# UNITED STATES AIR FORCE ABBREVIATED AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

**MQ-9, T/N 09-004065**

**26TH WEAPONS SQUADRON**
**57TH WING**
**NELLIS AIR FORCE BASE, NEVADA**

**LOCATION: Douglas County, Nevada**

**DATE OF ACCIDENT: 5 December 2012**

**BOARD PRESIDENT: Lieutenant Colonel Eric C. Grace**

**Conducted in accordance with Air Force Instruction 51-503**
**Abbreviated Accident Investigation pursuant to Chapter 11**

**EXECUTIVE SUMMARY**
**AIRCRAFT ACCIDENT INVESTIGATION**

**MQ-9, T/N 09-004065**
**Douglas County, Nevada**
**5 December 2012**

On 5 December 2012, at approximately 03:10:30 Zulu time (Z) (19:10:30 Pacific Standard Time), MQ-9 Reaper Remotely Piloted Aircraft, tail number (T/N) 09-004065, crashed in an unpopulated area three miles northeast of Mount Irish, Douglas County, Nevada (NV), following a stall induced by an unrecognized reverse thrust condition that caused the aircraft to impact the ground after link to the aircraft was lost. The Mishap Remotely Piloted Aircraft (MRPA), one inert Guided Bomb Unit (GBU-38), a Hellfire training missile, a Mission Kit, and one M299 missile rail were destroyed. The total damage to United States government property was assessed at $9,646,088. There were no fatalities, injuries, or damage to other property.

The MRPA was an asset of the 26 Weapons Squadron (26 WPS), 57th Wing (57 WG), Nellis AFB. The Mission Control Element (MCE) Mishap Preflight Pilot (MMPP) and MCE Mishap Pilot (MMP) were temporarily assigned to the 26 WPS. The MCE Mishap Instructor Pilot (MMIP) was assigned to the United States Air Force Weapons School. The MCE Mishap Sensor Operator (MMSO) was assigned to the 26 WPS. The MCE Ground Control Station (GCS) was maintained by Science Applications International Corporation (SAIC).

The mishap sortie was part of the Intelligence Preparation of the Environment tactical scenario of the Weapons School Mission Employment phase. During the transit to the range, the MMP used a series of autopilot modes to control the aircraft. When MMP turned off the altitude hold mode of the autopilot and had the throttle positioned aft of full forward, a misconfigured throttle commanded the aircraft engine to produce reverse thrust. This specific condition went unrecognized by the MMP. Returning to base early for a perceived engine issue, the MMP allowed the aircraft to decelerate below stall speed. The MRPA stalled in flight and link was lost. Less than one minute later, the MRPA impacted the ground in an unpopulated area.

The Abbreviated Accident Investigation Board (AAIB) president found by clear and convincing evidence that the causes of the mishap were 1) the Pilot/Sensor Operator station 1 (PSO1) (pilot seat) throttle quadrant settings of the controlling Ground Control Station (GCS) were improperly configured during the preflight reconfiguration from MQ-1 to MQ-9 operations prior to sortie execution, 2) this throttle anomaly went unrecognized because the MMP did not execute the Rack Configuration and Presets checklists on his control rack prior to gaining control of the MRPA, and 3) the MMP stalled the MRPA due to an unrecognized, commanded reverse thrust condition that existed whenever the pilot's throttle was at any position except full forward. Additionally, the AAIB found by a preponderance of evidence that MMPP failed to execute his GCS preflight in accordance with technical order procedures substantially contributing to the mishap.

*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.*

## SUMMARY OF FACTS AND STATEMENT OF OPINION

**MQ-9, T/N 09-004065**
**Douglas County, Nevada**
**5 December 2012**

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| 11 RS | 11th Reconnaissance Squadron |
| 15 RS | 15th Reconnaissance Squadron |
| 17 RS | 17th Reconnaissance Squadron |
| 18 RS | 18th Reconnaissance Squadron |
| 2 SOS | 2d Special Operations Squadron |
| 26 WPS | 26th Weapons Squadron |
| 26 WPS/CC | 26th Weapons Squadron Commander |
| 29 ATKS | 29th Attack Squadron |
| 31 TES | 31st Test and Evaluation Squadron |
| 42 ATKS | 42d Attack Squadron |
| 432 ACMS | 432d Aircraft Communications Squadron |
| 432 AMXS | 432d Aircraft Maintenance Squadron |
| 432 WG | 432d Wing |
| 556 TES | 556th Test and Evaluation Squadron |
| 53 WG | 53d Wing |
| 57 WG | 57th Wing |
| AAIB | Abbreviated Accident Investigation Board |
| ACC | Air Combat Command |
| AF | Air Force |
| AFB | Air Force Base |
| AFI | Air Force Instruction |
| AFIP | Air Force Institute of Pathology |
| AFPAM | Air Force Pamphlet |
| AFSAS | Air Force Safety Automated System |
| AFSOC | Air Force Special Operations Command |
| AFTO | Air Force Technical Order |
| AGL | Above Ground Level |
| AIB | Accident Investigation Board |
| AMU | Aircraft Maintenance Unit |
| ATC | Air Traffic Control |
| AWACS | Airborne Warning and Control System |
| BETA | Reverse Thrust |
| C2 | Command and Control |
| Capt | Captain |
| Col | Colonel |
| Deg | Degrees |
| DNIF | Duties Not Including Flying |
| DO | Director of Operations |
| DoD | Department of Defense |
| EPs | Emergency Procedures |
| FCIF | Flight Crew Information File |
| FDP | Flight Duty Period |
| fpm | Feet Per Minute |
| g | Gravitational Force |
| GBU | Guided Bomb Unit |
| GCS | Ground Control Station |
| GCST | Ground Control Station Technician |
| HDD | Head-Down Display |
| HLZ | Helicopter Landing Zone |
| HUD | Head-Up Display |
| IAW | In Accordance With |
| IMDS | Integrated Maintenance Data System |
| IP | Instructor Pilot |
| IPOE | Intelligence Preparation Operation of the Environment |
| ISR | Intelligence, Surveillance and Reconnaissance |
| KU Band | Satellite Communication |
| KVM | Keyboard Video Mouse |
| L | Local Time |
| L3 | Satellite Communications Contractor |
| LGCST | Lead Ground Control Station Technician |
| LMC | Launch and Recovery Element Mishap Crew |
| LMP | Launch and Recovery Element Mishap Pilot |
| LMS | Lead Maintenance Supervisor |
| LMSO | Launch and Recovery Element Mishap Sensor Operator |
| LOS | Line of Sight |
| LRE | Launch and Recovery Element |
| LREGCST | Launch and Recovery Element Ground Control Station Technician |
| Lt Col | Lieutenant Colonel |
| Maj | Major |
| MAJCOM | Major Command |
| MC | Mission Commander |
| MCE | Mission Control Element |
| ME | Mission Employment |
| MFL | Mishap Flight Lead |
| MFW | Multi-Function Workstation |
| MGCST | Mishap Ground Control Station Technician |
| MMC | Mission Control Element Mishap Crew |
| MMIP | Mission Control Element Mishap Instructor Pilot |
| MMMX | Mission Control Element Mishap Maintenance |
| MMP | Mission Control Element Mishap Pilot |
| MMPP | Mission Control Element Mishap Preflight Pilot |
| MMS | Mishap Maintenance Supervisor |
| MMSO | Mission Control Element Mishap Sensor Operator |
| MPC | Mission Planning Cell |
| MPCC | Mission Planning Cell Chief |
| MRPA | Mishap Remotely Piloted Aircraft |
| MOA | Military Operation Airspace |
| MS | Mishap Sortie |
| MSA | Minimum Safe Altitude |
| MSgt | Master Sergeant |
| MSL | Mean Sea Level |
| MTS | Multi-special Targeting System |
| MX | Maintenance |
| NAFB | Nellis Air Force Base |
| NM | Nautical Miles |
| NOTAMs | Notices to Airmen |

