UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION
BOARD REPORT

MQ-1B, T/N 02-3098

11TH RECONNAISSANCE SQUADRON
432D WING
CREECH AIR FORCE BASE, NEVADA

LOCATION: CREECH AFB, NV

DATE OF ACCIDENT: 04 APRIL 2014

BOARD PRESIDENT: LT COL CALVIN B. POWELL

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

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR COMBAT COMMAND
JOINT BASE LANGLEY-EUSTIS VA

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OCT 2 1 2014

ACTION OF THE CONVENING AUTHORITY

The Report of the Abbreviated Accident Investigation Board, conducted under the provisions of AFI 51-503, that investigated the 4 April 2014 mishap, at Creech Air Force Base, Nevada, involving an MQ-1B, T/N 02-3098, assigned to the 11th Reconnaissance Squadron, 432d Wing, Creech Air Force Base, Nevada, complies with applicable regulatory and statutory guidance; on that basis it is approved.

JAMES N. POST III
Major General, USAF
Vice Commander

EXECUTIVE SUMMARY
ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION

MQ-1B, T/N 02-3098
Creech AFB, Nevada
04 April 2014

On 04 April 2014, at approximately 2322 Greenwich Mean Time (GMT), the mishap remotely piloted aircraft (MRPA), an MQ-1B, tail number 02-3098, assigned to the 11th Reconnaissance Squadron, 432d Wing, Creech Air Force Base (AFB), Nevada (NV), impacted the runway surface and was substantially damaged during a launch and recovery (LR) training flight at Creech AFB, NV. General Atomics-Aeronautical Systems, Inc. (GA-ASI), the MQ-1B manufacturer, determined upon initial inspection that some MRPA systems are repairable. Total loss to the United States (US) Government is up to $4,500,000, pending repairs. There were no injuries or damage to other government (US or foreign) or civilian property. The mishap crew (MC) consisted of a student pilot, referred to as the mishap upgrading pilot (MUP), a student sensor operator, referred to as the mishap upgrading sensor operator (MUSO), the mishap instructor pilot (MIP), and the mishap instructor sensor operator (MISO). The MUP controlled the MRPA during the mishap. The MUP and MUSO were current and qualified MQ-1B mission aircrew and were training for LR operations. The mishap sortie was their fourth LR training flight.

During the MC's ninth practice landing of the mishap training flight, the MRPA experienced low-level wind shear (LLWS) during a critical phase of the landing. At the same time, the MUP adjusted power to the minimum setting and raised the nose slightly, as is customary when landing. LLWS occurs when the wind speed and direction changes so quickly that the aircraft loses lift. Had the wind not shifted so rapidly, the MRPA would have most likely touched down for a normal landing. As the MUP commanded full throttle in response to the wind shear, the MRPA bounced off the runway, forcing the MRPA's nose upward. Air Force technical order guidance for the MQ-1B in such a scenario directs the pilot to command a nose high flight path and hold that command steady. Furthermore, the pilot should push the throttle to maximum power. The MUP commanded maximum power immediately, but failed to hold a positive pitch, or nose high flight path, to arrest the pitch oscillations. Had the MUP followed this procedure correctly, it is highly likely that the aircraft would have recovered to normal flight. The MUP, instead, attempted to correct the MRPA back to level flight. The MUP overcorrected and the MRPA bounced a second time. The MUP overcorrected again, essentially "chasing" the MRPA's oscillating pitch, or nose position up and down. This sequence continued and increased in intensity for four bounces, resulting in a pilot induced oscillation (PIO). With the landing gear sheared off by the fifth and final impact, the MRPA rotated and skidded to a stop on the runway with its nose facing back the way it had come, suffering significant damage.

The Abbreviated Accident Investigation Board President determined, by clear and convincing evidence that the cause of the mishap was a combination of low-level wind shear leading to a bounced landing, and the MUP's failure to perform the Air Force technical order critical action procedure correctly to avoid a PIO. Furthermore, the Board President determined by a preponderance of evidence that the MUP's lack of training, enhanced by negative transfer from previous experiences, substantially contributed to the mishap.

SUMMARY OF FACTS AND STATEMENT OF OPINION
MQ-1B, T/N 02-3098
04 April 2014

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ACRONYMS AND ABBREVIATIONS

12 AF	Twelfth Air Force
11 RS	11th Reconnaissance Squadron
432 WG	432d Wing
AAIB	Abbreviated Accident Investigation Board
ACC	Air Combat Command
AFB	Air Force Base
AFE	Aircrew Flight Equipment
AFH	Air Force Handbook
AFI	Air Force Instruction
AFSOUTH	United States Southern Air Forces
AFTO	Air Force Technical Order
ANG	Air National Guard
ATC	Air Traffic Control
CAP	Critical Action Procedure
DVR	Digital Video Recorder
GA-ASI	General Atomics-Aeronautical Systems, Inc.
GCS	Ground Control Station
GMT	Greenwich Mean Time
IFG	In Flight Guide
IP	Instructor Pilot
ISO	Instructor Sensor Operator
LOS	Line of Sight
LR	Launch and Recovery
LRE	Launch and Recovery Element
Lt Col	Lieutenant Colonel
MC	Mishap Crew
MCE	Mission Control Element
MIP	Mishap Instructor Pilot
MISO	Mishap Instructor Sensor Operator
MRPA	Mishap Remotely Piloted Aircraft
MSL	Mean Sea Level
MTS	Multi-spectral Targeting System
MUP	Mishap Upgrading Pilot
MUSO	Mishap Upgrading Sensor Operator
NOTAM	Notice to Airmen
NTTR	Nevada Test and Training Range
NV	Nevada
Ops Sup	Operations Supervisor
PIO	Pilot Induced Oscillations
PST	Pacific Standard Time
RPA	Remotely Piloted Aircraft
RTB	Return to Base
SAR	Search and Rescue
SIB	Safety Investigation Board
SO	Sensor Operator
T/N	Tail Number
TO	Technical Order
US	United States
USO	Upgrading Sensor Operator

