UNITED STATES AIR FORCE
ABBREVIATED AIRCRAFT
ACCIDENT INVESTIGATION
BOARD REPORT

MQ-1B, T/N 07-3197

18TH RECONNAISSANCE SQUADRON
432D WING
CREECH AIR FORCE BASE, NEVADA

LOCATION: UNDISCLOSED LOCATION

DATE OF ACCIDENT: 24 SEPTEMBER 2015

BOARD PRESIDENT: LT COL DEREK G. EMMONS

Abbreviated Aircraft 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

OFFICE OF THE VICE COMMANDER
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25 MAR 2016

ACTION OF THE CONVENING AUTHORITY

The Report of the Accident Investigation Board, conducted under the provisions of AFI 51-503, that investigated the 24 September 2015 mishap, in an undisclosed location, involving an MQ-1B, T/N 07-3197, assigned to the 432nd Wing, Creech Air Force Base, Nevada, complies with applicable regulatory and statutory guidance; on that basis it is approved.

//Signed//

JERRY D. HARRIS, JR.
Major General, USAF
Vice Commander

EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION

MQ-1B, T/N 07-3197
Undisclosed Location
24 September 2015

On 24 September 2015, at approximately 0902 Zulu (Z) time, the Mishap Remotely Piloted Aircraft (MRPA), an MQ-1B Predator, tail number (T/N) 07-3197, assigned to the 432d Wing, Creech Air Force Base (AFB), Nevada (NV) and operated by the 18th Reconnaissance Squadron (RS), Creech AFB, NV, entered cloud coverage and crashed while on a mission in an undisclosed location. The MRPA was destroyed upon impact and the wreckage was not recovered. Damage to the MRPA is estimated at $5,156,042. No injuries, deaths, or damage to private property were reported from the mishap.

On 24 September 2015, at approximately 0200Z, after normal maintenance and pre-flight checks, the MRPA departed for a mission from an undisclosed air base. The mishap crew (MC) conducted a changeover briefing with the previous crew, took control of the MRPA, and continued its mission orbit. At approximately 0902Z, the MRPA entered clouds just as the Ground Control Station (GCS) experienced momentary interruptions (lost link) to the radio link the aircrew uses to control the MQ-1B. The lost link coincided with the MRPA entering clouds. Upon entering the clouds, the MC attempted to reverse direction of flight. The MC visually detected ice on the aircraft and the Multi-spectral Targeting System (MTS) camera after rotating the MTS camera to the rearward facing position. Aircraft systems also detected the formation of ice on the MRPA. Turbulence and icing caused the MRPA's angle of attack and roll control to become erratic. The MRPA's airspeed dropped below stall speed, and the MRPA stalled causing the MRPA to lose link to the GCS completely. At 0904Z, the GCS received one data sample indicating the MRPA was in an extreme nose-down attitude and had lost approximately 10,000 feet of altitude. Based upon the last data sample and with the MRPA lost link and unrecoverable, the MC suspected the aircraft had crashed. At 1015Z, another aircraft operating in the area confirmed the crash via video feed.

The Abbreviated Accident Investigation Board (AAIB) President found by a preponderance of the evidence the cause of the mishap was inadvertent entry into clouds coinciding with a momentary loss of the MRPA's satellite datalink with the GCS. The MRPA, its aircraft skin already cooled below freezing, flew into clouds, which caused ice to accumulate on the structure. Icing and turbulence resulted in degraded flight performance, which forced the MRPA into a stalled condition, prohibiting positive datalink with the GCS. The MC was unable to regain control over the MRPA prior to impact with the ground. The AAIB President found by a preponderance of the evidence the following substantially contributing factors: unforecasted and rapidly deteriorating localized weather, breakdown of visual scan, and complacency.

SUMMARY OF FACTS AND STATEMENT OF OPINION
MQ-1B, T/N 07-3197
24 SEPTEMBER 2015

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

12 AF (AFSOUTH)	12th Air Force (Air Forces Southern)
15 RS	15th Reconnaissance Squadron
18 RS	18th Reconnaissance Squadron
432 WG	432d Wing
432 AMXS	432d Aircraft Maintenance Squadron
432 OSS	432d Operations Support Squadron
99 ABW	99th Air Base Wing
A1C	Airman First Class
AAIB	Abbreviated Accident Investigation Board
A/C	Aircraft
ACC	Air Combat Command
ACCSUP	Air Combat Command Supplement
ACT	Aircraft
AFB	Air Force Base
AFE	Air Flight Equipment
AFH	Air Force Handbook
AFI	Air Force Instruction
AFRES	Air Force Reserve
AFSAS	Air Force Safety Automated System
AFTO	Air Force Technical Order
AGL	Above Ground Level
AIB	Accident Investigation Board
Alt	Altitude
AM	Ante Meridiem
AMXS	Aircraft Maintenance Squadron
ANG	Air National Guard
AO	Area of Operations
AOA	Angle of Attack
AOR	Area of Responsibility
Approx	Approximately
ARMS	Aviation Resource Management System
A/S	Airspace
ATKS	Attack Squadron
AWACS	Airborne Warning and Control System
BPO	Basic Post-flight
C	Celsius
Capt	Captain
CFACC	Combined Forces Air Component Commander
Col	Colonel
Comm	Communications
CRM	Crew Resource Management
DoD	Department of Defense
DTV	Daylight Television
E	Enlisted
ED	Enerdyne
EOG	Expeditionary Operations Group
FCIF	Flight Crew Information File
FMV	Full Motion Video
FPM	Feet Per Minute
ft	Feet
GA-ASI	General Atomics-Aeronautical Systems
GCS	Ground Control Station
HDD	Heads-Down Display
HFACS	Human Factors Analysis and Classification System
hrs	Hours
HUD	Heads-Up Display
IAW	In Accordance With
IFG	Inflight Guide
IOS	Intelligence Operations Supervisor
IP	Instructor Pilot
IR	Infrared
IRC	Instrument Refresher Course
ITC	Undisclosed Supported Unit
JFACC	Joint Forces Air Component Commander
JSTARS	Joint Surveillance Target Attack Radar System
K	Thousand
KCAS	Knots Calibrated Airspeed
KIAS	Knots Indicated Airspeed
KTAS	Knots True Airspeed
kts	Knots
L	Local Time
LL	Lost Link
LRE	Launch/Recovery Element
Lt Col	Lieutenant Colonel
Maj	Major
MAJCOM	Major Command
MC	Mishap Crew
MCE	Mission Control Element
MFR	Memorandum for Record
MIC	Mission Intelligence Coordinator
MIDS	Midnight Shift
Min	Minutes
mIRC	Internet Relay Chat
MP1	Mishap Pilot 1
MP2	Mishap Pilot 2
MRPA	Mishap Remotely Piloted Aircraft
MS	Mishap Sortie
MSgt	Master Sergeant
MSL	Mean Sea Level
MSN	Mission
MSO1	Mishap Sensor Operator 1
MSO2	Mishap Sensor Operator 2
MTS	Multi-spectral Targeting System
MX	Maintenance
NV	Nevada
OC	Operations Center
Ops	Operations
Ops Sup	Operations Supervisor
ORM	Operational Risk Management
OSS	Operations Support Squadron