| | |
|---|---|
| NTTR | Nevada Test and Training Range |
| NV | Nevada |
| OG | Operations Group |
| Ops | Operations |
| Ops Sup | Operations Superintendent |
| Ops Sup 1 | First Operations Superintendent |
| OPS Sup 2 | Second Operations Superintendent |
| Ops Tempo | Operations Tempo |
| ORF | Operations Read Files |
| ORM | Operational Risk Management |
| PEX | Patriot Excalibur |
| PFA | Pre Flight Authorizations |
| PHA | Physical Health Assessment |
| PMATS | Predator Mission Aircrew Training System |
| PPSL | Predator Primary Satellite Link |
| PSI | Pounds Per Square Inch |
| PSO | Pilot/Sensor Operator |
| RPA | Remotely Piloted Aircraft |
| RTB | Return-To-Base |
| SAIC | Science Applications International Corporation |
| SAR | Synthetic Aperture Radar |
| SCL | Standard Conventional Load |
| SEPT | Situational Emergency Procedures Training |
| SIB | Safety Investigation Board |
| SO | Sensor Operator |
| SrA | Senior Airman |
| SRF | Squadron Read File |
| SSgt | Staff Sergeant |
| SWP | Subordinate Work Package |
| TCTO | Time Compliance Technical Order |
| TDY | Temporary Duty |
| T/N | Tail Number |
| TO | Technical Order |
| U.S. | United States |
| USAF | United States Air Force |
| USAFWS | United States Air Force Weapons School |
| VDVR | Video graphics array Digital Video Recoder |
| VIT | Variable Information Table |
| Vol | Volume |
| Vul | Vulnerability |
| WIC | Weapons Instructor Course |
| WP | Work Package |
| WRPA | Wingman Remotely Piloted Aircraft |
| WUG | Weapons School Undergraduate Student |
| Z | Zulu time |

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 17 January 2013, Lieutenant General William J. Rew, Vice Commander, ACC, appointed Lieutenant Colonel Eric C. Grace to conduct an Abbreviated Accident Investigation Board (AAIB) of a mishap that occurred on 5 December 2012 involving an MQ-9 remotely piloted aircraft approximately 3 miles northeast of Mount Irish, Douglas County, Nevada (NV). The AAIB was conducted in accordance with (IAW) Air Force Instruction (AFI) 51-503, *Aerospace Accident Investigations*, Chapter 11, at Nellis Air Force Base (AFB), NV, from 25 January through 14 February 2013. Additional board members were a Legal Advisor and Recorder (Tab Y-3).

### 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 5 December 2012, at approximately 03:10:30 Zulu time (Z), 1910:30 Local time (L), the mishap remotely piloted aircraft (MRPA), an MQ-9 Reaper, tail number (T/N) 09-004065, an asset of the 26th Weapons Squadron (26 WPS), 57th Wing (57 WG), Nellis AFB, NV, following a stall induced by an unrecognized reverse thrust condition, impacted the ground approximately 3 miles northeast of Mount Irish, Douglas County, NV after link to the aircraft was lost. (Tabs V-14.1 and AA-7). The MRPA, one inert Guided Bomb Unit (GBU-38), a Hellfire training missile, a Mission Kit, and one M299 missile rail were destroyed. The total damage to United States (U.S.) Government property was assessed at $9,646,088 (Tab P-4). There were no injuries or damage to other government or civilian property reported (Tab P-3).

## 3. BACKGROUND

The MRPA belonged to the 26 WPS, 57 WG, ACC at Nellis AFB. The Launch and Recovery Element (LRE) Mishap Crew (LMC), consisting of the LRE Mishap Pilot (LMP) and LRE Mishap Sensor Operator (LMSO), was assigned to the 556th Test and Evaluation Squadron (556 TES), 53d Wing (53 WG), ACC at Creech AFB, NV (Tab V-5.1 and V-6.1). The MRPA was maintained by the 432d Aircraft Maintenance Squadron (432 AMXS), 432d Wing (43 WG), ACC at Creech AFB (Tab V-13.1). The Mission Control Element (MCE) Mishap Preflight Pilot (MMPP) and MCE Mishap Pilot (MMP) were on temporary assignment to the 26 WPS, United States Air Force Weapons School (USAFWS), 57 WG, ACC at Nellis AFB. The MCE Mishap Instructor Pilot (MMIP) was assigned to the USAFWS, 57 WG, ACC at Nellis AFB. The MCE

Mishap Sensor Operator (MMSO) was assigned to the 26 WPS, 57 WG, ACC at Nellis AFB. The MCE Ground Control Station (GCS) was maintained by Science Applications International Corporation (SAIC), under contract with the Air Force Special Operations Command (AFSOC) (Tab V-14.2).