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

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 08 July 2014, Lieutenant General Lori J. Robinson, Vice Commander, Air Combat Command, appointed Lieutenant Colonel (Lt Col) Calvin B. Powell to conduct an abbreviated accident investigation of a 04 April 2014, MQ-1B remotely piloted aircraft (RPA), tail number (T/N) 02-3098, mishap on Creech Air Force Base (AFB), Nevada (NV) (Tab Y-2). Hereinafter, the MQ-1B RPA, T/N 02-3098, is referred to as the Mishap Remotely Piloted Aircraft (MRPA). The abbreviated accident investigation was conducted in accordance with Air Force Instruction (AFI) 51-503, *Aerospace Accident Investigations*, Chapter 11, at Creech AFB, NV, from 18 July 2014 through 06 August 2014. Board members were the Board President, a legal advisor and a recorder (Tab Y-2).

b. Purpose

This is a legal investigation convened to inquire into the facts surrounding the aircraft or aerospace accident, to prepare a publicly-releasable report, and to gather and preserve all available evidence for use in litigation, claims, disciplinary actions, administrative proceedings, and for other purposes.

2. ACCIDENT SUMMARY

On 04 April 2014, at approximately 2322 Greenwich Mean Time (GMT), the MRPA, assigned to the 11th Reconnaissance Squadron (11 RS), 432d Wing, Creech AFB, NV, impacted the runway surface and was substantially damaged during a launch and recovery (LR) training mission at Creech AFB, NV (Tab Y-2; Tab K-3; Tab S-2 thru S-6). The impact caused significant damage to the MRPA (Tab S-6). General Atomics-Aeronautical Systems, Inc. (GA-ASI), the MQ-1B manufacturer, determined upon initial inspection that some MRPA systems are repairable (Tab EE-6).

The mishap crew (MC) consisted of a student pilot, referred to as the mishap upgrading pilot (MUP), a student sensor operator, referred to as the mishap upgrading sensor operator (MUSO), the mishap instructor pilot (MIP), and the mishap instructor sensor operator (MISO) (Tab K-3). The MUP controlled the MRPA during the accident (Tab DD-6). The MUP and MUSO were current and qualified MQ-1B mission aircrew and were training for LR operations (Tab K-3; Tab G-5; Tab G-105).

The mishap sequence began at 2322:04GMT, when low-level wind shear (LLWS) occurred at a critical phase of landing (Tab DD-6). LLWS occurs when wind speed and direction change so rapidly and in such a manner that the lift generated by the wings changes nearly instantaneously (Tab BB-12). This caused a sudden decrease in lift, so the MRPA bounced off the runway, and

the nose pitched up as the MUP responded by commanding maximum power (Tab DD-6; Tab EE-5). Beginning at 2322:05GMT, the MRPA had five touchdowns, or ground impacts, during the mishap landing sequence, with the nose of the MRPA pitching higher after each touchdown (Tab EE-5 thru EE-6). After each touchdown, as the MRPA bounced off the runway and its upward pitch angle increased, the MUP reacted by decreasing the pitch command (Tab EE-5 thru EE-6). Approaching each touchdown, the MUP attempted to adjust the downward pitch angle of the MRPA with an increase in pitch command (Tab EE-5 thru EE-6). This caused an overcorrected pitch angle so the nose of the MRPA came down and struck the runway with increasing force at each touchdown, until the final touchdown when the MRPA no longer had any landing gear (Tab EE-6; Tab S-2). Then the MRPA skidded along the runway until it came to a stop at 2322:24GMT (Tab DD-6; Tab EE-6; Tab N-13 thru N-15). Both propellers, all three landing gear, and the tails, which hang down from the bottom of the aircraft, were sheared off (Tab S-2 thru S-6).

3. BACKGROUND

The MRPA was an asset of the 11 RS, 432 WG, Creech AFB, NV (Tab K-3). The 432 WG is a component of Twelfth Air Force (12 AF), headquartered at Davis Monthan AFB, Arizona (Tab CC-7). 12 AF is a component of Air Combat Command (ACC), headquartered at Langley AFB, Virginia (Tab CC-10 thru CC-12). At the time of the mishap, the mishap crew (MC) controlled the MRPA from a Ground Control Station (GCS) at Creech AFB, NV, on an LR training event (Tab K-3).

a. Air Combat Command (ACC)

ACC is a major command of the United States Air Force and primary force provider of combat airpower to America's warfighting commands (Tab CC-10). Its mission is to organize, train, equip, and maintain combat-ready forces for rapid deployment and employment while ensuring strategic air defense forces are ready to meet the challenges of peacetime air sovereignty and wartime air defense (Tab CC-10). ACC operates 1300 fighter, bomber, reconnaissance, battle-management, and electronic-control aircraft; provides command, control, communications and intelligence systems; and conducts global information operations (Tab CC-10). Over 83,000 active duty and civilian personnel, and when mobilized, 51,000 Air National Guard (ANG) and Reserve members compose ACC (Tab CC-10).

b. Twelfth Air Force (12 AF)

12 AF controls ACC's conventional forces in the western United States and has the warfighting responsibility for US Southern Command as well as the US Southern Air Forces (AFSOUTH) (Tab CC-7). It manages all Air Force assets and personnel in the AFSOUTH area of responsibility, which includes Central and South America (Tab CC-7). 12 AF works closely with nations in the Caribbean, Central and South America (Tab CC-7). 12 AF directs eight active duty wings and one direct reporting unit as well as 17 gained wings and other units of the ANG and Reserve (Tab CC -7).

