UNITED STATES AIR FORCE
ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION
BOARD REPORT

MQ-9A, T/N 15-4301

9TH ATTACK SQUADRON
49TH WING
HOLLOMAN AIR FORCE BASE, NEW MEXICO

LOCATION: HOLLOMAN AIR FORCE BASE, NEW MEXICO

DATE OF ACCIDENT: 6 DECEMBER 2021

BOARD PRESIDENT: COLONEL GARY RAFNSON

Abbreviated Accident Investigation,
Conducted IAW Air Force Instruction 51-307

EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION

MQ-9A, T/N 15-4301
HOLLOMAN AIR FORCE BASE, NEW MEXICO
6 DECEMBER 2021

On 6 December 2021, the Mishap Aircraft (MA), an unmanned MQ-9A, Tail Number (T/N) 15-4301, crashed on takeoff and impacted the airfield at Holloman Air Force Base (HAFB), New Mexico. The MA was assigned to the 49th Wing (49 WG) and operated by the 9th Attack Squadron (9 ATKS) Formal Training Unit (FTU). The MA was destroyed, resulting in damage costs of one aircraft's portion of a complete MQ-9 unit (which consists of four aircraft with sensors, one ground control station, and one Predator Primary Satellite link costing a combined $56.5 million). There were no injuries or fatalities.

That morning, the Mishap Pilot (MP) applied takeoff power to the MA and began the takeoff down runway 25 at HAFB. The MA experienced a complete loss of engine power seconds after becoming airborne. Loss of engine power was due to the MP misidentifying the flap lever. Instead of pushing the flap lever forward to reduce the flaps, the MP pulled the condition lever backwards which shut off the engine. Upon realizing that the engine had lost power, the mishap crew (MC), consisting of the MP, a mishap sensor operator (MS), and a mishap safety observer (MSO), initiated an engine restart with the MA not yet at the apogee of its flight path. The MP commanded increased aircraft pitch as the MA decelerated. The MA stalled, then impacted the runway and exploded. The wreckage eventually came to rest just off the runway's prepared surface.

The Accident Investigation Board President found by a preponderance of the evidence one cause of the mishap was the MP's misidentifying the flap lever and, instead of pushing forward on the flap lever, pulling aft or back on the condition lever—shutting off the engine. The Accident Investigation Board President also found by a preponderance of the evidence a second cause of the mishap was the MP undercontrolling the MA by commanding increased aircraft pitch when approaching stall conditions on takeoff. This lack of adequate aircraft control placed the MA outside the parameters for safe flight as the engine began to restart. Further, the Accident Investigation Board President found by a preponderance of the evidence that the design of the pilot Ground Control Station (GCS) substantially contributed to the mishap because of the (1) proximity between the condition lever and flap lever, (2) lack of lever markings, (3) lack of any color differentiation between the levers, and (4) lack of a condition lever safety guard. Finally, the Accident Investigation Board President found by a preponderance of the evidence that the MP's lack of proficiency in Launch and Recovery (L/R) operations substantially contributed to the mishap by not being able to takeoff or establish a glide with minimum acceptable levels of speed, accuracy, and safety.

SUMMARY OF FACTS AND STATEMENT OF OPINION
MQ-9A, T/N 15-4301
HOLLOMAN AIR FORCE BASE, NEW MEXICO
6 DECEMBER 2021

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ACRONYMS AND ABBREVIATIONS

‘	Feet
AETC	Air Education and Training Command
AF	Air Force
AFI	Air Force Instruction
AFMAN	Air Force Manual
AIB	Accident Investigation Board
ATKS	Attack Squadron
CTI	Crew Training International
DoD	Department of Defense
FTU	Formal Training Unit
GCS	Ground Control Station
HAFB	Holloman Air Force Base
HFACS	Human Factors Analysis and Classification System
L/R	Launch and Recovery
MA	Mishap Aircraft
MC	Mishap Crew
MGCS	Mishap Ground Control Station
MP	Mishap Pilot
MS	Mishap Sensor Operator
MSO	Mishap Safety Observer
ORM	Operational Risk Management
PIC	Pilot-In-Command
SDO	Squadron Duty Officer
T/N	Tail Number
USAF	United States Air Force
WG	Wing

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 8 December 2021, Lieutenant General Marshall B. Webb, Commander, Air Education and Training Command (AETC), appointed Colonel Gary B. Rafnson as the Abbreviated Accident Investigation Board president to conduct an Abbreviated Accident Investigation for a mishap that occurred on 6 December 2021 involving an MQ-9A aircraft, Tail Number (T/N) 15-4301, at Holloman Air Force Base (HAFB) (Tab Y-2). The abbreviated aircraft accident investigation was conducted in accordance with Air Force Instruction (AFI) 51-307, *Aerospace and Ground Accident Investigations*, at HAFB in March 2022 (Tabs Y-2 and Y-3). The board members included a Legal Advisor and Recorder (Tab Y-2).

b. Purpose

In accordance with AFI 51-307, *Aerospace and Ground Accident Investigations*, this Abbreviated Accident Investigation Board 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.