**a. Air Combat Command (ACC)**

ACC is the primary force provider of combat airpower to America's warfighting commands. To support global implementation of national security strategy, ACC operates fighter, bomber, reconnaissance, battle-management, and electronic-combat aircraft. It also provides command, control, communications and intelligence systems, and conducts global information operations (Tab CC-3).

**(1) Launch and Recovery Element Mishap Crew**

**(a) 53d Wing (53 WG)**

The 53 WG serves as the focal point for the Combat Air Forces in electronic warfare, armament and avionics, chemical defense, reconnaissance and aircrew training devices. The 53 WG is responsible for operational testing and evaluation of new equipment and systems proposed for use by these forces (Tab CC-7).

**(b) 556th Test and Evaluation Squadron (556 TES)**

The 556 TES executes MQ-1 Predator and MQ-9 Reaper Remotely Piloted Aircraft (RPA) operational test and evaluation and tactics development supporting ACC and AFSOC objectives. The 556 TES provides operational expertise for the test and evaluation of new sensors, hardware, weapons, and software upgrades for both airframes as well as critical RPA integration expertise in the intelligence community's processing, exploitation, and dissemination of data (Tab CC-12).

**(2) Mission Control Element Mishap Crew**

**(a) 57th Wing (57 WG)**

The 57 WG provides advanced aerospace training to world-wide combat air forces and showcases aerospace power to the world while overseeing the dynamic and challenging flying operations at Nellis AFB. It manages all flying operations at Nellis AFB and conducts advanced aircrew, space, logistics, and command and control training through the USAFWS, Red Flag and Green Flag exercises. Important components of the training include adversary tactics replication, graduate level instruction, and tactics development (Tab CC-15).

**(b) United States Air Force Weapons School (USAFWS)**

The USAFWS is comprised of 18 squadrons. The USAFWS teaches graduate-level instructor courses that provide the world's most advanced training in weapons and tactics employment to officers of the combat air forces and mobility air forces. Every six months, the school produces approximately 80 graduates who are expert instructors on weapons, weapons systems, and air and space integration (Tab CC-17).

**(c) 26th Weapons Squadron (26 WPS)**

The 26 WPS is responsible for the Weapons Officer and Sensor Operator Advanced Tactics Course training to produce the USAF's most highly trained Weapons and Tactics Instructors. The 26 WPS trains pilots to expertly employ and integrate the MQ-1B and MQ-9 with the rest of the airborne, cyber, and space assets that the USAF brings to the fight with its Department of Defense partners (Tabs V-14.1 and CC-20).

**(3) Launch and Recovery Element Mishap Ground Control Station Maintenance**

**(a) 432d Wing (432 WG)**

The 432 WG, Creech AFB, consists of combat-ready Airmen who fly the MQ-1B Predator and MQ-9 Reaper aircraft to support U.S and Coalition warfighters. Creech AFB continues to serve as the aerial demonstration training site of the Air Force's Thunderbirds, and to engage in daily Overseas Contingency Operations as the home base of remotely piloted aircraft systems which fly missions across the globe (Tab CC-21 to CC-22).

**(b) 432d Aircraft Maintenance Squadron (432 AMXS)**

The 432 AMXS ensures that Airmen, MQ-1B and MQ-9 aircraft and ground control stations are fully mission capable to support aircrew training, combat operations, operational test and evaluation, and natural disaster support (Tab CC-23).

**b. Air Force Special Operations Command (AFSOC)**

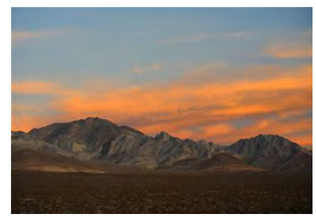
AFSOC provides Air Force special operations forces for worldwide deployment and assignment to regional unified commands. The command's Special Operations Forces are composed of highly trained, rapidly deployable Airmen, conducting global special operations missions ranging from precision application of firepower, to infiltration, exfiltration, resupply and refueling of special operations forces operational elements (Tab CC-25).

**Mission Control Element Mishap Ground Control Station Maintenance**

**Science Applications International Corporation (SAIC)**

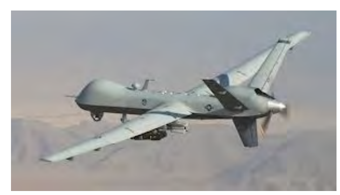
SAIC provides a full suite of intelligence, surveillance and reconnaissance (ISR), and cybersecurity solutions across a broad spectrum of national security programs. SAIC institutionalized the design, integration and deployment of quick reaction capability systems in all regimes: air, land, maritime, and space. They contribute solutions to a broad array of customers including all 16 agencies within the intelligence community, and they extend that support into key elements of the Department of Defense, Department of Homeland Security, Department of Justice, and Department of State (Tab CC-29 to CC-30).

**c. Nevada Test and Training Range (NTTR)**



The NTTR is responsible for the largest contiguous air and ground space available for military operations in the free world. With 1,200 possible targets, realistic threat systems and the support of an opposing enemy force that cannot be replicated anywhere else in the world, the NTTR is home to America's most advanced aerial test and training environment, providing Airmen with a peacetime battlefield to hone their combat skills. The NTTR provides the warfighter a flexible, realistic and multidimensional battle-space to conduct testing, training and tactics development in support of U.S. national interests. The NTTR acts as the single point of contact for range customers (Tab CC-31).

**d. MQ-9 Reaper and the Unmanned Aircraft System**



The MQ-9 is an armed, multi-mission, medium-altitude, long endurance remotely piloted aircraft (RPA) that is employed primarily in a hunter/killer role against dynamic execution targets and secondarily as an intelligence collection asset. Given its significant loiter time, wide-range sensors, multi-mode communications suite, and precision weapons – it provides a unique capability to autonomously execute the kill chain against high value, fleeting, and time sensitive targets (Tab CC-35).