c. 432d Wing (432 WG)

The 432 WG, also known as the 432d Air Expeditionary Wing (AEW) "Hunters," employs the MQ-1B Predator and MQ-9 Reaper RPA to provide real-time reconnaissance, surveillance, and precision attack against fixed and time-critical targets to support American and coalition forces worldwide (Tab CC-5). The 432 WG also conducts initial qualification training for LR aircrew, intelligence, weather, and maintenance personnel who will fly and support RPA systems (Tab CC-5). The wing's organization includes three groups, nine RPA flying squadrons, an operational support squadron, and three maintenance squadrons (Tab CC-5).

d. 11th Reconnaissance Squadron (11 RS)

Re-designated and reactivated in July 1995, the 11 RS became the first RPA squadron in the Air Force and provided deployable, long-endurance, serial reconnaissance and surveillance from 1996 through 2002 (Tab CC-2 thru CC-4). The 11 RS transitioned to RPA flying training at Creech AFB, NV in 2003 (Tab CC-3).

e. MQ-1B Predator

The MQ-1B Predator is an armed, multi-mission, medium-altitude, long endurance remotely piloted aircraft (RPA) employed primarily in a killer/scout role as an intelligence collection asset and secondarily against dynamic execution targets (Tab CC-15). The MQ-1B's capabilities make it uniquely qualified to conduct irregular warfare operations in support of Combatant Commander objectives (Tab CC-15).

The MQ-1B is part of an Unmanned Aircraft System (UAS) (Tab CC-15). The system is comprised of the aircraft, which can be outfitted with a variety of sensors and weapons, a GCS, and a communications architecture that establishes a line of sight (LOS) or satellite link between the aircraft and the GCS, along with operations and maintenance crews to support mission tasks (Tab CC-15).

The primary concept of operations, Remote Split Operations, forward deploys a launch and recovery element (LRE) in or near the operational mission area, while maintaining a mission control element (MCE) at a rear echelon location, typically in the continental US (Tab CC-16). LRE crews are responsible for takeoff and landing operations utilizing a GCS and LOS antenna located at the deployed location (Tab CC-15 thru CC-16). The MCE crew, is transferred control of the RPA from the LRE and executes command and control of the mission via beyond-line-of-sight satellite links and then returns control of the aircraft to the LRE for landing (Tab CC-16). This concept allows for a much smaller number of personnel at deployed locations and simplifies command and control functions as well as the logistical supply challenges for the weapons system (Tab CC-16).

The basic crew for the MQ-1B is a rated pilot to control the aircraft and command the mission, an enlisted aircrew member, or Sensor Operator (SO), to operate sensors and assist in weapons employment, plus a mission intelligence coordinator, when required (Tab CC-15). The MQ-1B operates on a 5,000 foot or greater hard-surface runway with clear line-of-sight to a ground data terminal antenna which provides communications for takeoff and landing (Tab CC-15).

General Atomics-Aeronautical Systems, Inc. (GA-ASI) is the manufacturer of the MQ-1B Predator and associated GCS (Tab CC-16). The aircraft has a 55 foot wingspan, is 27 feet in length, is 6.9 feet in height, and utilizes a Rotax 914F four-cylinder engine (Tab CC-16). GA-ASI designed the Predator system in response to the Department of Defense requirement to provide the warfighter persisten intelligence, surveillance, and reconnaissance information combined with a kill capability (Tab CC-16).

4. SEQUENCE OF EVENTS

a. Mission

The MRPA launched uneventfully from Creech AFB, NV, at 1544GMT, on a scheduled 8-hour 40-minute local sortie to support training for multiple successive LR upgrade crews, by order of the 11 RS Commander (Tab T-9; Tab K-3). Prior to the mishap, four crews completed training as scheduled and without incident (Tab T-9). The fifth crew was the MC, which took control of the MRPA at 2206GMT (Tab DD-5; Tab T-9). The MRPA returned to Creech AFB for training at 2229GMT (Tab DD-5). The MC accomplished multiple practice runway approaches prior to the mishap sequence (Tab DD-5). The mishap sequence began at 2322:04GMT (1622:04PST), under MUP control, during a practice approach to Runway 26 (Tab DD-6).

b. Planning

On 04 April 2014, the MC arrived at the 11 RS in the early afternoon to prepare for flight operations (Tab V-2.1 thru V-5.3). The MC conducted a crew brief, led by the MUP, at approximately 2045GMT in accordance with AFI 11-202, Vol. 3, *General Flight Rules*, 22 October 2010, and the 11 RS briefing guide (Tab V-2.1 thru V-5.3). The brief covered, but was not limited to, weather, special interest items, training rules, and instruction for practice runway approaches (Tab V-2.1 thru V-5.3).

The MIP and MISO were familiar with the training requirements, had similar expectations for student performance, and possessed appropriate technical orders (TO), procedures, guidance and experience to accomplish the mission requirements (Tab V-4.1 thru V-5.3). The MUP and MUSO prepared separately for the mishap sortie (Tab V-2.1 thru V-3.3). Both understood the required training events and performance expectations (Tab V-2.1 thru V-3.3).

c. Preflight

The MC stepped to the GCS following a brief by the 11 RS Operations Supervisor (Ops Sup) at approximately 2145GMT (Tab V-2.1 thru V-5.3). The brief included, but was not limited to, current and forecasted weather, active runway, bird status, and MRPA and GCS status (Tab V-2.1 thru V-5.3).