2. ACCIDENT SUMMARY

On 6 December 2021, the Mishap Aircraft (MA), an unmanned MQ-9A, T/N 15-4301, crashed on takeoff and impacted HAFB's airfield (Tabs A-5 and Z-16). The MA was assigned to the 49th Wing (49 WG) and operated by the 9th Attack Squadron (9 ATKS) Formal Training Unit (FTU) (Tabs A-6 and K-24). The Mishap Crew (MC) consisted of a Mishap Pilot (MP) assigned to the 6th Attack Squadron (6 ATKS) as well as an Mishap Sensor Operator (MS) and Mishap Safety Observer (MSO) who were both contractors with Crew Training International (CTI) (Tabs K-2, K-9, K-11 and K-24). The MA was destroyed, resulting in damage costs of one aircraft's portion of a complete MQ-9 unit (which consists of four aircraft with sensors, one ground control station, and one Predator Primary Satellite link costing a combined $56.5 million) (Tabs A-5 and DD-18).

3. BACKGROUND

a. Air Education and Training Command

AETC was established and activated in January 1942, making it the second oldest major command in the Air Force (Tab DD-2). AETC's mission is to recruit, train, and educate exceptional Airmen (Tab DD-2). AETC includes Air Force Recruiting Service, two Numbered Air Forces and the Air University (Tab DD-3). The command operates 12 major installations and supports tenant units on numerous bases across the globe (Tab DD-3). There are also 16 Active Duty and 7 Reserve wings in AETC (Tab DD-3).

b. 19th Air Force (19 AF)

19 AF is responsible for the training of aircrews, remotely piloted aircraft crews, air battle managers, weapons directors, Air Force Academy Airmanship programs, and survival, escape, resistance, and evasion specialists to sustain the combat capability of the United States Air Force, other services and our nation's allies (Tabs DD-4 and DD-5). 19 AF includes 19 training locations, with 16 Total Force wings: 10 Active Duty, one Air Force Reserve, and five Air National Guard units (Tab DD-11). It commands more than 32,000 personnel and operates over 1,350 aircraft of 29 different models, flying more than 490,000 hours annually, which is 44 percent of the Air Force total flying hours (Tab DD-11).

c. 49th Wing

The 49 WG is based at HAFB (Tab DD-13). Its mission is to train fighter and remotely piloted aircraft pilots as well as enable Basic Expeditionary Airfield Resources Base, Test Group, and other Mission Partners to succeed (Tab DD-13). The wing focuses on FTU instruction in the F-16 Fighting Falcon and MQ-9 Reaper aircraft (Tab DD-13). Each year the wing schedules, supports, and controls more than 130,000 flight hours from its three runways (Tab DD-13). In addition to the flying training mission, HAFB annually deploys more than 700 highly-trained individuals to support worldwide taskings and contingencies (Tab DD-14).

d. 6th, 9th, 29th Attack Squadrons (6 ATKS, 9 ATKS, 29 ATKS)

The 6 ATKS, 9 ATKS, and 29 ATKS operate under the 49th Operations Group under the 49 WG at HAFB (Tab DD-15). These squadrons train U.S. Air Force and allied aircrews in MQ-9 pilot and sensor operator upgrade training (Tab DD-15).

e. Crew Training International

CTI is a company headquartered in Memphis, Tennessee, that employs over 450 people in 19 states and across the world (Tab DD-16). CTI develops advanced training solutions for the Department of Defense (DoD), government, and commercial training programs (Tab DD-16). Two of the three crewmembers in the mishap were CTI contractors (Tabs V-1.2 and V-2.2).

f. MQ-9 Reaper

The MQ-9 Reaper is part of a remotely piloted aircraft system consisting of sensor/weapon-equipped aircraft, ground control stations, and satellite link equipment (Tab DD-17). The basic crew consists of a rated pilot to control the aircraft and command the mission, and an enlisted aircrew member to operate sensors and guide weapons (Tab DD-17). The primary concept of operations--remote split operations--employs (1) a Launch-and-Recovery (L/R) ground control station for take-off and landing operations at the forward operating location while (2) the crew based in continental United States executes command and control of the remainder of the mission via beyond-line-of-sight links (Tab DD-18). The MQ-9 aircraft has a wingspan of 66 feet (‘), can carry 3750 pounds of weapons and sensors, and has a range of 1150 miles (Tab DD-18).

g. MQ-9 Launch-and-Recovery Operations

Because of remote split operations, not all MQ-9 pilots are qualified in taking off and landing (Tab BB-8). This additional qualification for the MQ-9 is known as L/R operations (Tab BB-8). L/R flying involves operating the aircraft in the fully-manual mode vice normal operations that use the autopilot hold modes (Tab CC-18). Of all assigned and attached pilots in the 6 ATKS, 9 ATKS, and 29 ATKS, only 18% were certified to land or takeoff on the day of the mishap (Tab CC-18). There is no single unit dedicated to only the L/R mission at HAFB (Tab DD-14).

