 1944z (Tab EE-4, V-7.6, V-3.10). At the time of the impact, the MA was 118 nautical miles from the recovery location (Tab EE-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

Block 1 of the 781H Forms, dated 25 October 2020 to 27 October 2020, showed MGC 1 serviced the MA's oil after the in-flight incident on 26 October 2020 due to a leak in the -8 oil line (Tab D-99). MGC 1 replaced the -8 oil line because a broken clamp punctured the line (Tabs D-94 and Z-13). However, there was no documentation in the 781A Forms confirming the oil system was serviced or needed to be serviced (Tab D-92 to D-97). Moreover, MGC 1 testified that he

removed the Magnetic Chip Detector (MCD) and the intake runners when replacing the -8 oil line; however, the 781A Forms indicated MGC 1 did not remove either (Tabs D-92 to D-97, V-8.5 and V-8.10). The original -8 line was inspected and found to be in compliance with a Time Compliance Technical Order (TCTO) number 2J-T102-520 as of 28 October 2015 (Tab U-5). The MA's historical records revealed a recurring maintenance problem with the data link system on 11 October 2020 and 19 October 2020 (Tab D-27 and D-56). The active 781H Form showed the basic post and preflight inspections were completed and verified on 27 October 2020 for the mishap flight (Tab U-9). The MPS complied with ER requirements in accordance with TO 00-20-1 (Tabs U-9 to U-12, BB-36 to BB-39).

b. Inspections

The 781A Forms between 4 October 2020 and 25 October 2020 indicated routine inspections were completed without any significant discrepancies (Tab D-9 to D-89). There were discrepancies in the engine logbook under the service records tab showing no updates were made since 29 August 2019 (Tab U-5 to U-8). The Federal Aviation Administration (FAA) requires maintenance personnel to update the engine logbook with all maintenance and inspections performed on the engine (Tabs D-115 and U-3 to U-8). The MA's engine logbook did not show the engine was installed; however, there was a record of installation in the Integrated Maintenance Data Systems (IMDS) on screen 713 (Tabs D-115 and U-3 to U-8). The FAA requires maintenance personnel to update the propeller logbook anytime maintenance or inspections are completed on the propeller (Tab D-140 to D-142). In this case, the propeller log did not contain any record of the propeller being installed on the MA; however, IMDS screen 714 showed it was installed (Tab D-113 and D-143 to D-156).

c. Maintenance Procedures

The TO for the -8 oil line requires technicians remove certain engine components before removing and replacing the -8 oil line, namely: the spinner cone, beta tube, propeller, and engine plenum assembly (Tab BB-12). Removing these components provides more workspace for the maintenance personnel to remove and replace the oil line (Tab Z-3 to Z-11). There are no annotations in the 781A Forms to suggest MGC 1 removed these obstructing components before replacing the -8 oil line (Tab D-92 to D-97). Moreover, MGC 1 testified he did not remove the component parts before replacing the -8 oil line because the Mishap Flight Chief (MFC) instructed him not to (Tab V-8.3 to V-8.8). As such, MGC 1 struggled to attach the replacement -8 oil line because the limited workspace made it difficult to maneuver his hands and tools in the confined area (Tab V-8.7).

d. Maintenance Personnel and Supervision

Amentum's training records showed a date when an employee began receiving training on a given task or the date when the employee completed a given task, but not both (Tab T-126 to T-159). As such, it is difficult to tell how much training an employee received on a given task, and in some cases, whether the employee was ever approved to perform the task (Tab T-126 to T-159).

The training records for MGC 1 showed he began working for Amentum on 1 August 2018 (Tab T-126). They also showed that on 8 October 2020, MGC 1 began training on 140 separate

maintenance tasks, none of which has a completion date annotated (Tab T-126 to T-159). Moreover, his records showed on that same day, 8 October 2020, he completed 479 tasks, none of which has a start date annotated (Tab T-126 to T-159). At the time when MGC 1 replaced the -8 oil line, he was signed off on approximately 735 maintenance tasks (Tab T-126 to T-159). However, when replacing the -8 oil line, MGC 1 verified the post-repair engine run and oil leak check (specifically engine runs, oil and fuel leak checks, and oil servicing), but according to his training records, he was not approved to perform these procedures (Tabs D-96, D-97, and Tab T-127).