The MC performed a review of maintenance forms and received the crew change-out brief from the previous crew at approximately 2200GMT, according to the 11 RS In-Flight Guide (IFG) (Tab V-2.1 thru V-5.3; Tab DD-5). The previous crew highlighted to the MC a concern for shifting and gusting winds at Creech AFB (Tab V-2.1 thru V-5.3; Tab DD-5). The MC took control of the MRPA at approximately 2206GMT (Tab DD-5).

d. Summary of Accident

The MRPA launched uneventfully from Creech AFB, NV, from Runway 26 at 1544GMT (T-9). Prior to the MC taking control of the MRPA at 2206GMT, four crews completed training as scheduled and without incident (Tab T-9; Tab DD-5).

Following the crew change-out brief from the previous crew, which highlighted shifting and gusting winds at Creech AFB, the MC began training in accordance with the MC brief (Tab V-2.1 thru V-5.3). The MRPA then returned to Creech AFB for practice runway approaches to Runway 26 at approximately 2229GMT (Tab DD-5).

The MC flew eight practice runway approaches prior to the mishap approach (Tab DD-5 thru DD-6). Throughout these practice runway approaches the winds were shifting and variable (Tab DD-5 thru DD-6). For various reasons, and with no apparent trends, the MUP's practice approaches resulted in a go-around each time prior to the mishap approach (Tab DD-5). Out of concern for the shifting wind conditions, the MIP flew two of the eight in order to assess the conditions firsthand (Tab DD-5). The MIP was able to accomplish touch-and-goes (Tab DD-5).

The MUP flew the mishap practice approach at 2320:12GMT (Tab N-13; Tab DD-5). The reported wind resulted in a four knot tail wind, in essence pushing the MRPA slightly (Tab N-13). At 2322:02GMT, the MRPA approached the runway and was in a favorable position to perform a normal touch-and-go, where the pilot allows the landing gear to touch the runway and then immediately takes off again (Tab DD-6; Tab EE-5). As the MUP adjusted the power to the minimum setting and raised the nose of the MRPA just slightly, as is customary for a normal touch-and-go, the MRPA experienced LLWS (Tab DD-6).

Air Force Handbook (AFH) 11-203, Vol. 1, *Weather for Aircrews*, 12 January 2012, defines LLWS (Tab BB-12). Generally, LLWS occurs when the wind speed and direction change so rapidly and in such a manner that the lift generated by the wings changes nearly instantaneously (Tab BB-12). The pilot must react immediately with a change in power settings and pitch to overcome the adverse effects of LLWS (Tab BB-12).

The mishap sequence began at 2322:04GMT, as the LLWS created a decrease in lift. The MRPA bounced off the runway, and the nose pitched up as the MUP responded by commanding maximum power (Tab DD-6; Tab EE-5).

e. Impact

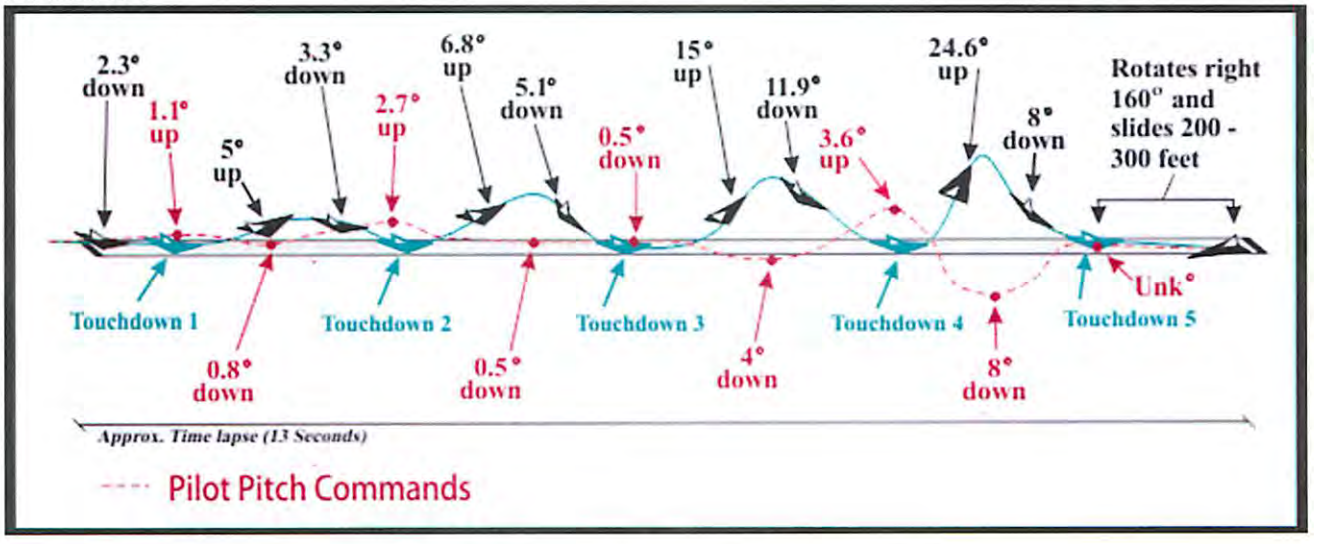
Beginning at 2322:05GMT, the MRPA had five touchdowns, or ground impacts, during the mishap landing sequence, with the nose of the MRPA pitching higher after each touchdown (Tab EE-5 thru EE-6). After each touchdown, as the MRPA bounced off the runway and its upward pitch angle increased, the MUP reacted by decreasing the pitch command (see Table 1 and Figure 1) (Tab EE-5 thru EE-6). Approaching each touchdown, the MUP attempted to adjust the downward pitch angle of the MRPA with an increase in pitch command (see Table 1 and Figure 1) (Tab EE-5 thru EE-6). This caused an overcorrected pitch angle so the nose of the MRPA came down and struck the runway with increasing force at each touchdown, until the final touchdown when the MRPA no longer had any landing gear (Tab EE-6; Tab S-2). Then the MRPA rotated 160° to the right and skidded along the runway until it came to a stop at 2322:24GMT (Tab DD-6; Tab EE-6; Tab N-13 thru N-15).