4. SEQUENCE OF EVENTS

a. Mission

On 6 December 2021, the MP, MS, and MSO were scheduled as part of a group of 12 L/R crewmembers to support planned FTU flights (Tab K-34). The FTU missions were scheduled under the authority of the both the 6 ATKS and 9 ATKS Directors of Operations (Tabs K-33 to K-36). The planned missions were to takeoff from HAFB and climb to nearby training airspace (Tab K-35). Upon reaching the designated airspace, the L/R crews would give over aircraft control to scheduled student trainees and instructors (Tab K-35).

b. Planning

The 12 L/R crewmembers began receiving specific direction from the one among them designated as the Squadron Duty Officer (SDO) (Tabs K-34 and BB-58). The SDO began assigning each person to a mission and Ground Control Station (GCS) (Tab K-24). The SDO assigned the MP and MS together to the Mishap GCS (MGCS) (Tab K-24).

The SDO conducted an Operational Risk Management (ORM) assessment by collectively asking the 11 other L/R crewmembers if anyone had any applicable risk factors according to the unit's current ORM guide (Tab K-37). All 11 people reported increased risk because of both the early report time, as well as being tired (the one exception was the MS reported being alert) (Tab K-37). Two crewmembers, to include the MP, also reported increased risk because of being inexperienced in L/R duties (Tab K-37). As a result, nine crewmembers were assessed to have "green" individual risk while the two inexperienced crewmembers, to include the MP, were the only people that were assessed to have "yellow" individual risk—requiring that the "PIC/Top 3 mitigate risk" where "PIC" stands for Pilot-In-Command (Tab K-37). The SDO then assigned the MSO, as an experienced L/R pilot, to the MGCS to mitigate the risk associated with inexperienced L/R pilots (Tabs K-24 and V-5.4). The 11 L/R crewmembers then collectively received weather, Notices to Airmen (recently published information essential to flight operations but not known far enough in advance to be publicized by normal longer-term means), and operations briefs during a mass briefing from the SDO. (Tab V-3.5).

c. Preflight

With the exceptions of (1) having to switch to a ready-made spare aircraft because the original aircraft was leaking fuel, and (2) accomplishing a computer reset to fix radios, the MA and MGCS preflight checks and taxi checks were conducted without incident (Tabs R-84 and R-85).

d. Summary of Accident

The beginning of the takeoff from runway 25 at taxiway delta was uneventful on the morning of the mishap (Tab CC-18). Seconds later, the MP attempted to raise the flaps with the gear still down (Tab R-114). But instead of moving the left-most lever (flaps) up to the neutral/middle position, the MP pulled the second lever from the left (condition lever)—shutting off the engine (Tabs R-114 and CC-3). Applicable engine-shutdown warnings began to occur, to include a condition lever aft warning as well as an "Engine Out Detected" warning verbally called out by the MS to the MP (Tab R-123). The MP continued flying on runway heading but did not establish a glide after the engine stopped producing thrust (Tabs Z-16 and CC-19). The aircraft continued to simultaneously climb and decelerate (Tab CC-3).

After prompting by the MS and MSO, the MP (1) moved the flap lever to the neutral/middle position, and (2) moved the condition lever to the full-forward/run position which initiated an engine restart (Tabs R-119 and CC-4). At this point the aircraft was already slightly below stall speed and not yet at the apogee of its flight path (Tab CC-19).

The engine began restarting shortly after the condition lever warning disappeared with the MA at the apogee of its flight path (Tab CC-19). The MP increased the pitch command to almost double the takeoff attitude as the engine began to restart (Tab CC-19). The MA descended to half of the apogee altitude before beginning its total and terminal stall (Tab CC-19). The engine had nearly restarted as it impacted the ground, gaining half of its final torque in the final second alone (Tab CC-19). The time between applying initial takeoff power and impact was just under one minute (Tab CC-19).

e. Impact

The MA impacted approximately 50’ north of centerline on the approach end of runway 070 (Figure 3 Tab Z-16). It exploded and continued to simultaneously disintegrate and move southwest approximately 435’ until stopping south of taxiway golf and west of taxiway lima (Figure 3 Tab Z-16, Figure 4 Tab Z-17). The MA was destroyed, resulting in damage costs of one aircraft’s portion of a complete MQ-9 unit (which consists of four aircraft with sensors, one ground control station, and one Predator Primary Satellite link costing a combined $56.5 million) (Tabs A-5 and DD-18).

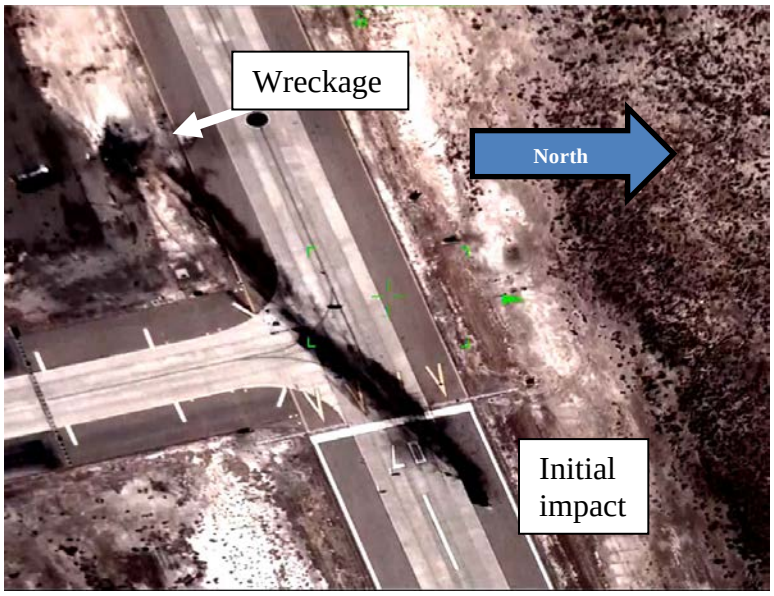

Figure 3 (Tab Z-16)

Figure 4 (Tab Z-17)

f. Egress and Aircrew Flight Equipment

Not applicable.

g. Search and Rescue

Not applicable.

h. Recovery of Remains

Not applicable.