The MQ-9 Reaper is part of an Unmanned Aircraft System, or UAS, not just an Aircraft. A fully operational system consists of an aircraft (with sensors), a Ground Control Station (GCS), a Predator Primary Satellite Link (PPSL) and operations and maintenance personnel for deployed 24-hour operations. The basic crew for the MQ-9 Reaper is one pilot and one sensor operator (SO) (Tab CC-35). They fly the MQ-9 Reaper from inside the GCS via a line of sight (LOS) radio data link and via a satellite data link for beyond LOS flight (Tab CC-37). A ground data terminal antenna provides LOS communications for takeoff and landing, while the PPSL provides beyond LOS communications during the remainder of the mission. The MQ-9 Reaper is manufactured by General Atomics (GA) Aeronautical Systems Incorporated (Tab CC-36).

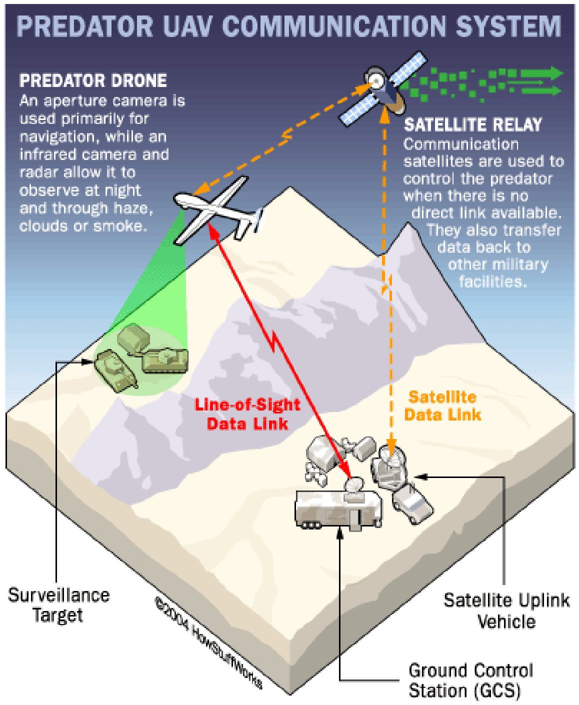



**Figure 1. MQ-1B Predator/MQ-9 Reaper Unmanned Aerial Vehicle Communication System**

## 4. SEQUENCE OF EVENTS

### a. Mission

The mishap sortie, flown by the 26 WPS on Wednesday, 5 December 2012, was in support of the Mission Employment (ME) phase of the USAFWS syllabus as part of the Intelligence Preparation of the Environment (IPOE) tactical scenario (Tab V-4.1 to V-4.2 and V-14.3). The ME phase is the capstone integration exercise for USAFWS squadrons and is comprised of 7 – 8 mission scenarios (Tab V-4.1). The multi-aircraft exercise involved more than 15 different airframes to include 2 MQ-9 Reapers (Tabs K-11, V-4.1 and V-14.2). The Mission Control Element (MCE) Mishap Crew (MMC) operated in an ISR role observing the enemy and collecting intelligence to be applied to later ME phase missions (Tab V-4.2 and V-14.3). The mishap sortie consisted of the MRPA, flown by the MCE Mishap Pilot (MMP) and the MCE Mishap Sensor Operator (MMSO), as well as the Wingman Remotely Piloted Aircraft (WRPA), flown by the mishap wingman pilot and mishap wingman sensor operator (Tab K-5). This 26 WPS mission was authorized by the 26 WPS/CC (Tab V-14.3).

### b. Planning

Mission planning was intense and occurred on 4 and 5 December 2012. On 4 December 2012, the MMC participated in a full day of integration planning (approximately 12 hours) led by the Mission Planning Cell Chief and the Mission Commander, who also led the mass briefing the next day (Tab V-4.2 and V-14.3). The aircrews received the air tasking order (ATO), the enemy order of battle, and the overall Commander's intent for the exercise on the afternoon of 4 December 2012 (Tab V-4.2 and V-10.2). The USAFWS students were then given the opportunity to mission plan and determine how to best utilize and integrate resources in the IPOE scenario to meet the published Commander's intent (Tab V-4.2). On 5 December 2012, the MMC attended a mass briefing where all participating aircrew received the detailed mission execution plan (Tab V-4.2 and V-14.3). The MMP, as the MQ-9 Flight Lead, then conducted the MMC flight briefing immediately following the mass briefing (Tab V-1.2 and V-4.2). The mass briefing was approximately an hour and the MMP flight briefing was approximately 40 minutes in length (Tab V-3.1 and V-4.2). All mission planning was conducted IAW USAFWS and 26 WPS syllabus standards (Tab V-14.3).

**c. Preflight**

**(1) Preflight Maintenance and Launch**

On 5 December 2012, the 432 AMXS preformed preflight inspections and launched the MRPA. The Mishap Maintenance Supervisor (MMS) reviewed the AFTO 781 series forms, IMDS inquiries, and confirmed that there were no outstanding maintenance issues. The MMS also conducted a visual preflight inspection of the MRPA prior to signing off in the aircraft maintenance forms indicating that the MRPA was mission ready. No discrepancies were noted to prevent the MRPA from flying the mishap sortie (Tab V-12.1). Prior to stepping to the aircraft, the LMC filed the flight plan, received the weather report, gathered the Notices to Airmen (NOTAMs), reviewed airspace issues, and preformed their GCS preflight procedures. The LMP conducted an aircraft inspection, walk around, and systems checks prior to engine start-up (Tab V-6.1). At approximately 01:01(Z), on 5 December 2012, the MRPA departed Creech AFB uneventfully (Tabs K-3 and V-5.1). The LMC flew the MRPA to Range 63B High (airspace block) for MCE handover (Tab AA-3). During this time, the LMC noted no discrepancies or anomalies in aircraft performance (Tab V-6.3). The LMC handed the MRPA over to the MMC at approximately 01:59(Z) (Tab AA-3).