Table 1 and Figure 1 illustrate the series of pitch angle changes and countering pitch commands, which characterize the Pilot Induced Oscillation (PIO) in this case (Tab EE-5 thru EE-6).

TABLE 1

	TD 1	1 to 2	TD 2	2 to 3	TD 3	3 to 4	TD 4	4 to 5	TD 5
Pitch Angle	-2.3	+5.0	-3.3	+6.8	-5.1	+15.0	-11.9	+24.6	-8.0
Pitch Command	+1.1	-0.8	+2.7	-0.5	-0.5	-4.0	+3.6	-8.0	UNK

FIGURE 1



f. Egress and Aircrew Flight Equipment (AFE)

Not applicable.

g. Search and Rescue (SAR)

Creech AFB Ground Controller activated the crash response at 2322:25GMT (Tab N-13). Runway 26 operations suspended at 2324GMT (Tab N-14). Fire Command and accompanying responders convened on the runway environment at 2324GMT (Tab N-14). Crash response crews disabled MRPA battery power at 2328:28GMT (Tab N-16). Runway 26 and surrounding environment was clear of debris at approximately 0355GMT on 05 April 2014 (Tab DD-7).

h. Recovery of Remains

Not applicable.

5. MAINTENANCE

There is no evidence to suggest maintenance procedures, inspections, operations, or supervision were a factor in this mishap.

a. Forms Documentation

The MRPA AFTO Form 781 series for 01 April 2014 to 04 April 2014 were complete and accurate with no significant discrepancies (Tab D-3 thru D-9). The mishap flight was the first sortie for the MRPA since 03 April 2014 (Tab U-2). The MRPA AF IMT 711C indicated total airframe time of 2070.2 hours and total engine time of 35.5 hours (Tab D-2). The MRPA AFTO Forms 781A and 781K documented upcoming routine inspections and a required sheet metal repair for a minor nick on the front right side of the body (Tab D-3 thru D-9).

b. Inspections

The MRPA AF IMT 711C and AFTO Form 781K indicated all inspections were current (Tab D-2; Tab D-9).

c. Maintenance Procedures

The MRPA AFTO Form 781A indicated 432 WG maintenance personnel performed the required preflight inspections prior to flight on 04 April 2014 (Tab D-3 thru D-6).

d. Maintenance Personnel and Supervision

The MRPA AFTO Form 781A indicated maintenance supervision performed the required preflight quality checks prior to flight on 04 April 2014 (Tab D-3 thru D-6).

e. Fuel, Hydraulic, and Oil Inspection Analyses

According to AF IMT 711C, fluid analysis was not accomplished post mishap (Tab D-2).

f. Unscheduled Maintenance

Not applicable.

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

The MRPA AFTO Form 781A documented on 03 April 2014 a required sheet metal repair for a minor nick on the front right side of the body (Tab D-6).

During the mishap, the MRPA sustained significant damage (Tab S-2). Specifically, the tails, both propellers, and all three landing gear were sheared off (Tab S-2 thru S-6). Furthermore, the wings and body had multiple holes and cracks as a result of the crash (Tab S-6).

b. Evaluation and Analysis

GA-ASI reviewed the data loggers and indicated all MRPA and GCS systems operated normally prior to and during the mishap event (Tab EE-8). The datalink had adequate strength throughout the mishap sortie (Tab EE-8). GA-ASI analysis and AF IMT 711C indicated the MRPA was repairable post mishap (Tab D-2; Tab EE-6).

7. WEATHER

a. Forecast Weather

The Creech AFB forecast produced at 1900GMT, and provided to the MC during the Ops Sup step brief, indicated the weather would change between 2300GMT and 2400GMT to winds from 220° at 9 knots, visibility of ten miles, a scattered cloud layer at 7000 feet Mean Sea Level (MSL), a broken cloud layer at 10,000 feet MSL, and an overcast cloud layer at 18,000 feet MSL (Tab F-2 thru F-3).

b. Observed Weather

The automated weather sensor at Creech AFB indicated at 2333GMT, 11 minutes after the mishap, winds were from 160° at 13 knots and shifting, visibility was ten miles, and a scattered cloud layer existed at 10,000 feet MSL (Tab F-7). Wind calls from the Tower Controller indicated variable and shifting winds of less than 6 knots between 2230GMT and 2322GMT (Tab N-4 thru N-16).

c. Space Environment

Not applicable.

d. Operations

The MC conducted all operations within the prescribed operational weather limits (Tab V-2.1 thru V-5.3).

8. CREW QUALIFICATIONS

a. Mishap Upgrading Pilot (MUP)

The MUP was a current and qualified MCE Evaluator Pilot in the MQ-1B and upgrading for LR operations at the time of the mishap (Tab G-3). The MUP was initially qualified in the MQ-1B on 07 September 2012, became instructor qualified on 27 August 2013, accomplished the most recent recurring flight evaluation on 24 January 2014, became evaluator qualified on 11 February 2014, and was previously qualified as an F-16 pilot and T-37 evaluator pilot (Tab G-3 thru G-36). At the time of the mishap, the MUP had a total of 2463.1 hours of military flying time, which included 340.9 hours in the MQ-1B and 1148.6 hours in the T-37 (Tab G-37 thru G-46). Furthermore, the MUP had a total of 88.5 hours of MQ-1B simulator time (Tab G-37 thru G-46). Recent flight and simulator time is as follows (Tab G-39; G-44 thru G-45).