5. MAINTENANCE

a. Maintenance Documentation

A review of the maintenance records for the MA and MGCS leading up to the mishap day revealed no relevant discrepancies or issues, and showed no overdue time compliance technical orders (Tab U-4). All preflight inspections and release procedures were followed (Tab U-4).

b. Inspections

All MA and MGCS maintenance inspections were current and complied with all relevant authorities (Tab U-4). No evidence indicated that MA and MGCS maintenance inspections were a factor in this mishap (Tab U-4).

c. Maintenance Procedures

Maintenance personnel conducted all maintenance procedures in accordance with applicable technical orders and guidance (Tab U-4). No evidence indicated that maintenance procedures were a factor in this mishap (Tab U-4).

d. Maintenance Personnel and Supervision

No evidence indicated that the training, qualifications, and supervision of the maintenance personnel were a factor in this mishap (Tab U-4).

e. Fuel, Hydraulic, and Oil Inspection Analyses

No evidence indicated that mechanical fluids were a factor leading up to this mishap (Tab U-4). While fluids were collected from the wreckage the day after the mishap, neither the safety investigation nor this investigation analyzed the samples (Tab U-2).

f. Unscheduled Maintenance

The pilot set of control computers in the MGCS was removed and replaced 19 days prior to the mishap (Tab U-4). In addition, the sensor operator's keyboard/mouse screws were tightened five days prior to the mishap (Tab U-4). No evidence indicated that these two sole items of unscheduled maintenance were factors in this mishap (Tab U-4).

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

General Atomics Aeronautical Systems, Inc. manufactures the MQ-9 Reaper remotely piloted aircraft system (Tab DD-18). Honeywell International, Inc. manufactures the engine used in the MQ-9 (Tab DD-18). The mishap destroyed the MA (Tab A-5). No MA wreckage was sent away to be inspected for any post-mishap structural analysis report (Tab CC-3).

Figure 5 (Tab Z-18) below shows the layout of the GCS Control Console with the Throttle Quadrant to the pilot's left.

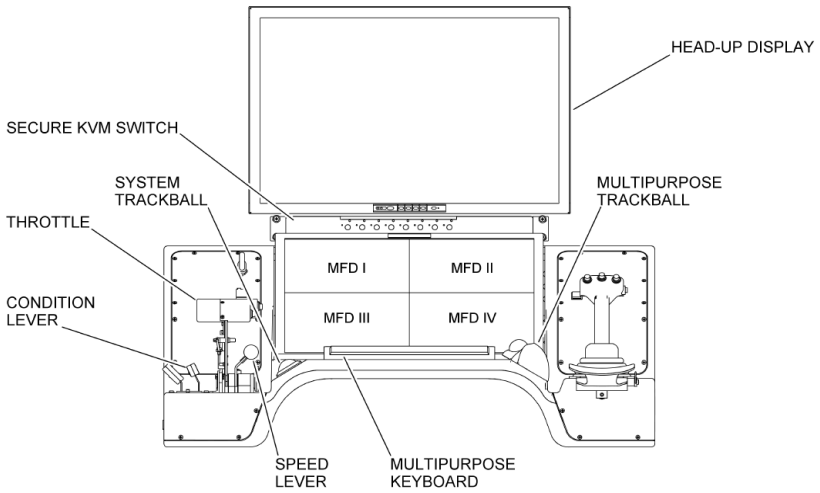

Figure 5 (Tab Z-18)

The design layout of the Control Console places the flap lever and the condition lever, forward and left of the Throttle Quadrant (Figure 6 Tab Z-19). The flap lever and condition lever are close together, without labels, markings, and are the same color (Figure 6 Tab Z-19).