PA	Public Affairs
PID	Positive Identification
PIREPS	Pilot Reports
PPSL	Predator Primary Satellite Communications Link
PM	Post Meridiem
PR	Pre-Flight Inspection
PT	Point
RL	Return Link
ROC	Remotely Piloted Aircraft Operations Center
RS	Reconnaissance Squadron
SAR	Search and Rescue
SCAR	Strike, Coordination, and Reconnaissance
Sec	Seconds
SEPT	Situational Emergency Procedures Training
SIB	Safety Investigation Board
SME	Subject Matter Expert
SMSgt	Senior Master Sergeant
SO	Sensor Operator
SSgt	Staff Sergeant
TCTO	Time Compliance Technical Order
TCu	Towering Cumulus
TGT	Target
T/N	Tail Number
TO	Technical Order
TSgt	Technical Sergeant
US	United States
VVI	Vertical Velocity Indication
WX	Weather
Z	Zulu

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

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 30 December 2015, Major General Jerry D. Harris, Vice Commander, Air Force Combat Command (ACC), appointed Lieutenant Colonel (Lt Col) Derek G. Emmons to conduct an abbreviated aircraft accident investigation of a mishap that occurred on 24 September 2015 involving a MQ-1B remotely piloted aircraft in an undisclosed location. (Tab Y-4) The abbreviated aircraft accident investigation was conducted in accordance with Air Force Instruction (AFI) 51-503, *Aerospace and Ground Accident Investigations*, 14 April 2015, Chapter 11, at Nellis Air Force Base (AFB), Nevada (NV), from 11 January 2016 through 4 February 2016. A legal advisor and recorder were appointed as members of the board. (Tab Y-4) A pilot, flight surgeon, and weather technician were also appointed to the board as subject matter experts. (Tab Y-5 to Y-7)

b. Purpose

In accordance with AFI 51-503, *Aerospace and Ground Accident Investigations*, this Abbreviated Accident Investigation Board (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.

2. ACCIDENT SUMMARY

On 24 September 2015, at approximately 0904 Zulu (Z) time, the mishap remotely piloted aircraft (MRPA), a MQ-1B Predator, tail number (T/N) 07-3197, assigned to 432d Wing (432 WG) and operated by the 18th Reconnaissance Squadron (18 RS), Creech AFB, NV, entered cloud coverage and crashed while on a mission in an undisclosed location. (Tabs DD-4, K-2, S-2, and U-3) The Mishap Crew (MC) consisted of Mishap Pilot 1 (MP1) and Mishap Sensor Operator 1 (MSO1). (Tab K-3) The MRPA was destroyed upon impact and wreckage was not recovered. (Tab Q-1) Damage to government property is valued at $5,156,042. (Tab P-2) No injuries, deaths, or damage to private property were reported from the mishap. (Tab P-2)

3. BACKGROUND

The MRPA was assigned to the 432 WG, 12th Air Force (Air Forces Southern) (12 AF (AFSOUTH)), Air Combat Command (ACC), located at Creech AFB, NV. (Tabs U-3 and CC-3 to CC-12) The MC was assigned to the 18 RS, Creech AFB, NV. (Tab G-10 and G-18)

a. Air Combat Command

ACC organizes, trains, equips and maintains 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. Additionally, ACC develops strategy, doctrine, concepts, tactics, and procedures for air and space power employment. The command provides conventional and information warfare forces to all unified commands to ensure air, space and information superiority for warfighters and national decision-makers. The command can also be called upon to assist national agencies with intelligence, surveillance and crisis response capabilities. ACC numbered air forces provide the air component to U.S. Central, Southern and Northern Commands, with Headquarters ACC serving as the air component to Joint Forces Commands. ACC also augments forces to U.S. European, Pacific, Africa-based and Strategic Commands. (Tab CC-3)

b. 12th Air Force (Air Forces Southern)