**(2) Mission Control Element**

On 4 December 2012, at approximately 05:00(Z), MCE GCS 5029 had been reconfigured from the MQ-1B platform to MQ-9 by SAIC GCS Technicians (Tabs D-4, V-7.1 and V-8.1). During the rack reconfiguration, SAIC GCS Technicians conducted a throttle assembly adjustment (Tab V-7.1). The SAIC GCS Technicians actively failed to properly execute the throttle quadrant assembly controls adjustment portion of TO 1Q-1(M)B-2-2 on the PSO1 (pilot seat) throttle quadrant when reconfiguring it for MQ-9 operations (Tabs J-12 and DD-6). The Mishap GCS Technician (MGCST) configured PSO1 while the Lead GCS Technician (LGCST), shift supervisor, configured PSO2 (sensor operator seat). Both SAIC technicians used TO 1Q-1(M)B-2-2, work packages 005 00 and 009 02, to perform this maintenance but had different results (Tabs J-12, V-7.5 to V-7.6 and V-8.1).

The MMP had previously arranged to have another MQ-9 pilot, MCE Mishap Preflight Pilot (MMPP), run the GCS Rack Configuration and Presets checklists for both the MRPA and the Wingman Remotely Piloted Aircraft (WRPA) prior to his flight's arrival on 5 December 2012. The MMP requested this in order to allot more time for mission product organization and overall mission preparation prior to taking control of the MRPA (Tab V-1.1, V-2.1 to V-2.2 and V-14.4). The MMPP completed his preflight of both GCSs two and a half hours prior to the MMC's arrival (Tab V-2.3). He performed all preflight procedures, including the rack configuration alone and without a sensor operator (Tab V-2.2). The MMPP actively failed to properly execute all parts of the throttle detent check in step 17 of the rack configuration checklist in accordance with TO 1Q-9(M)A-1CL-1 during his preflight of MCE GCS 5029 (Tabs J-12 and V-4.5).

After the mass briefing on 5 December 2012, the MMC received a step briefing from the 26 WPS Operations Superintendent (Ops Sup 1) where they received updates to the weather report, NOTAMs, airspace issues, and aircraft data (Tab V-10.1 and V-11.1). Ops Sup 1 used the "26 WPS Top 3 Step Brief" checklist to run the MMC's Go/No-Go checks, looking at items such as training currencies, flight authorization sign-out, and Operational Risk Management (ORM) status (Tab V-10.2 and V-10.4). Following the Step briefing from Ops Sup 1, the MCE drove from their squadron to the GCS compound (Tab V-3.1 and V-4.3).

At 01:30(Z), the MMC arrived at MCE GCS 5029 and began running their preflight and gaining handover checklists (Tabs V-1.3, V-3.2 and AA-3). Once inside the GCS, the MMP bypassed the Rack Configuration checklist and started his checks with the Gaining Handover series of checklists, preparing for handover. The MMP only ran parts of his Presets checklist and did not execute, nor confirm, the PSO1 rack configuration (Tab V-1.3).

### d. Summary of Accident

At 01:01(Z), on 5 December 2012, the MRPA departed Creech AFB for the NTTR (Tabs K-3 and V-6.2). The LMC noted no anomalies during their launch and departure (Tab V-5.1 and V-6.1). In preparation for handing the MRPA off to the MMC, the LMC flew the MRPA within Range 63B High airspace for the next 58 minutes (Tabs M-2 and AA-3). During this time, the LMC noted no discrepancies with the MRPA's pitch, power and onboard systems, thus insuring the aircraft was performing properly prior to handoff (Tab V-5.1 and V-6.1).

At 01:59(Z), the MMC took control of the MRPA and began heading northeast from Range 63 enroute to the Caliente military operations airspace (MOA) via the Sally Corridor. During the transit, the MMP used a series of autopilot modes to control and navigate the aircraft (Tab J-4). Forty-five minutes later the MMC was established at their hold point in Caliente at 26,000 feet mean sea level (MSL) (Tab AA-3). There was a broken layer of clouds at the MMC's hold altitude as he flew northbound (Tab V-4.4). The MMP used autopilot inputs to initiate his descent down to 25,000 feet MSL, but was unable to stay clear of the clouds (Tab V-1.3). The MMP was advised by Control that they would have to return to base if they could not work within their preplanned assigned altitude block. The package commander (F-15C) advised Control to execute a "Split War," which was a weather contingency execution plan that was pre-briefed during the mass briefing earlier that day. During this time, the MMC proceeded towards the Coyote Bravo MOA and once again climbed up to 26,000 feet MSL to see if they could climb above the broken layer of clouds (Tab AA-3).

At 02:58(Z), the MMP turned off the autopilot altitude hold mode and began a manual descent out of 26,000 feet MSL, initially setting 6 degrees nose low attitude and about 20 degrees of left bank (Tabs J-4, V-1.3 and AA-3). During this time, the airspeed hold mode of the autopilot was still engaged and the throttle was in the full forward position (Tabs J-4 and AA-3). As the aircraft accelerated to 143 knots indicated airspeed (KIAS), the MMP pulled the throttle aft (toward the rear) in an effort to reduce his airspeed for the descent (Tabs V-1.3 and AA-4). This is the first instance where the improperly configured throttle anomaly presented itself. With the throttle aft of the full forward position and the altitude hold off, the MRPA's engine responded to the 100% detent command (reverse thrust) which was being commanded by the PSO1 (pilot seat) throttle quadrant of MCE GCS 5029. As the reverse thrust command took effect, the nose of the MRPA dropped to -15 degrees nose low (Tabs J-5 and AA-4).

While still in the descent, the MMP turned off the airspeed hold mode of the autopilot. At this time, the pitch trim was changed to a value of -15 degrees in order to match the value of the pitch angle when the airspeed hold mode was turned off (Tab J-5). Pitch trim was used to set nose attitude to maintain a certain speed (Tab FF-3). Twelve seconds after airspeed hold was disabled, the MMP started to slow his descent by pulling the nose up to -3 degrees nose low while passing through 13,000 feet MSL. Seconds later the MRPA's airspeed decreases towards the calculated stall speed of the aircraft and "Aileron Tip Stall Override" was indicated in the HUD and the stall protect feature of the aircraft pushed the nose of the aircraft down to -15 degrees nose low attitude in an effort to increase airspeed (Tabs J-5 and AA-4). HUD audio analysis revealed that the MMP was inputting data into the Head Down Display (HDD) when the stall protect initiated and aggressively nosed the aircraft downward to keep the aircraft from stalling. This initiation of the stall protect went unnoticed by the MMP (Tab AA-4).