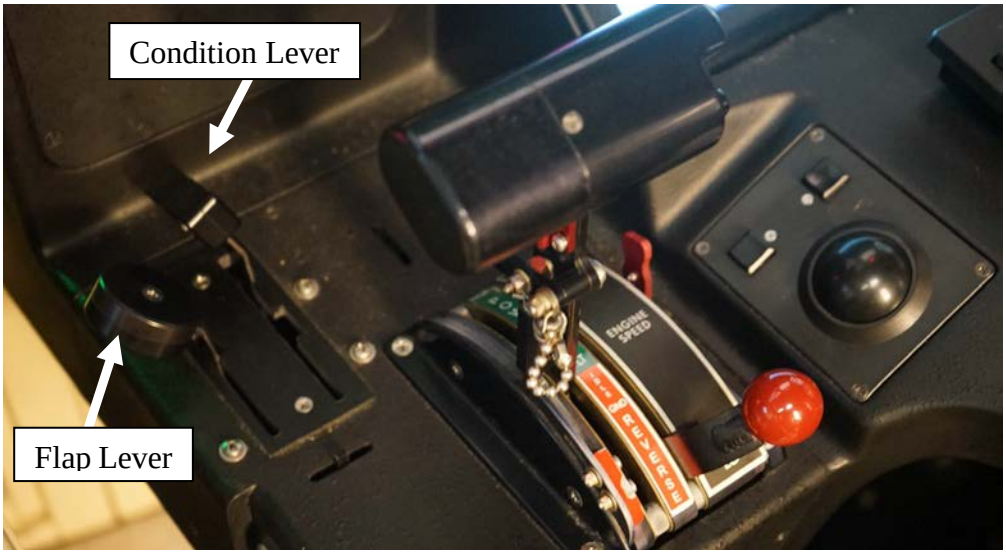

Figure 6 (Tab Z-19)

The condition lever and flap lever are not normally actuated in-flight unless performing L/R operations or in an emergency situation (Tab CC-18). It is normal to position the flaps to 15 degrees for takeoff (Tab CC-18). The neutral/middle position for the flap lever aligns the flap control surface with that of the wing for zero degrees of deflection (Tab CC-18). The flaps must be moved (to the neutral/middle position) after takeoff (Tab CC-18). Moving the condition lever aft from the full-forward position will shut the engine off (Tab CC-18).

b. Evaluation and Analysis

General Atomics contractors reviewed mishap data logs and provided a report (Tabs CC-3 and CC-16). All equipment and components were functioning as intended (Tab CC-3). The MA was following all MGCS commands (Tab CC-3).

7. WEATHER

a. Forecast Weather

The briefing prior to the mishap flight indicated that the forecast weather for takeoff was to be clear skies, greater than 7 statute miles visibility, winds variable at 6 knots, with no other significant weather at the both the scheduled and actual takeoff times (Tab F-2).

b. Observed Weather

The surveillance video from a nearby building that recorded the accident showed clear skies and unrestricted visibility (Tab Z-20). Takeoff winds were from the south at 9 knots (Tab K-12).

c. Space Environment

The space environment and associated weather are not applicable to this incident.

d. Operations

No evidence suggests the MA operated outside of prescribed operational weather limits (Tab CC-18).

8. CREW QUALIFICATIONS

a. Mishap Pilot

The MP was a regular Air Force officer assigned to the 6 ATKS at the time of the mishap (Tab V-3.2). His basic aircraft handling characteristics training included 40 hours of flying in a Diamond DA20 Katana 2-seat light aircraft during Initial Flight Training five years prior to the mishap (Tab V-3.3). Three graded aircraft sorties at MQ-9 initial qualification training included basic aircraft handling demonstrations four years prior to the mishap (Tab G-21).

The MP began L/R qualification training six months prior to the mishap (Tab G-21). The MP performed 22.2 hours of fully-manual mode aircraft flying over 70 days during initial L/R training (Tab G-21). The MP's maximum-possible simulated L/R training in both the L/R qualification course and afterwards at HAFB included 43.1 hours of primary time in 17 simulator sorties since May of 2021 (Tabs G-9 to G-11). The MP failed his initial emergency procedures evaluation on 17 August 2021 because of unsafe airmanship and situational awareness (Tab G-16). He passed a subsequent emergency procedures evaluation on 24 August 2021 (Tab G-15). At graduation from initial L/R training, both his flying performance and situational awareness were characterized as "Slightly Below Average" (Tab G-20). Forty-nine days passed before the MP began L/R duties at HAFB (Tab T-3).

The MP was a current and qualified pilot in the MQ-9A at the time of the mishap with 1521.8 total MQ-9A hours and 102 days (representing only 5% of the MS's L/R experience and 3% of the MSO's L/R experience) since passing his initial MQ-9A L/R checkride (Tabs G-4, G-15 to G-18 and K-21). Despite his passed checkride, last logged takeoff on 9 November 2021, and last logged full-stop landing on 30 November 2021, the MP was not annotated as being L/R-qualified on both the 11 November 2021 and 1 December 2021 6 ATKS Letters of X's (Tab T-3 and CC-18). The MP's most recently logged pattern proficiency sortie was his checkride 102 days prior to the mishap (Tab G-13). The MP's most recent L/R emergency procedures simulator was sometime between 30 days prior (according to testimony at Tab V-3.3) and 89 days prior (according to Aviation Resource Management data at Tab G-13) to the mishap. The MP was struggling with L/R duties and asked for assistance from safety observer pilots because of his inexperience (Tab V-4.2). His recent flight hours—both L/R and non-L/R time—were as follows (Tab G-3):

	Hours	Sorties
30 days	15.7	19
60 days	25.2	29
90 days	31.2	32

b. Mishap Sensor Operator

The MS was a CTI contractor at the time of the mishap (Tabs K-11 and V-1.2). The MS was a current and qualified instructor sensor operator in the MQ-9A at the time of the mishap with 1455.5 total MQ-9A hours and over six years of MQ-9A L/R experience (21 times more than the MP) (Tabs G-26, G-43 and K-22). Recent flight hours were as follows (Tab G-24):