Twelfth Air Force is responsible for the readiness of seven active duty wings and one direct reporting unit. These subordinate commands operate more than 360 aircraft with more than 20,300 uniformed and civilian Airmen. The command is also responsible for the operational readiness of 7 Twelfth Air Force-gained wings and other units of the Air Force Reserve and Air National Guard. (Tab CC-7)

c. 432d Wing

The 432 WG trains and employs existing and rapidly expanding unmanned precision attack and intelligence, surveillance, and reconnaissance combat missions there in support of overseas contingency operations. (Tab CC-10)

c. 18th Reconnaissance Squadron

The 18 RS provides combatant commanders with persistent intelligence, surveillance and reconnaissance, full-motion video, and precision weapons employment. Global operations architecture supports continuous MQ-1B Predator employment providing real-time actionable intelligence, strike, interdiction, close air support, and special missions to deployed war fighters. (Tab CC-12)

d. 78th Attack Squadron

The 78th Attack Squadron maintains highly experienced and skilled, combat-ready citizen Airmen charged with training and equipping the Combat Air Forces to conduct Integrated and Expeditionary Combat Operations, as well as training operations. (Tab CC-13)

d. MQ-1B

The MQ-1B Predator is an armed, multi-mission, medium-altitude, long-endurance remotely piloted aircraft that is employed primarily as an intelligence-collection asset and secondarily against dynamic execution targets. 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 (SCAR) against high-value, fleeting, and time-sensitive targets. Predators 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, route clearance, target development, and terminal air guidance. The MQ-1's capabilities make it uniquely qualified to conduct irregular warfare operations in support of combatant commander objectives. (Tab CC-13)

4. SEQUENCE OF EVENTS

a. Mission

The purpose of MC's 24 September 2015 MQ-1B mission was to collect intelligence and video surveillance of an undisclosed target area. (Tab V-3.2 and V-4.2) The mission was authorized via a Crew Flight Authorization, under the authority of the 18 RS Operations Supervisor (Ops Sup). (Tab K-3)

b. Planning

The MC met Go/No Go criteria as annotated on the Crew Flight Authorization, accomplished all required preflight mission planning, and received a standard pre-mission mass briefing from the Ops Sup. (Tabs K-3, V-1.1, V-2.1, V-3.2, V-4.1 to V-4.2, and V-5.1) An Operational Risk Management (ORM) worksheet for the sortie was accomplished. (Tab AA-3) The purpose of the worksheet is to systematically evaluate aircrew for stressors or environmental factors that could negatively impact mission readiness, identify risks, and determine mitigating factors for the planned mission. (Tab AA-3) The ORM analysis for the sortie indicated an elevated level of moderate risk due to MSO1's currency, experience level, interruption to sleep cycle, and minor fatigue and stress. (Tab AA-3) A risk mitigation plan was in place to relieve MSO1 during the mission to compensate for the break in proficiency and was approved at the appropriate level of authority, the Ops Sup. (Tab AA-3) The pre-mission crew briefing was led by MP1 and covered all items in accordance with (IAW) governing instructions and directives. (Tab V-2.1, V-3.2, V-4.2, and V-5.1) The weather forecast provided during the mass briefing included clear conditions for the mission with no weather hazards along the route of flight or in the planned target area. (Tabs F-2, V-1.2, V-2.1, V-3.2, V-4.2, and W-3) There is no evidence to suggest mission planning was a factor in this mishap.

c. Preflight

The MC received separate pre-departure briefings from the Ops Sup IAW governing instructions and directives prior to relieving the previous crew and assuming flight duties. (Tab V-1.1, V-2.1, and V-4.2) MP1 assumed flight duties at 0800Z after receiving an updated weather briefing on the current conditions from the previous pilot during their changeover briefing. (Tab R-4) The MSO1 assumed flight duties at 0846Z after receiving an updated weather briefing on the current conditions from the previous sensor operator (SO) during their changeover briefing. (Tab V-2.1 and V-7.1) The current conditions included a complete overcast condition in the target area with tops of the clouds 6,000 to 7,000 feet below the MRPA operating flight level. (Tabs R-7 and V-4.2) There is no evidence to suggest that MC preflight procedures were a factor in this mishap.

d. Summary of Accident

At 0800Z, MP1 gained control of the MRPA from the previous pilot who had already established the MRPA in an orbit over the target area. (Tabs M-2, R-4, and V-4.2) At 0821Z, MP1 and the previous SO conducted a weather scan utilizing the Multi-spectral Targeting System (MTS) camera. (Tab N-3) From 0822:19Z to 0836:39Z, there was no crew communication over the radio or intercom. (Tab N-3) From 0836:39Z to 0841:38Z, MP1, the previous SO, and the Mission Intelligence Coordinator (MIC) engaged in conversation regarding ages of squadron personnel, music, the effects of MQ-1B missions on the younger members of the squadron, and previous duty locations. (Tab N-3 to N-5) Sometime during the time MP1 and the previous SO worked together that night, they engaged in a personal conversation that was not broadcast over the flight intercom because they had moved their headset microphones away from their mouths. (Tab V-4.3)

At 0843:08Z, MP1 and MIC begin discussing missions being conducted by other aircraft. (Tab N-5) These discussions continued until 0856:33Z and while the discussions occurred, MSO1 assumed flight duties from the previous SO at 0846:09Z. (Tab N-5) The previous SO noticed some vertical development of the clouds toward the end of his time in the Ground Control Station (GCS) and advised MSO1 of that fact during their changeover, but did not recommend a weather sweep to MP1. (Tab V-4.2) Once the MC was situated in the GCS, MSO1 stated "A lot of clouds" at 0848:38Z. (Tab N-6) At 08:56:34Z, MP1, MSO1, and MIC focused their attention on newly provided mission coordinates. (Tab N-6) At 0901:42Z, MSO1 stated, "The clouds look like they're getting closer." (Tab N-7) At 0901:46Z, MP1 called for a weather scan and at 0901:48Z, the MC initiated another MTS camera weather scan by placing the camera into its forward position. (Tab N-7)