The training records for MGC 2 showed he began working for Amentum on 31 August 2018 (Tab T-160). At the time of the -8 oil line repair, MGC 2 was fully trained on all the maintenance tasks they performed (Tab T-160 to T-193).

The training records for MPS showed he began working for Amentum on 8 July 2018 (Tab T-119). At the time of the -8 oil line repair, MPS was trained on all MPS tasks on 22 September 2020 (Tab T-119 to T-125). Further, MPS testified that Amentum employees would receive on-the-job training once they arrived at a location (Tab V-6.1). However, the training records indicated that Amentum approved MGC 1 and MGC 2 to perform hundreds of tasks in one day respectively (Tab T-119 to T-193).

e. Fuel, Hydraulic, Oil, and Oxygen Inspection Analyses

At 1901z, the oil pressure began to decrease (Tabs Z-28 and EE-3). At 1903z, the oil level was at 100 percent, but by 1908z, the oil level had drained to 0 percent (Tab EE-3, Z-28). Conversely, during the sortie two days before the mishap, the MA experienced a slow loss of oil due to a small hole in the -8 oil line (Tab EE-3, Z-25). There is no evidence to suggest the MA had any fuel system concerns at the time of mishap (Tab Z-28).

Oxygen and hydraulic systems are not applicable for the MQ-9A.

f. Unscheduled Maintenance

There was only one major unscheduled maintenance task performed on the MA since the last scheduled 200-hour inspection (Tab D-94). These corrective actions included removal and installation of the -8 oil line (Tab D-94).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

(1) MQ-9A Oil Delivery System

The oil system of the MQ-9A consists of one oil tank assembley with sensors to measure oil temperatures and oil levels (Tab BB-25 to BB-28). The oil tank has an electrically connected MCD that all oil passes through when leaving the tank (Tab BB-25 to BB-28). The oil is pulled from the oil tank by the high-pressure pump (Tab BB-25 to BB-28). The oil is then pushed into the engine oil filter assembly which flows through the oil filter bypass valve, allowing oil to bypass the engine filter if it gets clogged (Tab BB-25 to BB-28). The oil then goes through the oil regulator valve that releases oil pressure if it is too high before reaching the gearbox (Tab BB-25

to BB-28). The oil then flows through the oil pressure transducer, which reads the oil pressure (Tab BB-25 to BB-28). From there, the oil passes the oil temperature bulb on the forward side of the gearbox (Tab BB-25 to BB-28). Oil is than sent to the gearbox and turbine sections of the engine to cool, lubricate and clean the components inside the engine (Tab BB-25 to BB-28). The oil is then pulled from these sections by one turbine scavenge pump and two gearbox scavenge pumps (Tab BB-25 to BB-28). The oil then flows back through the -8 oil line before passing a second MCD that is not electrically connected (Tab BB-25 to BB-28). From that point, oil feeds into the fuel heater assembly, where the fuel system cools it, then moves to the temperature control valve (Tab BB-25 to BB-28). When the oil hits the temperature control valve, if the oil is too hot, it will be routed to the oil cooler assembly and back to the tank; if the oil is not hot, then it will bypass the oil cooler and go straight to the oil tank (Tab BB-25 to BB-28).