	Hours	Sorties
30 days	7.5	15
60 days	29.4	46
90 days	41.7	64

c. Mishap Safety Observer

The MSO was a CTI contractor at the time of the mishap (Tab V-2.2). The MSO was a current and qualified instructor pilot in the MQ-9A at the time of the mishap with 1310.2 total MQ-9A hours and over 11 years of MQ-9A L/R experience (39 times more than the MP) (Tabs G-51, G-77 and K-22). Recent flight hours were as follows (Tab G-50):

	Hours	Sorties
30 days	8.7	14
60 days	13.6	25
90 days	27.5	47

9. MEDICAL

a. Qualifications

All members were medically qualified for their duties at the time of the mishap (Tabs G-22, G-48 and G-83).

b. Health

There is no evidence to suggest that health was a factor in this mishap (Tab G-22).

c. Pathology

Pathology and toxicology were not factors in this mishap (Tab T-4).

d. Lifestyle

There is no evidence to suggest lifestyle was a factor in this mishap (Tabs R-215 to R-244).

e. Crew Rest and Crew Duty Time

There is no evidence to suggest crew rest or duty time were factors in this mishap (Tabs K-37 and R-215 to R-244). On the day of the mishap, the MS reported that he was “alert” while the MP and MSO both reported that they were “tired” but not “exhausted” because of the early morning showtime (Tab K-37).

10. OPERATIONS AND SUPERVISION

a. Operations

There is no evidence to suggest that operations tempo or any other operations issues were factors in the mishap (Tab CC-18).

b. Supervision

The MP's applicable designated risk factors that morning included: fatigue, show time, currency (previous takeoff was 14 days prior according to testimony in Tab V-3.5 but 27 days prior according to Aviation Resource Management data in Tab G-13), and experience level (Tab K-37). The takeoff currency logged on the day of the mishap was "0-10" Days" (Tab K-37). The MP's overall individual risk level would not have changed if "11-20 Days" had been logged for takeoff currency in accordance with his testimony (Tab K-38). If "21+ Days" had been logged for takeoff currency in accordance with Aviation Resource Management data, then the MP's overall individual risk level would have increased to red for high risk (Tab K-39). The SDO did not assess the MP as a high-risk pilot and mitigate the risk by either (1) lowering one or more designated risk factors and/or (2) contacting the squadron commander (Tab K-39). While safety observers are not an explicitly measured risk mitigation on the unit's ORM matrix, the SDO felt that the assignment of a safety observer mitigated the current risk and obviated any need to contact the squadron commander (Tabs K-39 and V-5.4).

11. HUMAN FACTORS ANALYSIS

a. Introduction

The Department of Defense Human Factors Analysis and Classification System 7.0 (DoD 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-82). Four human factors were identified as relevant to the mishap: (1) Unintended Operation of Equipment; (2) Undercontrolled Aircraft; (3) Controls and Switches are Inadequate; (4) Selected Individual with Lack of Proficiency.

b. Causal

(1) AE101 Unintended Operation of Equipment

HFACS AE101, Unintended Operation of Equipment, is a factor when an individual's movements inadvertently activate or deactivate equipment, controls, or switches when there is no intent to operate the control or device (Tab BB-65). This action may be noticed or unnoticed by the individual (Tab BB-65). The MP pulled the condition lever back to the detent/stop position instead of moving the required flap lever forward to the neutral/middle position (Tabs R-114 and CC-18). This action shut off the engine (Tab CC-18).

(2) AE104 Undercontrolled Aircraft

HFACS AE104, Undercontrolled Aircraft, is a factor when an individual responds inappropriately to conditions by under-controlling the aircraft (Tab BB-65). The error may be a result of preconditions or a temporary failure of coordination (Tab BB-65). The MP attempted to, but did not, establish a glide after the engine stopped producing thrust (Tabs R-115 and CC-18). Establishing a glide at the loss of engine power at standard MQ-9 engine-out descent rates would have enabled the MA to stay airborne for about 5-10 more seconds before impact (Tab CC-19).

c. Contributory

(1) PE204 Controls and Switches are Inadequate

HFACS PE204, Controls and Switches are Inadequate, is a factor when the location, shape, size, design, reliability, lighting or other aspect of a control or switch are inadequate (Tab BB-69). The design of the pilot GCS Throttle Quadrant places the condition lever and the flap lever in close proximity, with a lack of markings, and are the same color (Figure 6 Tab Z-19). There have been at least two other United States Air Force (USAF) MQ-9A accidents caused by a pilot unintentionally moving the condition lever (Tab CC-7).