At approximately 0901:54Z, as the camera reached the forward position, the MRPA simultaneously entered the clouds and experienced momentary interruptions to the satellite datalink, which is the radio link the aircrew uses to control the MQ-1B. (Tabs J-2, N-7, and DD-5) Upon entering the clouds, the MC deselected the auto pilot modes, gained manual control over the MRPA, and attempted to reverse direction of flight. (Tabs J-2, V-2.2, and DD-5) At 0902:06Z, MP1 commanded the Landing Configuration, which turned off: the Preprogrammed mode; Stall Protect; Airspeed, Heading and Altitude hold; and Cruise mode. (Tab DD-5) The MC also visually detected ice on the MTS camera. (Tab V-2.2) Ice was visually confirmed on the MRPA as the MTS camera was placed in the rearward facing position and aircraft systems

detected the formation of ice on its structure. (Tabs J-2, V-2.2, and DD-5) Localized turbulence associated with the weather contributed to flight control challenges. (Tabs W-3 to W-4, BB-22 to BB-23, BB-32, BB-35, DD-4, and DD-6) As MRPA angle of attack (AOA) and roll control became erratic, MP1 initiated the Loss of Control Prevent checklist. (Tabs N-7, BB-52 to BB-53, and DD-5) The MRPA AOA and roll control remained erratic, airspeed reduced below stall speed, and the MRPA stalled causing the MRPA to lose link to the GCS completely. (Tabs N-7 and DD-4 to DD-6) At 0904:01Z, the satellite datalink was momentarily restored and indicated the MRPA's pitch angle was -20 degrees, roll angle was approximately -13 degrees, yaw rate was +30 degrees per second, and had lost approximately 10,000 feet of altitude. (Tabs J-2 and DD-5) The datalink was lost again and was never recovered. (Tab DD-5) At this point in the mission, the MC suspected the aircraft had crashed. (Tab V-2.2)

e. Impact

At 0904:01Z and prior to MRPA impact with the ground, the return link was momentarily restored, providing a single sample of flight data information received in the return link. (Tabs J-2 and DD-5) The MRPA's altitude was approximately 5,000 feet Mean Sea Level, pitch angle was -20 degrees, roll angle was approximately -13 degrees, and yaw rate was +30 degrees per second. (Tabs J-2, R-11, and DD-5) Another aircraft operating in the area confirmed the crash via video feed at 1015Z. (Tab R-9 to R-11) The wreckage was not recovered. (Tab Q-1)

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

The Air Force Technical Order (AFTO) 781 series forms for the MRPA were documented IAW applicable maintenance guidance. (Tabs D-2 to D-6 and U-3 to U-39) The forms indicated no outstanding issues that would have prevented the MRPA from flying on 24 September 2015. (Tabs D-2 to D-6 and U-3 to U-39) The MRPA flew 2,398 sorties with a total of 10,357.3 hours of flight time prior to departure on the mishap mission. (Tabs D-2 and U-4)

The GCS had three pending maintenance actions to replace parts related to securing a corner of one of the Heads-Down Display screens. (Tabs D-5 and U-29) Additionally, an inspection was

due post flight for an uninterrupted power supply component. (Tab U-30) There is no evidence to suggest that the maintenance of this GCS was a factor in this mishap.

Although there was no documentation in the maintenance forms, the previous SO testified that the nose camera was not functioning properly during the mishap mission. (Tab V-4.2)

b. Inspections

The most recent aircraft inspections were the Basic Post/Preflight Inspection completed at 0300Z on 22 September 2015 and the 150 Hour Aircraft Periodic Inspection performed on 17 September 2015. (Tab U-4) Engine Serial Number GTA6772999 was installed on 9 June 2015. (Tab D-2) The most recent engine inspection was the 60 Hour Inspection performed on 22 September 2015. (Tab D-2) There is no evidence to suggest that inspections were a factor in this mishap.

c. Maintenance Procedures

Review of maintenance documents revealed the overall maintenance practices of the MRPA's maintenance personnel complied with technical orders and safety guidelines. (Tabs D-2 to D-6 and U-3 to U-43)

d. Maintenance Personnel and Supervision

According to the forms review, all preflight maintenance for the MRPA was properly performed prior to the mishap flight. (Tabs D-2 to D-6 and U-3 to U-43) All preflight maintenance on the MRPA prior to the mishap was performed by personnel assigned to maintenance units within 432 WG. (Tab U-44)

e. Fuel, Hydraulic, and Oil Inspection Analyses

Due to the destruction of the MRPA, post-mishap fluid analysis was not conducted nor provided. (Tab Q-1)

f. Unscheduled Maintenance

There were no unscheduled maintenance actions performed on the MRPA. (Tabs D-2 to D-6 and U-3 to U-43)

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

The MRPA was not recovered. (Tab Q-1) As a result, no structural or systems evaluation could be accomplished.

b. Evaluation and Analysis

The previous pilot operated the MRPA from 0655Z to 0800Z during which time all functions were operating within normal operational limits. (Tab R-4) The manufacturer, General Atomics Aeronautical System Incorporated (GA-ASI), analyzed the mishap and provided a detailed report. (Tab DD-3 to DD-11) GA-ASI analyzed the information saved in the data logs, which contain a time-stamped record of the aircraft systems' status, and summarized the data into narrative format. (Tab DD-4 to DD-5)