A few seconds later, the MMP turned on the altitude hold and set it for 12,000 feet MSL (Tab J-6). When the altitude hold was turned on, the detent command was overridden by the digital flight control software and the full reverse command was now changed back to positive thrust as directed by the autopilot (Tab J-10). At this time, the MMP also set a new airspeed hold of 111 KIAS (Tabs J-6 and AA-4). The MRPA was now flying properly as it had been prior to the descent (Tab J-6). With the MRPA under control, the MMP noticed a "Closed Loop Power – failed" warning on the HDD (Tab AA-4). This indication was not one that was familiar to the MMP, MMSO, nor the MMIP (Tab V-1.4, V-3.3 and V-4.4). This warning was displayed because the torque value went to zero momentarily as the propeller transitioned through a neutral state, or full fine positioning (Tab J-10).

Approximately a minute later, the MMSO began relaying TO 1Q-9(M)A-1 instructions to the MMP on how to clear the warning (Tabs V-3.3 and AA-4). In response, the MMP turned off the altitude hold mode of the autopilot and closed loop power (Tab J-10 to J-11). When he did, the detent command was once again commanded based on the position of the throttle and the deactivation of the digital flight control software (Tab J-10). The nose of the MRPA immediately began to push over to -15 degrees because of the airspeed hold and the engine began producing reverse thrust (Tab AA-4). The MMP appeared to notice the transit of the nose pitching downward this time (Tab AA-5). Ten seconds later, the MMP turned closed loop power back on and unknowingly cleared the warning (Tab J-10 to J-11).

By this time, the aircraft had descended to 10,950 feet MSL and the MMP engaged the altitude hold mode of the autopilot. The reverse thrust command was once again overridden by the digital flight controls and the detent command was reduced back to 0%. As the propeller transitioned through full fine positioning, the HDD indicated a second "Closed Loop Power – failed" indication. This was not noticed by the MMC as a new or second indication (Tab AA-5).

As the MMP began a climb back up to 12,000 feet MSL and placed the throttle at the full forward position, he disabled the altitude hold. The detent command remained at 0% because the throttle was now at the full forward position. This was the last change to the altitude hold (Tabs J-7 and AA-5). Ten seconds later as the MMP was manually flying the airplane and leveling off at 12,000 feet MSL, he pulled his throttle aft of the full forward position and the engine received the reverse thrust command again. As the detent command reached 100%, the MRPA pitched down to -15 degrees nose low because the airspeed hold was still enabled (Tab AA-5). The MMP noticed the nose transit and executed the "**Landing Configuration – Command**" boldface as a part of his loss of control prevent checklist, and as a result disabled stall protection and airspeed hold (Tabs V-1.4, V-4.4 and AA-5). Still unaware of the aircraft engine's reverse thrust condition, the MMP then used manual inputs to bring the nose of the aircraft back to a level attitude (Tab V-1.4 and V-4.4). As the MRPA's airspeed approached the calculated stall speed of 81 KIAS, an Aileron Tip Stall Override and Stall warnings were displayed at the top of the HUD. As the angle of attack (AOA) approached 12 units, the MMP applied full power by placing the throttle in the full forward position. That action deactivated the reverse thrust condition and the MRPA was out of the stall regime at 03:06:10(Z) (Tab AA-5).

Twenty seconds later, the MMP changed HUD modes to bring his engine and aircraft performance instruments into view as he was climbing back to 12,000 feet MSL (Tab AA-5). At that time, the MMP verbalized to the MMSO that the original closed loop power failure had not cleared and queried if there was any further guidance in the checklist. While discussing this with the MMSO, the MMP set pitch trim to +3 degrees nose high. This was the last change to the value of the pitch trim (Tab AA-6).

At 03:07:30(Z), the MMP leveled off at 12,000 feet MSL and turned the airspeed hold back on. Nine seconds later, the MMP pulled his throttle back as a part of his level off and the nose of the aircraft immediately pitched downward as the reverse thrust command took hold. At nine degrees nose low, the MMP pulled back on the stick to counter the pitch downward. The MMP pushed his throttle back to full forward and the detent command was reduced back to 0%. The MMP suspected that this pitch downward was somehow related to his activation of the airspeed hold mode, so he turned the airspeed hold mode off. This was the last change made to any autopilot hold mode and stall protect was still off (Tab AA-6).

Thirty seconds after the level off attempt at 12,000 feet MSL, the MMP discussed his switch changes and HUD indications with the MMIP. During that discussion the MMP focused his attention away from his level off and the aircraft matched the previously set trim value of +3 degrees. The MMP decided to return to base and informed Control of his intentions (Tab AA-6).

Forty-five seconds later, the MMSO informed the MMP that he had climbed to 13,220 feet MSL and that he needed to descend back to 12,000 feet MSL for the flight home (Tab AA-6). The MMP pulled his throttle back to 96% after initiating a descent and in doing so, immediately activated the full reverse thrust detent command (Tab AA-6 to AA-7). The MMP pushed the nose of the aircraft down to -6 degrees nose low in order to command a descent, but he did not set a new pitch trim at that attitude. As a result of the pitch trim, the nose immediately transited from -6 degrees nose low to +3 degrees nose high. With his attention elsewhere, the MMP did not notice how rapidly he was losing airspeed. He allowed the rapidly depleting airspeed to decrease below the calculated and displayed stall speed of 80 KIAS with the aircraft in a +3 degree nose high attitude (Tab AA-6). The audible stall warning was initiated and stall warnings were displayed in the HUD; however, the MMP was not able to nose the aircraft over enough to maintain airspeed (Tab AA-7).