	Flt Hours	Sorties	Sim Hours	Sim Events
Last 30 Days	7.2	4	2.5	1
Last 60 Days	9.2	5	12.5	5
Last 90 Days	18.6	10	13.5	6

b. Mishap Instructor Pilot (MIP)

The MIP was a current and qualified MCE/LRE Instructor Pilot in the MQ-1B at the time of the mishap (Tab G-81; Tab G-100). The MIP was initially qualified in the MQ-1B on 24 November 2009, became instructor qualified on 08 November 2010, became LR instructor qualified on 22 July 2011, and accomplished the most recent recurring flight evaluation on 16 May 2013 (Tab G-81 thru G-88). At the time of the mishap, the MIP had a total of 563.6 hours of military flying time, all of which was in the MQ-1B and included 384.5 hours instructing (Tab G-89 thru G-101). Furthermore, the MIP had a total of 853.5 hours of MQ-1B simulator time, which included 636.2 hours instructing (Tab G-89 thru G-101). Recent flight and simulator time is as follows (Tab G-90; G-97 thru G-100).

	Total Flt Hours	IP Hours	Sorties	Total Sim Hours	Sim IP Hours	Sim Events
Last 30 Days	13.4	13.4	8	16.7	11.5	7
Last 60 Days	21.4	19.7	13	34.7	27	15
Last 90 Days	31.9	29.4	21	50.9	43.2	22

c. Mishap Upgrading Sensor Operator (MUSO)

The MUSO was a current and qualified MCE Evaluator SO in the MQ-1B and upgrading for LR operations at the time of the mishap (Tab G-103). The MUSO was initially qualified in the MQ-1B on 11 June 2008, became instructor qualified on 22 April 2011, accomplished the most recent recurring flight evaluation on 28 August 2013, and became evaluator qualified on 12 December 2013 (Tab G-103 thru G-116). At the time of the mishap, the MUSO had a total of 2604.6 hours of military flying time, all of which was in the MQ-1B (Tab G-117 thru G-126). Furthermore, the MUSO had a total of 132.2 hours of MQ-1B simulator time (Tab T-4 thru T-8). Recent flight and simulator time is as follows (Tab T-4 thru T-8).

	Flt Hours	Sorties	Sim Hours	Sim Events
Last 30 Days	4.3	3	14.5	6
Last 60 Days	9.8	6	20.8	12
Last 90 Days	36.5	15	24.6	15

d. Mishap Instructor Sensor Operator (MISO)

The MISO was a current and qualified MCE/LRE Instructor SO in the MQ-1B at the time of the mishap (Tab G-128; Tab G-150). The MISO was qualified in the MQ-1B since 21 December 2009, became instructor qualified on 08 November 2010, became LR instructor qualified on 08 July 2011, and accomplished the most recent recurring flight evaluation on 12 April 2013 (Tab G-128 thru G-135). At the time of the mishap, the MISO had a total of 683.4 hours of military flying time, all of which was in the MQ-1B and included 370.3 hours instructing (Tab G-136 thru G-150). Furthermore, the MIP had a total of 895.5 hours of MQ-1B simulator time, which included 484.7 hours instructing (Tab G-136 thru G-150). Recent flight and simulator time is as follows (Tab G-147 thru G-150).

	Total Flt Hours	ISO Hours	Sorties	Total Sim Hours	Sim ISO Hours	Sim Events
Last 30 Days	15.5	9.4	9	16.7	14.0	7
Last 60 Days	23.6	17.0	14	32.2	22.5	14
Last 90 Days	36.9	24.8	24	48.4	34.5	21

9. MEDICAL

a. Qualifications

At the time of the mishap, the MC were medically qualified for flight duty without restrictions and had current annual flight physical examinations/preventive health assessments on record (Tab DD-2).

b. Health

Medical and dental records indicated that the MUP, MIP, and MUSO were in good health and had no duty or performance-limiting condition or illness (Tab DD-2). According to the medical professional's records review, the MISO indicated marginal health during the week leading up to

the mishap (Tab DD-2). The MISO testified marginal health did not inhibit performance on 04 April 2014 (Tab V-5.1 thru V-5.3).

c. Toxicology

The Medical Clinic at Creech AFB, NV collected blood and urine samples from the MUP, MIP, MUSO, and MISO on 04 April 2014 after the mishap (Tab DD-3). All toxicology testing for ethanol, illegal substances, or drugs of abuse resulted in negative findings (Tab DD-3).

d. Lifestyle

There is no evidence to suggest lifestyle factors were relevant to this mishap (Tab DD-3).

e. Crew Rest and Crew Duty Time

AFI 11-202, Vol. 3, *Flying Operations-General Flight Rules*, 22 October 2010, requires aircrew members to have proper "crew-rest" prior to performing in-flight duties and adhere to proper duty time requirements. A review of the MC's rest and sleep cycles in the 72 hours leading to the mishap indicated that crew-rest and crew-duty time requirements were met (Tab DD-3; Tab V-2.1 thru V-5.3).

10. OPERATIONS AND SUPERVISION

a. Operations

The MC testified operations tempo and duty requirements were normal and sustainable during the days leading up to and including the day of the mishap (Tab V-2.1 thru V-5.3).

The MUP entered the LR training program on 04 February 2014 (Tab G-53). The MUP held a demanding position at Creech AFB and was, therefore, not a full-time student in the LR program (Tab V-2.1). As a result, on average the MUP accomplished an event approximately every four days (Tab G-55 thru G-56). During the four weeks prior to the mishap, the MUP accomplished four events, with the longest break in training reaching twelve days (Tab G-55 thru G-56).

b. Supervision

The MIP and MISO were current and qualified to instruct the MC on 04 April 2014 (Tab G-81; Tab G-128). The MC conducted a crew brief, led by the MUP with instruction by the MIP and MISO, at approximately 2045GMT, in accordance with AFI 11-202, Vol. 3, and the 11 RS briefing guide (Tab V-2.1 thru V-5.3). The 11 RS Ops Sup briefed the MC at approximately 2145GMT (Tab V-2.1 thru V-5.3). The Ops Sup brief included, but was not limited to, current and forecasted weather, active runway, and MRPA and GCS status (Tab V-2.1 thru V-5.3).