(2) SI008 Selected Individual with Lack of Proficiency

HFACS SI008, Selected Individual with Lack of Proficiency, is a factor when a supervisor selects an individual that is not proficient in a task, mission or event (Tab BB-77). The USAF MQ-9 community defines proficiency as "the demonstrated ability to accomplish a tasked event expediently, safely and accurately" (Tab BB-116). AFI 90-802, *Risk Management,* 1 April 2019, states that the appropriate use of risk management increases an organization's and individual's ability to safely and effectively accomplish their mission and activity while preserving lives and limited resources (Tab BB-121). The MP had not taken off in 27 days (Tab G-13). If this detail had been accurate on the ORM assessment, the SDO would have had to mitigate the risk by either (1) lowering one or more designated risk factors and/or (2) contacting the squadron commander (Tab K-39). The SDO felt that the assignment of a safety observer mitigated the risk and obviated any need to contact the squadron commander (Tab V-5.4).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publicly Available Directives and Publications Relevant to the Mishap

(1) AFI 10-220_IP, *Contractor's Flight and Ground Operations*, 21 August 2013
(2) AFI 11-202V2_AETCSUP, *Aircrew Standardization and Evaluation Program*, 12 March 2019
(3) AFI 11-418, *Operations Supervision*, 22 December 2021
(4) AFI 11-418_AETCSUP, *Operations Supervision*, 19 June 2020
(5) AFI 11-418_HOLLOMANAFBSUP, *Operations Supervision*, 14 April 2016
(6) AFI 21-103_AETCSUP, *Equipment Inventory, Status and Utilization Reporting*, 28 July 2020
(7) AFI 48-170, *Periodic Health Assessment*, 7 October 2020
(8) AFI 51-307, *Aerospace and Ground Accident Investigations*, 18 March 2019
(9) AFI 90-802, *Risk Management*, 1 April 2019
(10) AFMAN 11-2MQ-9V1 with Corrective Action, *MQ-9 Aircrew Training*, 6 April 2020
(11) AFMAN 11-2MQ-9V2, *MQ-9 Aircrew Evaluation Criteria*, 17 October 2019
(12) AFMAN 11-2MQ-9V3, *MQ-9 Operations Procedures*, 1 October 2020
(13) AFMAN 11-202V1, *Aircrew Training*, 1 October 2019
(14) AFMAN 11-202V1_AETCSUP, *Aircrew Training*, 7 May 2020
(15) AFMAN 11-202V2, *Aircrew Standardization and Evaluation Program*, 30 August 2021
(16) AFMAN 11-202V3, *Flight Operations*, 10 January 2022
(17) AFMAN 11-202V3_AETCSUP, *Flight Operations*, 30 November 2020
(18) DAFI 21-101_DAFGM2021-01, *Aircraft and Equipment Maintenance Management*, 1 October 2021
(19) DAFMAN 48-123, *Medical Examinations and Standards*, 8 December 2020
(20) DoD Human Factors Analysis and Classification System, Version 7
(21) HOLLOMANAFBI 11-250, *Airfield Operations and Base Flying Procedures*, 12 March 2018

NOTICE: All directives and publications listed above are available digitally on the Air Force Departmental Publishing Office website at: https://www.e-publishing.af.mil or the Air Force Safety Center website at: https://www.safety.af.mil.

b. Other Directives and Publications Relevant to the Mishap

(1) AFI 11-2MQ-1 & 9V3_49OGSUP, *MQ-1 and MQ-9 Operations Procedures*, 20 November 2018
(2) Air Force Tactics Techniques and Procedures 3-3.MQ-9, *Combat Aircraft Fundamentals MQ-9*, 9 April 2021 (For Official Use Only)
(3) Technical Order 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures*, 21 June 2021
(4) Technical Order 1 Q-9(M)A-1, United States Air Force Series 2400 Software and Above MQ-9A Flight Manual, 19 August 2021
(5) Technical Order 1 Q-9(M)A-1-1, Serial Numbers 004, 006, 008, and Above MQ-9A Flight Manual Appendix A Performance Data, 19 August 2021
(6) Technical Order 1 Q-9(M)A-1CL-1, United States Air Force Series 2400 Software and Above MQ-9A Flight Crew Checklist, 19 August 2021
(7) 49 Operations Group L/R Element Operating Instruction, January 2020 (For Official Use Only)
(8) 49 Operations Group Standards, May 2020

c. Known or Suspected Deviations from Directives or Publications

Deviations from directives or publications are previously discussed in paragraph 11.c (Tabs BB-116 and BB-121).

DD MONTH YEAR

GARY B. RAFNSON, Colonel, USAF
President, Abbreviated Accident Investigation Board

STATEMENT OF OPINION

MQ-9A, T/N 15-4301
HOLLOMAN AIR FORCE BASE, NEW MEXICO
6 DECEMBER 2021

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 6 December 2021, the Mishap Aircraft (MA), an unmanned MQ-9A, Tail Number (T/N) 15-4301, crashed on takeoff and impacted the airfield at Holloman Air Force Base (HAFB), New Mexico. The MA was assigned to the 49th Wing (49 WG) and operated by the 9th Attack Squadron (9 ATKS) Formal Training Unit (FTU). The MA was destroyed, resulting in damage costs of one aircraft's portion of a complete MQ-9 unit (which consists of four aircraft with sensors, one ground control station, and one Predator Primary Satellite link costing a combined $56.5 million). There were no injuries or fatalities.

That morning, the Mishap Pilot (MP) applied takeoff power to the MA and began the takeoff down runway 25 at HAFB. The MA experienced a complete loss of engine power seconds after becoming airborne. Loss of engine power was due to the MP misidentifying the flap lever. Instead of pushing the flap lever forward to reduce the flaps, the MP pulled the condition lever backwards which shut off the engine. Upon realizing that the engine had lost power, the mishap crew (MC), consisting of the MP, a mishap sensor operator (MS), and a mishap safety observer (MSO), initiated an engine restart with the MA not yet at the apogee of its flight path. The MP commanded increased aircraft pitch as the MA decelerated. The MA stalled, then impacted the runway and exploded. The wreckage eventually came to rest just off the runway's prepared surface.