Based upon the GA-ASI report, the GCS operated normally for the entire flight. (Tab DD-6) Prior to the mishap, the satellite datalink delay was normal. (Tab DD-6) The MRPA responded properly to GCS commands for pitch, roll, yaw and throttle. (Tab DD-6) Upon entering a cloud, aircraft ice detector indicated the presence of ice. (Tab DD-6) Airspeed and normal acceleration variations indicated strong turbulence. (Tab DD-6) MP1 commanded Landing Configuration to gain manual control of the MRPA, which also turned off Stall Protect IAW the Loss of Control Prevent critical action emergency procedure. (Tab DD-6)

Airspeed rapidly decreased from 80 Knots Indicated Airspeed (KIAS) to 60 KIAS and 3 KIAS below stall speed over a period of 7 seconds. (Tab DD-6) AOA and roll angle rapidly increased during this time resulting in the MRPA's stall and lost link condition. (Tab DD-6)

7. WEATHER

a. Forecast Weather

Weather forecasts provided during the mass briefing indicated clear conditions for the mission with no weather hazards along the route of flight or in the planned target area. (Tabs F-2 and W-3) According to AFI 11-2MQ-1&9, Volume 3, *Operations Procedures*, the pilot in command will not operate the aircraft within 25 nautical miles of known thunderstorm activity. (Tab BB-17)

b. Observed Weather

The MC and the MIC observed a low altitude overcast or marine layer formed over the target area. (Tab V-2.1 to V-2.2 and V-3.2) The overcast condition was due to a sea breeze causing the onshore flow of moisture. (Tabs W-3 to W-4 and BB-25) A review of the weather satellite imagery indicated a localized cell of towering cumulus clouds (TCu) in the target area, which was initiated by orographic lift. (Tab W-3 to W-4) The orographic lift forced a moist, unstable air mass up rapidly rising terrain near the coast to a higher elevation, which combined with daytime heating to create storm activity from a single cell of TCu. (Tabs W-3 to W-4, BB-25, and BB-34) A TCu cloud is a transition between the fair weather cumulus and the eventual cumulonimbus cloud, or thunderstorm cloud. (Tab BB-23) The presence of TCu clouds signals changes in atmospheric stability from stable to unstable, creating an atmosphere with thunderstorms probable within minutes. (Tab BB-23) The main feature of the this stage is the updraft, which may extend from near the surface to several thousand feet above the visible cloud top and results in turbulence and icing as the cumulus cloud continues to rise and grow. (Tab BB-23 and BB-32) The most violent turbulence occurs in the shear between updrafts and downdrafts, and in general, the most severe icing conditions are usually found just above the freezing level between 0°C and -5°C. (Tab BB-35) The storm continued to develop between

1000Z and 1100Z into a thunderstorm briefly before it subsided. (Tab W-3) The MRPA was established in its orbit over the target area at an altitude above the freezing level. (Tabs W-4 and DD-12) The MRPA system recorded outside air temperatures ranging from -1°C to -2°C after approximately 0645Z until the incident at approximately 0902Z, which resulted in the aircraft skin cooling to a temperature below freezing. (Tabs BB-26 to BB-27 and DD-12)

c. Space Environment

Not applicable.

d. Operations

Aircraft operations and systems employment were conducted within prescribed operational weather limitations until the aircraft penetrated TCu clouds at its flight level, making it susceptible to turbulence and airframe icing. (Tabs N-7, BB-22 to BB-23, BB-26 to BB-27, BB-32, BB-34 to BB-35, and DD-4) According to paragraph 4.3.5. of AFI 11-2MQ-1&9, Volume 3, *Operations Procedures,* the pilot in command will not operate the aircraft within 25 nautical miles of known thunderstorm activity. (Tab BB-17)

8. CREW QUALIFICATIONS

a. Mishap Pilot 1

MP1 was a current and qualified MQ-1B instructor pilot. (Tab G-3) MP1 had 978.7 total hours in the MQ-1B since 17 October 2013 of which 15.1 were instructor hours. (Tab G-5) Recent flight time is as follows (Tab G-7):

	Hours	Sorties
Last 30 Days	73.8	19
Last 60 Days	115.2	36
Last 90 Days	144.7	47

b. Mishap Sensor Operator 1

MSO1 was a current and qualified MQ-1B sensor operator. (Tab G-14) MSO1 had 470.4 hours in the MQ-1B since 1 October 2014. (Tab G-16) Recent flight time is as follows (Tab G-17):

	Hours	Sorties
Last 30 Days	36.0	9
Last 60 Days	96.5	24
Last 90 Days	183.9	47

There is no evidence to suggest MC qualifications were a factor in this mishap. There is no evidence to suggest experience level contributed to the mishap.

9. MEDICAL

a. Qualifications

At the time of the mishap, the MC was medically qualified for flight duty. (Tab T-7)

b. Health

There is no evidence to suggest the health of the MC contributed to the mishap. (Tab T-7)

c. Pathology

Toxicology results were negative for the MC. (Tab T-7)

d. Lifestyle

MP1 was on the midnight shift for a constant six weeks leading up to the incident and indicated a slightly elevated ORM analysis for personal stress relating to fatigue. (Tabs V-5.1 and AA-3) MP1's last leave was on 11 Aug for one day. (Tab T-3 to T-4)

The mishap sortie was MSO1's first mission after returning from 16 days of leave on 21 September 2015. (Tab T-5 to T-6) MSO1 had two days to acclimate to the midnight shift, received the appropriate crew rest prior to the mission, and did not exceed flight duty period while performing flight duties. (Tabs T-5 to T-6 and V-2.1) MSO1's input to the ORM analysis for the sortie indicated an elevated level of moderate risk due to MSO1's currency, experience level, interruption to sleep cycle, and minor fatigue and stress. (Tab AA-3) A risk mitigation plan was in place to relieve MSO1 during the mission to compensate for the break in proficiency and approved at the appropriate level of authority, the Ops Sup. (Tab AA-3)