At 03:09:41(Z), the MRPA was completely stalled at 68 KIAS, 29.5 units of AOA, a vertical velocity of -1,748 feet per minute descent, and the 100% detent command remained because the throttle was still at 96%. A few seconds later, the aircraft rolled to the left due to the left wing stalling out. At 03:09:53(Z), the MRPA attained an unrecoverable attitude and went lost link (Tab AA-7).

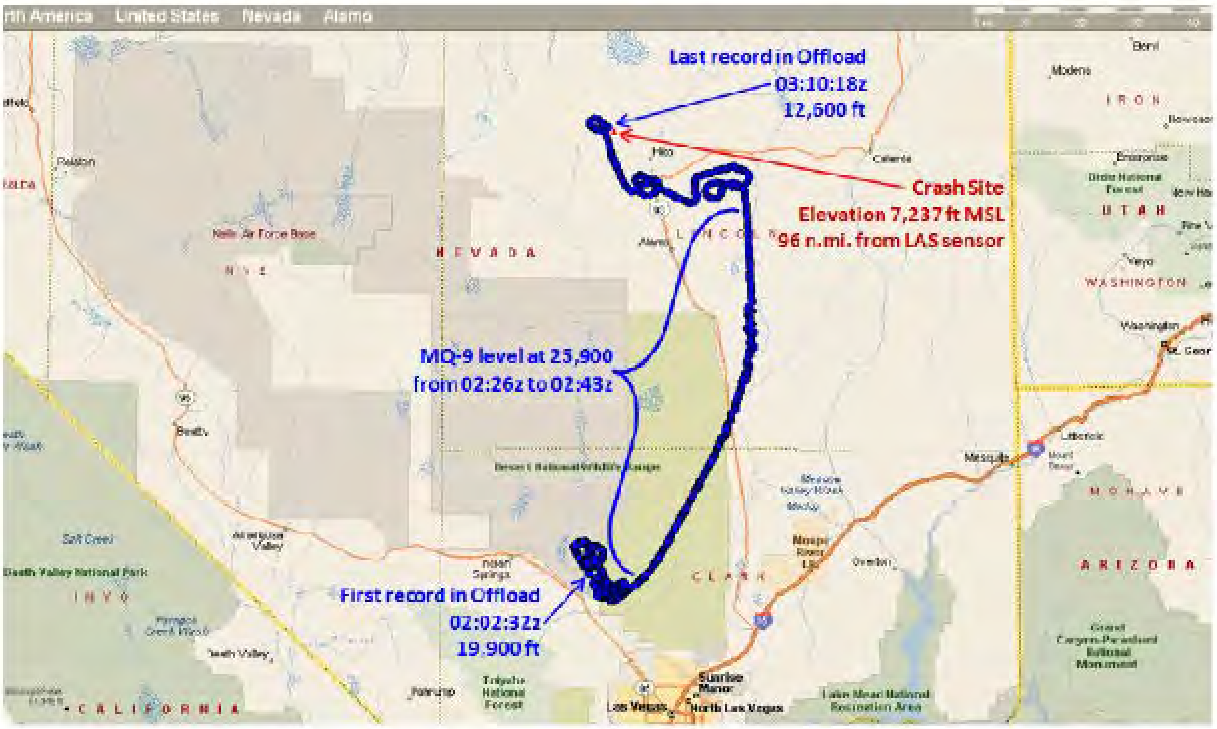



**Figure 2. Map of Mishap Flight (Tab M-2)**

## e. Impact

The MRPA impacted a non-residential area at 03:10:30(Z), (1910:30 L), approximately 3 miles northeast of Mount Irish, Douglas County, NV (Tab AA-7). The MRPA, one Guided Bomb Unit (GBU-38), a Hellfire training missile, a Mission Kit, and one M299 missile rail were destroyed. The total damage to United States (U.S.) Government property was assessed to be $9,646,088 (Tab P-4). There were no injuries or damage to other government or civilian property reported (Tab P-3).

### 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

#### (1) Aircraft Tail Number 09-004065

The 432 AMXS, at Creech AFB, was responsible for all scheduled and unscheduled maintenance on the MRPA (Tab V-12.1). The 432 AMXS tracks aircraft maintenance in the Integrated Maintenance Data System (IMDS). After maintenance is performed, information from the Air Force Technical Order (AFTO) series forms is transferred to the Integrated Maintenance Data System (IMDS). IMDS is a core-automated database used for tracking aircraft discrepancies, repairs events, and aircraft flight history (Tab U-11). The MMS reviewed all aircraft forms before signing the exceptional release and signing off that the MRPA was mission ready (Tab V-12.1). The AAIB reviewed the AFTO 781 series forms and all IMDS maintenance histories for the MRPA. The maintenance histories did not reveal any recurring maintenance problems or discrepancies that were relevant to the mishap (Tab U-11).

#### (2) MCE Ground Control Station 5029

Science Application International Corporation (SAIC), at Nellis AFB, was responsible for all scheduled and unscheduled maintenance of MCE GCS 5029. All GCSs are maintained through the guidance of applicable Air Force technical orders (TO) (Tab V-8.1)

SAIC tracks GCS maintenance in the IMDS. The AAIB reviewed the Air Force Technical Order (AFTO) 781 series forms and all IMDS maintenance histories for the MCE GCS 5029. The maintenance histories did not reveal any recurring maintenance issues and no discrepancies were documented that were relevant to the mishap (Tab U-11).

### b. Maintenance Inspections and Procedures

#### (1) Aircraft Tail Number 09-004065

All MRPA maintenance inspections and procedures were completed and documented IAW applicable maintenance schedules and guidance. Time Compliance Orders (TCTOs) are inspections or maintenance procedures requiring action on the aircraft by either date or flight hours. There were no overdue TCTOs directing modifications or inspections of the MRPA (Tab U-11).

**(2) MCE Ground Control Station 5029**

All maintenance inspections and procedures for MCE GCS 5029 were completed and documented IAW applicable maintenance schedules and guidance. There were no overdue TCTOs directing modifications or inspections of MCE GCS 5029 (Tab U-12).