(2) MQ-9A Oil Monitoring

The MQ-9A provides information on the oil system to aircrew with Variable Information Tables (VITs) (Tabs BB-25 to BB-28 and EE-4). VITs are tables that list categories and values of information in a textual format (Tab EE-4). Depending on the type and layout of the Ground Control Station, the aircrew can have two or more VITs displayed simultaneously, with the aircrew choosing which VITs to display (Tab EE-4). In the VITs, an electrically connected level sensor mounted to the tank reports the oil quantity (Tabs BB-25 to BB-28). The oil pressure transducer mounted on bulkhead 10 reads the oil pressure values and sends that data to the VITs and Head Up Display (HUD) (Tabs BB-25 to BB-28 and EE-4). Oil temperature is read from the oil temperature bulb located in the oil supply passage, which sends a signal to the HUD (Tabs BB-25 to BB-28 and EE-4).

b. Evaluation and Analysis

Not Applicable

7. WEATHER

a. Forecast Weather

Weather at the airfield during the time of the mishap was slightly hazy but not restricting visibility, with winds 270 at 6 knots (Tab W-3). The approximate mishap location weather was clear skies and no restriction to visibility, with winds 330 at 25 knots at 24,000 feet (Tab W-7 and W-12).

b. Observed Weather

Not Applicable

c. Space Environment

Not Applicable

d. Operations

Not Applicable

8. CREW QUALIFICATIONS

a. Mishap Pilot

The MP completed Initial Qualification Training at Holloman AFB on 18 October 2019 (Tab T-42). The MP completed Mission Qualification Training at Shaw AFB and became Combat Mission Ready on 24 September 2020, with no discrepancies (Tab T-5 and T-42). Recent flying hours/sorties for the previous 30, 60 and 90 days are: (Tab T-52, T-54, and T-56).

Mishap Pilot	Hours	Sorties
30 days	70.7	18
60 days	76.4	21
90 days	82.4	25

b. Mishap Sensor Operator

The MSO completed Initial Qualification Training at Holloman AFB on 15 December 2016 (Tab T-97). The MSO completed Mission Qualification Training at Whiteman AFB and became Combat Mission Ready on 12 January 2018 (Tab T-97). The MSO became Instructor qualified on 29 November 2018 and Evaluator qualified on 28 August 2020 at Shaw AFB (Tab T-97). Recent flying hours/sorties for the previous 30, 60 and 90 days are: (Tab T-114, T-116, and T-118).

Mishap Sensor Operator	Hours	Sorties
30 days	29	10
60 days	30.4	12
90 days	63.3	24

9. MEDICAL

a. Qualifications

The MCE and MGC were physically and medically qualified for the mission (Tab EE-6 to EE-5)

b. Health

Not Applicable

c. Pathology

The medical clinic collected blood and urine samples from everyone involved with the mishap, all tests came back negative for the aircrew (Tab EE-6). The toxicology test for MGC 1 also came back negative (Tab EE-5).

d. Lifestyle

Not Applicable

e. Crew Rest and Crew Duty Time

Prior to the start of flying duties the MP and MSO signed the Go/No-Go document stating that they were legally ready to fly as defined in Air Force Manual (AFMAN) 11-202 Vol 3 *Flight Operations* (Tabs AA-4 and EE-6).

10. OPERATIONS AND SUPERVISION

a. Operations

At the time of the mishap, the shift was preparing for changeover to the next shift (Tab V-1.4). The operations tempo was light, and the MCE was performing support for an intelligence, surveillance, and reconnaissance mission (Tab V-3.10).

b. Supervision

Every mission has an Ops Sup whose job is to oversee all aircraft flying and assist with anything from kinetic action to emergencies (Tab EE-3). At the time of the mishap, the Ops Sup took over coordinating with the outside agencies to ensure everyone who needed to be aware of the emergency aircraft was notified (Tab V-1.4 to V-1.5). These personnel were the CAOC Liaison Officer, Persistent Attack and Reconnaissance Operations Center Mission Director, ATC, and nearby aircraft (Tab V-1.4, V-5.6).

11. HUMAN FACTORS ANALYSIS

a. Introduction

The Department of Defense (DoD) Human Factors Analysis and Classification System 7.0 (HFACS 7.0) lists potential human factors that can play a role in aircraft mishaps and identifies potential areas of assessment during an accident investigation (Tab BB-41).

b. Relevant factors identified by AAIB

(1) Procedure Not Followed Correctly (AE103) is a factor when a procedure is performed incorrectly or accomplished in the wrong sequence (Tab BB-45). Prior to this mishap, MGC 1 failed to follow relevant TO while replacing the -8 oil line and clamps (Tab V-8.3).