There is no evidence to suggest the lifestyle of the MC contributed to the mishap.

e. Crew Rest and Crew Duty Time

Air Force instructions require aircrew members have proper crew rest prior to performing flight duties. (Tab BB-65 to BB-66) AFI 11-202, Volume 3, *General Flight Rules*, paragraph 2.1, defines crew rest as a minimum of 12 non-duty hours before Flight Duty Period (FDP) begins. (Tab BB-65 to BB-66) This period is free time, and includes time for meals, transportation, and the opportunity for at least 8 hours of uninterrupted sleep. (Tab BB-65 to BB-66) Crew rest cannot begin until after the completion of official duties. (Tab BB-65 to BB-66) All crew members confirmed their crew rest requirements were met by signing the Crew Flight Authorization. (Tabs K-3, V-2.1, and V5.1) There is no evidence to suggest crew rest or exceeding flight duty period was a factor in the mishap.

10. OPERATIONS AND SUPERVISION

a. Operations Tempo

MP1 expressed concerns of personal mental fatigue due to high operations tempo while performing duties on the midnight shift for six weeks. (Tab V-5.1)

b. Supervision

The Ops Sup is responsible for the safety and overall mission success of the missions flown on a given day. (Tab V-1.1) The Ops Sup provided the mass briefing for the flight period, reviewed the ORM analysis, reviewed the Go/No Go criteria, and authorized the flight via the Crew Flight Authorization. (Tabs K-3, V-1.1, V-2.1, V-3.2, V-4.1 to V-4.2, V-5, and AA-3) The Ops Sup can monitor missions on aircraft video feeds, aircraft intercom, and internet relay chat, and coordinates with supported units to ensure missions are being accomplished and objectives are being met. (Tab V-1.1) The Ops Sup was not monitoring the MC immediately prior to the mishap because he was acting as a safety observer for a mission executed by another aircraft in a different location. (Tab V-1.2) The Ops Sup returned from his safety observer duties just as the MRPA entered the clouds and lost link. (Tab V-1.2) When the signal was briefly restored moments later, the Ops Sup saw the MRPA had lost 10,000 feet in altitude, and knew it was going to crash, at which point he went to the GCS to support the MC. (Tab V-1.2)

The Intelligence Operations Supervisor (IOS) sits behind the MICs who are working active missions. (Tab V-6.1) The IOS supervises intelligence personnel in the operations center and serves as their direct chain of command. (Tab V-6.1) The IOS can monitor missions on aircraft video feeds, aircraft intercom, and internet relay chat. (Tab V-6.1) The IOS monitored the MC's video feeds during portions of the mission, including the weather scan completed at 0826Z, but was monitoring a different mission when the MRPA lost link. (Tab V-6.2)

There is no evidence to suggest operations or intelligence supervision contributed to the mishap.

11. HUMAN FACTORS ANALYSIS

The AAIB considered all human factors as prescribed in the Department of Defense Human Factors Analysis and Classification System (DoD HFACS) Version 7.0 to determine those human factors that directly related to the mishap. (Tab BB-45 to BB-49)

a. Breakdown in Visual Scan – DoD HFACS AE105

Breakdown in Visual Scan is a factor when the crew fails to effectively execute visual scan patterns. (Tab BB-46)

The nose camera, normally used for takeoff and landing, and can only be used to look directly forward of the aircraft for weather. (Tab DD-14) The MTS camera provides a full 360-degree view around the aircraft, but is the primary sensor when searching and tracking targets of interest. (Tabs V-1.2, V-2.1, and DD-14) To perform a weather sweep, the SO raises the MTS camera to the forward position and rotates it 360 degrees to observe the weather. (Tab V-DD-14)

Performing a weather scan is the responsibility of the pilot in command, but there is no requirement to perform a weather scan at specific intervals of time. (Tab V-DD-14) AFI 11-2MQ-1&9, Volume 3 does not include any direction or requirement to execute weather scans at specific intervals of time or during specific stages of operation. (Tab BB-8 to BB-17) The MC performed a weather scan at 0821:56Z. (Tab N-3) The previous SO noticed some vertical development of the clouds toward the end of his time in the GCS and advised MSO1 of that fact during their changeover, but did not recommend a weather sweep to MP1. (Tab V-4.2) MSO1 stated that there were "a lot of clouds" at 0848:38, shortly after assuming his duties in the GCS. (Tab N-6) MSO1 stated "The clouds look like they're getting closer" at 0901:42. (Tab N-7) MP1 did not direct the second weather scan until 0901:46Z, approximately 2 seconds before the MRPA entered the clouds. (Tab N-7)

b. Complacency – DoD HFACS PC208

Complacency is a factor when the crew has a false sense of security, is unaware of, or ignores hazards and is inattentive to risks. (Tab BB-48)

At 0821Z, MP1 and the previous SO conducted a weather scan utilizing the Multi-spectral Targeting System (MTS) camera. (Tab N-3) The MIC and previous SO noted the continuous cloud coverage prevented the accomplishment of the assigned mission and objectives because the MTS could not image the ground. (Tab V-3.2 and V-4.2) The MIC stated that when there is nothing pertinent to the mission is occurring, in this case caused by cloud cover, crews have "free time to talk and banter back and forth." (Tab V-3.3) From 0822:19Z to 0836:39Z, there was no crew communication over the radio or intercom. (Tab N-3) From 0836:39Z to 0841:38Z, MP1, the previous SO and the MIC engaged in conversation regarding ages of squadron personnel, music, the effects of MQ-1B missions on the younger members of the squadron, and previous duty locations. (Tab N-3 to N-5) Sometime between 0800Z and 0846:09Z, the MP1 and previous SO engaged in a personal conversation that was not broadcast over the flight intercom because they had moved their headset microphones away from their mouths. (Tab V-4.3)