I find by a preponderance of the evidence one cause of the mishap was the MP's misidentifying the flap lever and, instead of pushing forward on the flap lever, pulling aft or back on the condition lever—shutting off the engine. I also find by a preponderance of the evidence a second cause of the mishap was the MP undercontrolling the MA by commanding increased aircraft pitch when approaching stall conditions on takeoff. This lack of adequate aircraft control placed the MA outside the parameters for safe flight as the engine began to restart. Further, I find by a preponderance of the evidence that the design of the pilot Ground Control Station (GCS) substantially contributed to the mishap because of the (1) proximity between the condition lever and flap lever, (2) lack of lever markings, (3) lack of any color differentiation between the levers, and (4) lack of a condition lever safety guard. Finally, I find by a preponderance of the evidence that the MP's lack of proficiency in Launch and Recovery (L/R) operations substantially contributed to the mishap by not being able to takeoff or establish a glide with minimum acceptable levels of speed, accuracy, and safety.

2. CAUSES

MP Unintentional Activation of the Condition Lever

The MC completed mission planning and preflight duties at HAFB without incident. After completing start-up, taxi and pre-takeoff checks, which included the MP setting the MA's condition lever to the full-forward/run position, the MA took off.

Seconds after takeoff, while attempting to raise the flaps with the gear still down, the MP unintentionally moved the condition lever aft from the full-forward/run position to the detent/stop position. This action shut off the MA's engine.

Had the MP left the condition lever in the appropriate position, the mishap would not have occurred.

MP Undercontrolling Aircraft

Following the engine shut down, the MP maintained runway heading but did not establish a glide. The MP then initiated an engine restart by moving the condition lever to the full-forward/run position. At this point the MA was already slightly below stall speed and not yet at the apogee of its flight path.

The MP increased the pitch command to almost double the takeoff attitude as the engine began restarting now at the apogee of its flight path. The MA ended up descending to half of the apogee altitude before beginning its total and terminal stall. The engine had nearly restarted as the MA impacted the ground, gaining half of its final torque in the final second alone.

Establishing a glide at the loss of engine power at standard MQ-9 engine-out descent rates would have enabled the MA to stay airborne for about 5-10 seconds longer. Had the MP established a glide once the engine stopped working, the MA would likely have regained full thrust before any forced landing and the mishap might not have occurred. Even had the engine not recovered, the impact energy from an engine-out forced landing would have been less than from its fall from the apogee altitude, likely producing a less costly mishap.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

GCS Control Console Throttle Quadrant Design

The flap lever and the condition lever have very different functions. Yet they are close together, without markings, color differentiation, or any safety guard. The condition lever has no safety guard at its full-forward/run position. The next position that the condition lever is capable of being placed in is the detent/stop position. These levers could easily be mistaken by a nonproficient crewmember.

The condition lever is set forward during initial preflight checklists and not normally moved again unless in an emergency. The flap lever is normally actuated shortly after takeoff to bring the flaps from a takeoff position to the neutral/middle position by pushing the lever forward. The MP misidentified the flap lever on takeoff and, instead of pushing forward on the flap lever, pulled aft or back on the condition lever—shutting off the engine.

The GCS control console throttle quadrant design substantially contributed to the mishap.

MP Lack of Proficiency in L/R Operations

The MP shared a qualification that only 18% of his colleagues had that was critical to, but not actually the mission of, the unit in which he was assigned. His performance at L/R training was slightly below average. He failed his initial emergency procedures evaluation. He earned his qualification 102 days prior to the mishap, which was also his most recently logged pattern proficiency sortie. His last emergency procedures simulator was 89 days prior to the mishap. He did not perform L/R duties for 49 days after earning his qualification. His last takeoff was 27 days prior to the mishap. On the day of the mishap, he did not takeoff or establish a glide with minimum acceptable levels of speed, accuracy, and safety.

The MP's lack of proficiency in L/R operations substantially contributed to the mishap.

4. CONCLUSION

I find by a preponderance of the evidence one cause of the mishap was the MP's misidentifying the flap lever and, instead of pushing forward on the flap lever, pulling aft or back on the condition lever—shutting off the engine. I also find by a preponderance of the evidence a second cause of the mishap was the MP undercontrolling the MA by commanding increased aircraft pitch when approaching stall conditions on takeoff. This lack of adequate aircraft control placed the MA outside the parameters for safe flight as the engine began to restart. Further, I find by a preponderance of the evidence that the design of the pilot GCS substantially contributed to the mishap because of the (1) proximity between the condition lever and flap lever, (2) lack of lever markings, (3) lack of any color differentiation between the levers, and (4) lack of a condition lever safety guard. Finally, I find by a preponderance of the evidence that the MP's lack of proficiency in L/R operations substantially contributed to the mishap by not being able to takeoff or establish a glide with minimum acceptable levels of speed, accuracy, and safety.

DD MONTH YEAR

GARY B. RAFNSON, Colonel, USAF
President, Abbreviated Accident Investigation Board

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