11. HUMAN FACTORS

a. Introduction

AFI 91-204, *Safety Investigations and Reports,* 12 February 2014, Attachment 6, contains the Department of Defense Human Factors Analysis and Classification System that lists potential human factors that can play a role in aircraft mishaps (Tab BB-2).

b. Applicable Factors

(1) Procedural Error

Procedural error is a factor when a procedure is accomplished in the wrong sequence or using the wrong technique or when the wrong control or switch is used (Tab BB-3). This also captures errors in navigation, calculation or operation of automated systems (Tab BB-3).

In response to the first bounce, the MUP should have accomplished the PIO Recovery procedure in accordance with the TO 1Q-1(M)B-1 (Tab BB-8 thru BB-9). The TO 1Q-1(M)B-1 directs the pilot to: first, pull and hold the control stick back to establish a nose high pitch; second, command full power; and third, allow the aircraft to climb (Tab BB-8 thru BB-9). Procedural error occurred when the MUP did not pull and hold the control stick back to establish a nose high pitch (Tab EE-5 thru EE-6).

(2) Overcontrol/Undercontrol and Negative Transfer

Overcontrol/undercontrol is a factor when an individual responds inappropriately to conditions by either overcontrolling or undercontrolling the aircraft (Tab BB-3). The error may be a result of preconditions or a temporary failure of coordination (Tab BB-3).

Negative transfer is a factor when the individual reverts to a highly learned behavior used in a previous system or situation and that response is inappropriate or degrades mission performance (Tab BB-4).

The MUP undercontrolled the pitch command of the MRPA due to negative transfer from over 1800 hours flying the T-37 and F-16 aircraft (Tab V-2.1 thru V-2.3; Tab G-37 thru G-38). Specifically, in the T-37 a pilot in a similar scenario would very gently apply commands for a gradual pull up, to avoid stalling the aircraft (Tab V-2.1 thru V-2.3). In contrast, however, with the MQ-1B the pilot must command a higher nose position, three to five degrees above the horizon, and hold that command (Tab BB-10). Therefore, the response required in a T-37 and F-16, which the MUP automatically applied (undercontrol) due to experience and habit (negative transfer), will not work in an MQ-1B (Tab V-2.1 thru V-2.3).

The MUP overcontrolled the MRPA by creating a PIO (Tab EE-5 thru EE-6). TO 1Q-1(M)B-1 defines PIO as when the "pilot inadvertently commands an often increasing series of corrections in opposite directions, each attempting to recover the aircraft's reaction to the previous input with an overcorrection in the opposite direction" (Tab BB-10).

(3) Local Training Issues/Programs

Local Training Issues/Programs are a factor when one-time or recurrent training programs, upgrade programs, transition or any other local training is inadequate or unavailable and this creates an unsafe situation (Tab BB-5).

Training guidance for the MQ-1B LR program does not require an upgrading pilot to practice PIO recovery procedures until a training event that the MUP, in this case, was not yet eligible to accomplish (Tab G-58). The MUP, therefore, had not yet had the opportunity to learn the proper procedure through practice in the flight simulator (Tab G-58).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

(1) AFI 51-503, Aerospace Accident Investigations, 26 May 2010
(2) AFI 51-503, Aerospace Accident Investigations Air Combat Command Supplement, 05 September 2013
(3) AFI 91-204, Safety Investigations and Reports, 12 February 2014
(4) AFI 11-202, Volume 3, Flying Operations-General Flight Rules, 22 October 2010
(5) AFH 11-203, Volume 1, Weather for Aircrews, 12 January 2012

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

b. Other Directives and Publications Relevant to the Mishap

(1) TO 1Q-1(M)B-1, Flight Manual USAF Series MQ-1B System

c. Known or Suspected Deviations from Directives or Publications

Not applicable.

13. ADDITIONAL AREAS OF CONCERN

Not applicable.

06 AUGUST 2014

CALVIN B. POWELL, Lt Col, USAF
President, Abbreviated Accident Investigation Board

STATEMENT OF OPINION

MQ-1B, T/N 02-3098
CREECH AFB, NV
04 APRIL 2014

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 04 April 2014, at approximately 2322 Greenwich Mean Time (GMT), the mishap remotely piloted aircraft (MRPA), an MQ-1B, tail number 02-3098, assigned to the 11th Reconnaissance Squadron, 432d Wing, Creech Air Force Base (AFB), Nevada (NV), impacted the runway surface and was substantially damaged during a launch and recovery (LR) training mission at Creech AFB, NV. The impact caused significant damage to the MRPA. General Atomics-Aeronautical Systems, Inc. (GA-ASI), the MQ-1B manufacturer, determined upon initial inspection that some MRPA systems are repairable. Total loss to the United States (US) Government is up to $4,500,000, pending repairs. There were no injuries or damage to other government (US or foreign) or civilian property.