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

(1) AFH 11-203, Volume 1, *Weather for Aircrew*, 12 January 2012
(2) AFI 11-2MQ-1&9, Volume 1, *MQ-1&9, Aircrew Training*, 23 April 2015
(3) AFI 11-2MQ-1&9, Volume 3, *MQ-1 AND MQ-9, Operations Procedures,* 1 November 2012, *Incorporating Change 1*, 28 August 2015
(4) AFI 11-202, Volume 3, *General Flight Rules*, 7 November 2014, *AFGM2015-01*, 13 April 2015
(5) AFI 51-503, *Aerospace And Ground Accident Investigations*, 14 April 2015
(6) AFI 51-503_ACCSUP_I, *Aerospace And Ground Accident Investigations*, 05 September 2013
(7) 18th Reconnaissance Squadron, *Squadron Standards*, 24 February 2015

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) T.O. 1Q-1(M)B-1, *Flight Manual – USAF Series MQ-1B System*, 20 March 2015, *Change 1*, 18 August 2015
(2) T.O. 1Q-1(M)B-1-1, *Flight Manual Appendix A Performance Data – USAF Series MQ-1B System*, 29 November 2010, Change 1, 10 December 2012
(3) *DoD Human Factors Analysis and Classification System*, Version 7.0

//Signed//

4 February 2016

DEREK G. EMMONS, Lt Col, USAF
President, Abbreviated Accident Investigation Board

STATEMENT OF OPINION

MQ-1B, T/N 07-3197
UNDISCLOSD LOCATION
24 SEPTEMBER 2015

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 24 September 2015, at approximately 0902 Zulu (Z) time, the Mishap Remotely Piloted Aircraft (MRPA), a MQ-1B Predator, tail number (T/N) 07-3197, assigned to the 432d Wing, Creech Air Force Base (AFB), Nevada (NV) and operated by the 18th Reconnaissance Squadron (RS), Creech AFB, NV, entered cloud coverage and crashed while on a mission at an undisclosed location. The MRPA was destroyed upon impact and the wreckage was not recovered. Damage to the MRPA is estimated at $5,156,042. No injuries, deaths, or damage to private property were reported from the mishap.

On 24 September 2015, at approximately 0200Z, after normal maintenance and pre-flight checks, the MRPA departed for a mission from an undisclosed air base. The mishap crew (MC) conducted a changeover briefing with the previous crew, took control of the MRPA, and continued its mission orbit. At approximately 0902Z, the MRPA entered clouds just as the Ground Control Station (GCS) experienced momentary interruptions (lost link) to the radio link the aircrew uses to control the MQ-1B. The lost link coincided with the MRPA entering clouds. Upon entering the clouds, the MC attempted to reverse direction of flight. The MC visually detected ice on the aircraft and the Multi-spectral Targeting System (MTS) camera after rotating the MTS camera to the rearward facing position. Aircraft systems also detected the formation of ice on the MRPA. Turbulence and icing caused the MRPA's angle of attack and roll control to become erratic. The MRPA's airspeed dropped below stall speed, and the MRPA stalled causing the MRPA to lose link to the GCS completely. At 0904Z, the GCS received one data sample indicating the MRPA was in an extreme nose-down attitude and had lost approximately 10,000 feet of altitude. Based upon the last data sample and with the MRPA lost link and unrecoverable, the MC suspected the aircraft had crashed. At 1015Z, another aircraft operating in the area confirmed the crash via video feed.

I find by a preponderance of the evidence the cause of the mishap was inadvertent entry into clouds coinciding with a momentary loss of the MRPA's satellite datalink with the GCS. The MRPA, its aircraft skin already cooled below freezing, flew into clouds, which caused ice to accumulate on the structure. Icing and turbulence resulted in degraded flight performance, which forced the MRPA into a stalled condition, prohibiting positive datalink with the GCS. The MC was unable to regain control over the MRPA prior to impact with the ground. I find by a

preponderance of the evidence the following substantially contributing factors: unforecasted and rapidly deteriorating localized weather, breakdown in visual scan, and complacency.

I developed my opinion by analyzing factual data from historical records, flight data logs, manufacturer reports, maintenance records, witness testimony, flight planning products, Air Force Technical Orders, Air Force Instructions and guidance, and through consultation with subject matter experts.

2. CAUSE

I find by a preponderance of evidence the cause of this mishap was inadvertent entry into clouds coinciding with a momentary loss of the MRPA's satellite datalink with the GCS. The MRPA flew into clouds with aircraft skin cooled below freezing, accumulated ice on the structure, then icing and turbulence resulted in degraded flight performance. The reduced flight performance forced the MRPA into a stalled condition, prohibiting positive datalink with the GCS. The MC was unable to regain control over the MRPA prior to impact with the ground.