(2) Directed Individual to Violate Existing Regulations (SV003) is a factor when a supervisor directs a subordinate to violate existing regulations, instructions or technical guidance (Tab BB-55). Prior to this mishap, the MFC directed MGC 1 to disregard TO 00-79-21-09-00AAA-520A-A in an effort to expedite repair of the -8 oil line (Tab V-8.3).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

(1) AFI 51-307, *Aerospace and Ground Accident Investigations*, 18 March 2019

(2) AFI 51-307, Air Combat Command Supplement, *Aerospace and Ground Accident Investigations*, 3 December 2019

(3) Department of the Air Force Instruction (DAFI) 91-204, *Safety Investigations and Reports*, 10 March 2021

(4) AFMAN 11-202, Volume 3, *Flight Operations*, 10 June 2020

(5) Human Factors Analysis and Classification System, Version 7.0

NOTICE: Directives and publications 1-4 listed above are available digitally on the Air Force Departmental Publishing Office website at: https://www.e-publishing.af.mil. The Human Factors Analysis and Classification System, Version 7.0 publication is available on the Air Force Safety Center's website: https://www.safety.af.mil/Divisions/Human-Factors-Division/HFACS/

c. Other Directives and Publications Relevant to the Mishap

(1) TO 00-79-21-09-00AAA-720A-A, GEAR CASE TO CHIP DETECTOR HOUSING, -8 HOSE ASSEMBLY - INSTALL PROCEDURE, MQ-9A AIRCRAFT, 1 June 2016

(2) TO 00-79-00-00-00AAA-040A-A, ENGINE OIL - DESCRIPTION, MQ-9A AIRCRAFT, 01 June 2016

(3) TO 00-20-1, AEROSPACE EQUIPMENT MAINTENANCE INSPECTION, DOCUMENTATION, POLICIES AND PROCEDURES, TECHNICAL MANUAL, 06 September 2019 (publically releasable)

d. Known or Suspected Deviations from Directives or Publications

MCG 1 testified he deviated from TO 00-79-21-09-00AAA-720A-A, which requires technicians to remove certain engine components before removing and replacing the -8 oil line, namely the spinner cone, beta tube, propeller, and engine air intake plenum assembly (Tab V-8.3). When asked why he deviated from the technical data, MGC 1 explained: MFC directed MGC 1 to disregard the TO in an effort to expedite repair of the -8 oil line (Tab V-8.3).

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13 JANUARY 2021

STEVEN G. SHEPAN, Colonel, USAF
President, Accident Investigation Board

STATEMENT OF OPINION

MQ-9A, T/N 12- 4179
UNDISCLOSED LOCATION IN AFGHANISTAN
28 OCTOBER 2020

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 28 October 2020 at 1944 Zulu time (z) an unmanned MQ-9A, tail number (T/N) 12-4179, crashed into a mountainous region of an undisclosed location in Afghanistan. The mishap aircraft (MA) was operated remotely by a Mission Control Element (MCE) which was comprised of the mishap pilot (MP) and mishap sensor operator (MSO). The MCE was assigned to the 482d Attack Squadron—a unit located at Shaw Air Force Base, South Carolina, but belonging to the 432d Wing at Creech Air Force Base, Nevada. The MA suffered heavy damage at impact about 118 nautical miles from the recovery location, and was not recovered; instead it was rendered unsalvageable by kinetic means a short time later. There was no reported damage to civilian property, no injuries, and no fatalities. The loss of government property was valued at $14,128,206.