The mishap crew (MC) consisted of a student pilot, referred to as the mishap upgrading pilot (MUP), a student sensor operator, referred to as the mishap upgrading sensor operator (MUSO), the mishap instructor pilot (MIP), and the mishap instructor sensor operator (MISO). The MUP controlled the MRPA during the accident. The MUP and MUSO were current and qualified MQ-1B mission aircrew and were training for LR operations. The mishap sortie was their fourth LR training flight. During the mishap practice landing, the MRPA experienced low-level wind shear (LLWS) during a critical phase of the landing. At the same time, the MUP adjusted power to the minimum setting and raised the nose slightly, as is customary when landing. LLWS occurs when the wind speed and direction changes so quickly that the aircraft loses lift. As the MUP commanded full throttle in response to the wind shear, the MRPA bounced off the runway, forcing the MRPA's nose upward. The MUP attempted to correct the MRPA back to level flight. The MUP overcorrected, however, and the MRPA bounced a second time. The MUP again overcorrected. This sequence where the MUP "chased" the MRPA's oscillating pitch, or nose position up and down, continued and increased in intensity for a total of four bounces, resulting in what is considered a pilot induced oscillation (PIO). With the landing gear sheared off by the fifth and final impact, the MRPA rotated and skidded to a stop on the runway with its nose facing back the way it had come, suffering significant damage.

I find by clear and convincing evidence that the cause of the mishap was a combination of LLWS leading to a bounced landing, and the MUP's failure to perform the critical action procedure (CAP) correctly to avoid a PIO.

I find by a preponderance of evidence that the MUP's lack of training in the PIO recovery CAP, enhanced by negative transfer from the MUP's previous experience flying other aircraft with significantly different control characteristics, substantially contributed to the mishap.

I developed my opinion by analyzing factual data from the MRPA heads-up display (HUD) digital video recorder (DVR), MRPA and Ground Control Station (GCS) maintenance records, and the GA-ASI analysis report of the MRPA data loggers. I examined transcripts of the MC in-GCS and air traffic control (ATC) communications, performed a visual inspection of the MRPA, studied photos taken immediately after the mishap, and performed various flight simulations. Finally, I took into consideration subject matter expert testimony, interviews with the MC, and Air Force directives and guidance.

2. CAUSE

I find by clear and convincing evidence that the cause of the mishap was a combination of LLWS and the MUP's failure to perform the CAP correctly to avoid a PIO.

LLWS occurs when the wind speed and direction change so rapidly and in such a manner that the lift generated by the wings decreases nearly instantaneously. The pilot must increase power and maintain a nose up pitch to overcome the sinking effects. Often when an aircraft is close to the ground, as was the case in this mishap, the pilot's reaction cannot be quick enough to avoid contacting the ground. During this mishap, the MUP pushed the throttle to maximum power immediately upon detecting the wind shift. However, in this case the MRPA was so close to the ground that even the near immediate response was insufficient and the MRPA bounced off the runway. Had the wind not shifted so rapidly, the MRPA would have most likely touched down for a normal landing.

A PIO occurs when the pilot overcorrects an unexpected change in aircraft pitch (i.e., nose angle, either up or down) in an effort to correct back to straight and level flight. As the aircraft responds to the pilot's commands and overshoots level flight, the pilot then overcorrects in the other direction. As the pilot continues to "chase" the aircraft's pitch changes in this way, the oscillations back and forth from nose up to nose down increase in intensity and speed until, often, control of the aircraft is lost. A PIO is especially dangerous when the aircraft is close to the ground.

During this mishap, the unexpected change in pitch occurred when the aircraft bounced off the runway due to the LLWS. Following the bounce and resulting nose high position, the MUP attempted to return the aircraft to straight and level flight but instead overcorrected. The aircraft bounced off the runway a second time. The MUP continued to "chase" the ensuing pitch oscillations, only making matters worse, until the MRPA became uncontrollable.

Air Force technical order guidance for the MQ-1B in such a scenario directs a critical action procedure for the pilot to command a nose high flight path and hold that command steady. Furthermore, the pilot should push the throttle to maximum power. The MUP commanded full throttle immediately, but failed to hold a positive pitch, or nose high flight path, to arrest the

pitch oscillations. Had the MUP followed this procedure correctly, it is highly likely that the aircraft would have recovered to normal flight.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

I find by a preponderance of evidence that negative transfer from previous experience and lack of training in the appropriate procedures exaggerated, and therefore substantially contributed to, the MUP's incorrect response to the mishap scenario.

LLWS disrupted an otherwise normal landing and surprised the MC on the first bounce. This forced the MUP to react immediately. In such an immediate response, the MUP reverted to learned habit patterns. The MUP developed these habit patterns during more than 1800 hours flying the T-37 and F-16 aircraft. Specifically, in the T-37 a pilot in a similar scenario would very gently apply commands for a gradual pull up, to avoid stalling the aircraft. In contrast, however, with the MQ-1B the pilot must command a high nose position, three to five degrees above the horizon, and hold that command. Therefore, the learned response required in a T-37 and F-16, which the MUP automatically applied due to experience and habit, will not work in an MQ-1B.

Furthermore, the training guidance for the MQ-1B LR program does not require an upgrading pilot to practice PIO recovery procedures until a training event that the MUP, in this case, was not yet eligible to accomplish. The MUP, therefore, had not yet had the opportunity to learn the proper procedure through practice in the flight simulator. It is likely that if the MUP practiced the PIO recovery procedure in the simulator prior to the mishap, the newly formed habit patterns would have allowed a proper procedural reaction to the mishap scenario.

4. CONCLUSION

I find by clear and convincing evidence that the cause of the MQ-1B, tail number 02-3098, mishap on 04 April 2014, was a combination of low-level wind shear leading to a bounced landing and the MUP's failure to perform the critical action procedure correctly to avoid a PIO. Furthermore, I find by a preponderance of evidence that the MUP's lack of training, enhanced by negative transfer from previous experiences, substantially contributed to the mishap.

06 AUGUST 2014

CALVIN B. POWELL, Lt Col, USAF
President, Abbreviated Accident Investigation Board

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