Specifically, when the MRPA inadvertently entered weather with airframe skin cooled below the freezing level, moisture from the clouds immediately froze on contact resulting in a structural icing condition. The MC visually detected ice on the MTS camera. Ice was visually confirmed on the MRPA as the MTS camera was placed in the rearward facing position and aircraft systems detected the formation of ice on its structure. Onboard systems recorded airspeed and normal acceleration variations indicating strong turbulence. MP1's attempt to manually pilot the MRPA out of the clouds by reversing the MRPA's course was not successful as the localized turbulence associated with the updrafts found within towering cumulus (TCu) clouds combined with the icing condition to place the MRPA into a stalled condition. MP1 commanded the Landing Configuration, which turned off: the Preprogrammed mode; Stall Protect; Airspeed, Heading and Altitude hold; and Cruise mode. As MRPA angle of attack (AOA) and roll control became erratic, MP1 initiated the Loss of Control Prevent checklist. The AOA and roll control remained erratic, airspeed reduced below stall speed, and the MRPA stalled causing the MRPA to lose link to the GCS completely. At 0904:01Z, the satellite datalink was momentarily restored and indicated the MRPA's pitch angle was -20 degrees, roll angle was approximately -13 degrees, yaw rate was +30 degrees per second, and had lost approximately 10,000 feet of altitude. The datalink was lost again and was never recovered.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

a. Unforecasted and Rapidly Deteriorating Localized Weather

Despite a forecast of clear conditions and void of hazards, a low altitude overcast or marine layer formed over the target area due to a sea breeze causing the onshore flow of moisture. Additionally, orographic lift, caused by air flowing up rapidly rising terrain near the coast, forced the moist, unstable air mass to a higher elevation, which combined with daytime heating to create storm activity from a single, localized cell of towering cumulus (TCu) clouds. A TCu cloud is a transition between the fair weather cumulus and the eventual cumulonimbus cloud, or thunderstorm cloud. The presence of TCu clouds signals changes in atmospheric stability from

stable to unstable, creating an atmosphere with thunderstorms probable within minutes. The main feature of the this stage is the updraft, which may extend from near the surface to several thousand feet above the visible cloud top and can result in turbulence and icing as the cumulus cloud continues to rise and grow. The most violent turbulence occurs in the shear between updrafts and downdrafts, and in general, the most severe icing conditions are usually found just above the freezing level between 0°C and -5°C. The storm continued to develop between 1000Z and 1100Z into a thunderstorm briefly before it subsided. The MRPA was established in its orbit over the target area at an altitude above the freezing level. The MRPA system recorded outside air temperatures ranging from -1°C to -2°C after approximately 0645Z until the incident at approximately 0902Z, which resulted in the aircraft skin cooling to a temperature below freezing.

As the aircraft entered the weather, MP1 attempted to manually pilot the MRPA away from the hazard and into clear air, but turbulence and the rapid accumulation of ice on the structure immediately placed the MRPA into a flight regime that quickly approached out of control conditions. In response, MP1 initiated the Out of Control Prevention Critical Action Procedure in an attempt to keep the MRPA within normal flight parameters or return it to normal flight parameters if already exceeded. The General Atomics-Aeronautical Systems analysis of the flight data confirmed airspeed reduced below stall speed, and the MRPA stalled causing the MRPA to lose link to the GCS completely.

The MC flew the MRPA into TCu developing into the initial stages of a thunderstorm. If forecasted properly, the MC would be required to avoid the area of known thunderstorms by 25 nautical miles IAW paragraph 4.3.5. of AFI 11-2MQ-1&9, Volume 3, *Operations Procedures*. I find by preponderance of evidence the inaccurate weather forecasting data in the mishap location was a substantially contributing factor to the mishap.

b. Breakdown in Visual Scan – DoD HFACS AE105

Breakdown in Visual Scan is a factor when the crew fails to effectively execute visual scan patterns.

The nose camera is normally used for takeoff and landing, and can only be used to look for weather directly forward of the aircraft. The MTS camera provides a full 360-degree view around the aircraft, but is the primary sensor when searching and tracking targets of interest. The MC failed to recognize subtle changes in the weather prompting the need to conduct a more timely weather scan. The previous SO recognized vertical movement in the cloud cover but failed to inform MP1, choosing only to inform MSO1 during their changeover. MSO1 mentioned to MP1 that there were "lots of clouds" shortly after he took the SO seat, but MP1 did not recognize the need to perform a weather scan at that time. MSO1 did not inform MP1 the clouds were approaching the aircraft until approximately 6 seconds before the MRPA entered the clouds. MP1 did not direct a weather scan until 2 seconds before the MRPA entered the clouds. While AFI 11-2MQ-1&9, Volume 3 does not include any direction or requirement to execute weather scans at specific intervals of time or during specific stages of operation, the MC did have information about changes in the weather that might affect the mission but failed to act on it.

I find by preponderance of evidence the breakdown of visual scan was a substantially contributing factor to the mishap.

c. Complacency – DoD HFACS PC208

Complacency is a factor when the crew has a false sense of security, is unaware of, or ignores hazards and is inattentive to risks.

The combination of forecasted clear weather conditions absent of hazardous weather activity and the unforecasted overcast condition over the target area decreased the crew workload since targets could not be observed. The reduced workload allowed for non-mission related conversations, conversations about other missions, and personal conversations within the GCS but not over the intercom. These conversations and recorded intercom silence for approximately 15 minutes are indicative of complacency. The previous SO noticed some vertical development in the clouds toward the end of his time in the GCS, but did not mention the changes in the weather to the pilot. The personal and non-mission related conversations created a complacent atmosphere in the GCS, which delayed the weather scan until the moment the MRPA entered the clouds. I find by preponderance of evidence this complacency was a substantially contributing factor to the mishap.

4. CONCLUSION

I find by a preponderance of the evidence the cause of the mishap was inadvertent entry into clouds coinciding with a momentary loss of the datalink with the GCS. The MRPA flew into clouds with aircraft skin cooled below freezing, accumulated ice on the structure, then icing and turbulence resulted in degraded flight performance. The reduced flight performance forced the MRPA into a stalled condition, prohibiting positive datalink with the GCS. The MC was unable to regain control over the MRPA prior to impact with the ground. I find by a preponderance of the evidence the following substantially contributing factors: unforecasted and rapidly deteriorating localized weather, breakdown in visual scan, and complacency.

//Signed//

4 February 2016

DEREK G. EMMONS, Lt Col, USAF
President, Abbreviated Accident Investigation Board

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