Approximately 40 minutes before the crash, at about 1906z, the MSO noticed a significant drop in the oil level and alerted the MP. The MP and MSO scanned the aircraft but there were no visual indications of an oil leak. Within 5 minutes (between 1903z and 1908z) the oil level dropped from 100 percent to 0 percent. Together, the MCE reported the problem to the Operations Supervisor (Ops Sup) in the squadron operations cell, declared an emergency, ran the requisite checklists, and notified the recovery location of their intent to return. Shortly after re-routing to the recovery location, the CAOC ordered the MCE to attempt to salvage the MA in the event of an emergency landing. Then, at 1924z the engine failed due to oil starvation, so the MP controlled the glide of the MA to optimize range and begin the process of selecting a flat, unpopulated area where the MA might be recovered. As the MA lost altitude, the MCE and its supporting staff identified an ad hoc landing site and configured the MA for landing by lowering the landing gear at 1943z. As they approached, the safety observer directed the MP to change course because he observed what appeared to be a man-made structure in their trajectory. Accordingly, the MP turned the MA in the opposite direction and was unable to avoid a ridge resulting in a crash at 1944z.

During the MA's previous sortie, two days prior to the mishap, the MA experienced an in-flight incident due to a drop in oil level. During that flight, the pilot noticed the oil level at 0900z was between 95-100 percent, but had dropped to 66 percent by 1005z. The pilot did not declare an in-flight emergency due to oil levels still being in operational range, but immediately decided to return the MA to the recovery location and landed safely. The Mission Ground Crew (MGC) technicians diagnosed the reason for the oil leak—broken oil hose clamps and a small hole in the -8 oil line. To repair the oil line, the Technical Order (TO) required the MGC to remove certain component parts beforehand to allow sufficient space to accomplish the repair work; however, the MGC's primary maintenance technician (MGC 1) assigned to the repair did not remove these

components because the Mishap Flight Chief (MFC) told him not to. Because MGC 1 did not remove the required components, workspace was significantly reduced which complicated MGC 1's ability to replace the -8 oil line. Specifically, the limited workspace made it difficult to maneuver hands and tools in the confined area.

2. CAUSE

As the Abbreviated Accident Investigation Board (AAIB) President, I find, by a preponderance of the evidence, an oil leak, reducing the oil level to zero percent, caused the engine to fail, preventing the MA from returning safely to the recovery location.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

Moreover, I find, by a preponderance of the evidence, two factors substantially contributed to the mishap:

a. MGC 1 failed to follow the relevant TO while replacing the oil line and clamps.

The applicable TO for removal and replacement of the -8 oil line requires technicians to remove the spinner cone, beta tube, propeller and engine plenum assembly. These components are removed to increase workspace for the maintenance personnel to replace the oil line properly. There are no annotations in the 781A Forms to suggest MGC 1 removed the required components before replacing the -8 oil line. Moreover, MGC 1 testified he did not remove the component parts. This led to MGC 1 not properly repairing the -8 oil line which led to an oil leak during the mishap sortie.

b. MFC directed the MGC 1 to disregard a TO in an effort to expedite repair.

MGC 1 testified he did not remove the required components before replacing the -8 oil line because MFC directed him it was unnecessary. As such, MGC 1 struggled to attach the replacement -8 oil line because the limited workspace made it difficult to maneuver his hands and tools. When the MFC directed MGC 1 to not remove the required components before replacing the -8 oil line, it effected MGC 1's decision not to remove the component parts which led to MGC 1 not properly repairing the -8 oil line.

4. CONCLUSION

I reviewed the data logs, aircraft maintenance forms documentation, witness testimony, video evidence, photographic evidence and maintenance practices information provided by a subject matter expert. I find by a preponderance of the evidence, the oil leak, reducing the oil level to 0 percent caused the engine to fail, preventing the MA from returning safely to the recovery location. Further, I find by a preponderance of the evidence, each of the following factors substantially contributed to the mishap; (1) MGC 1 failed to follow the relevant TO while replacing the oil line and clamps; and (2) MFC directed MGC 1 to disregard a TO in an effort to expedite repair.

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13 JANUARY 2022

STEVEN G. SHEPAN, Colonel, USAF
President, Accident Investigation Board

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