**c. Maintenance Personnel and Supervision**

**(1) Aircraft Tail Number 09-004065**

All members of 432 AMXS who serviced the MRPA prior to its 5 December 2012 launch were current and qualified to work on the MQ-9 (Tabs U-12 and V-13.1). Furthermore, all preflight maintenance was supervised and signed off by MMS prior to launch (Tab V-12.1).

**(2) MCE Ground Control Station 5029**

Both the Lead GSC Technician (LGCST) and the GCS Technician (GCST) who serviced MCE GCS 5029 on 4 December 2012 were current and qualified to conduct all service and maintenance preformed including signing the exceptional release indicating the GCS was mission ready (Tabs G-61 and U-12).

**d. Fuel, Hydraulic, and Oil Inspection Analyses**

No fuel, engine oil, or hydraulic fluid analysis was completed and there is no evidence to suggest that any fluids were a factor in the mishap (Tab U-13).

**e. Unscheduled Maintenance**

Unscheduled Maintenance consists of repair or actions taken that are not the result of a scheduled inspection and normally are the result of a pilot-reported discrepancy (PRD) or a condition discovered by ground personnel (Tab U-11).

**(1) Aircraft Tail Number 09-004065**

A Review of AFTO 781 series forms and IMDS revealed no evidence to suggest that unscheduled aircraft maintenance was a factor in this mishap (Tab U-11).

**(2) MCE Ground Control Station 5029**

A Review of AFTO 781 series forms and IMDS since the 28-day GCS 5029 inspection on 27 November 2012 and the 30-day records review on 9 November 2012, revealed no evidence to suggest that unscheduled aircraft maintenance was a factor in this mishap (Tab U-11).

There is no evidence to suggest that any of the maintenance performed was a factor in this mishap.

## 6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

### a. Structures and Systems

General Atomics (GA) engineering analyzed evidence from the MRPA, LRE GCS 5037 and MCE GCS 5029 (Tab J-3 to J-42). GA reviews any mishap descriptions and field write-ups, and all relevant maintenance data. The data logs from the mishap flight, and any other relevant flights, are analyzed using an in-house tool called Signal Plotter. All retrieved and relevant hardware is inspected, tested, torn-down, and analyzed. Simulations may be performed using desktop simulator tools or the Software Integration Lab. If necessary, additional aerodynamic, electrical or mechanical analyses or testing are completed. Relevant design, manufacturing processes and history related to the potentially failed or suspect items are also reviewed along with relevant flight crew and maintenance procedures (Tab DD-3).

### b. Evaluation and Analysis

#### (1) LRE GCS 5037

GA analysis indicated that the MRPA responded correctly to all commands from LRE GCS 5037 (Tab J-10).

#### (2) MCE GCS 5029

GA analysis indicated that the MRPA experienced an MCE-commanded full reverse thrust in mid-flight condition during the MMC phase, which caused the aircraft to stall. The Full reverse thrust was inadvertently commanded because of the mis-calibrated throttle on PSO1 (Tabs J-3 and DD-6).

## 7. WEATHER

### a. Forecast Weather

The forecast weather was scattered to broken clouds at 10,000 feet MSL and scattered to broken clouds at flight level 220. The potential for light rime icing existed from 10,000 feet MSL up to flight level 220. Forecasted winds at flight level 250 were 260 degrees at 60 knots and at 10,000 feet were 270 degrees at 20 Knots. Sunset was 0029Z. Lunar illumination was 0% due to a moonrise time of 0717Z (Tab F-2 to F-5).

### b. Observed Weather

A thin scattered layer of clouds was observed at 10,000 feet MSL in the Sally Corridor. A broken layer of clouds that was one thousand feet thick was observed from flight level 250 to flight level 260 in the Caliente and Coyote MOAs. This weather deck prompted the MRPA's decent to 12,000 feet MSL and the execution of the split war weather contingency game plan (Tab AA-3). No visible moisture was observed below this deck in the vicinity of the mishap and no icing conditions were observed (Tabs V-4.4 and AA-3).

**c. Space Environment**

The AAIB examined the space weather environment for the operating area. An analysis of the space environment in the mission area indicated no phenomena that would have affected operations, and no anomalies were reported (Tab J-4).

**d. Operations**

The MMC encountered scattered to broken clouds at their northern hold point in the Caliente MOA. The MMP compensated by flying the MRPA to an offset orbit just south of their hold point. In accordance with the mission planning split war game plan, the MMP flew the MRPA towards the Coyote Bravo MOA and descended out of flight level 260 down to 12,000 feet MSL (Tab AA-3). No icing was observed on the MRPA upon inspection of the aircraft by the MMSO (Tabs V-3.3 and AA-3).

## 8. CREW QUALIFICATIONS

### a. MCE Mishap Preflight Pilot (MMPP)

**(1) Training**

The MMPP was a current and qualified pilot in the MQ-9 since 19 February 2009 and instructor pilot since 8 September 2010, and had accomplished a recurring flight evaluation on 20 September 2011 (Tab G-58).

**(2) Experience**

At the time of the mishap, the MMPP had a total of 1,190.6 hours flight time and 509 sorties in the MQ-9 (Tab G-16). The MMPP's flight time for the 30, 60, and 90 days prior to the mishap were as follows (Tab G-18):

| | Hours | Sorties |
|---|---|---|
| Last 30 Days | 11.0 | 6 |
| Last 60 Days | 31.0 | 16 |
| Last 90 Days | 45.5 | 24 |

### b. MCE Mishap Pilot (MMP)

**(1) Training**

The MMP was a current and qualified pilot in the MQ-9 since 17 October 2009 and instructor pilot since 17 October 2010, and had accomplished a recurring flight evaluation on 22 June 2012 (Tab G-3 and G-57).

**(2) Experience**

At the time of the mishap, the MMP had a total of 885.5 hours flight time and 428 sorties in the

MQ-9 (Tab G-8). The MMP's flight time for the 30, 60, and 90 days prior to the mishap were as follows (Tab G-9):

| | Hours | Sorties |
|---|---|---|
| Last 30 Days | 12.0 | 6 |
| Last 60 Days | 29.4 | 14 |
| Last 90 Days | 47.3 | 24 |

**c. MCE Mishap Instructor Pilot (MMIP)**

**(1) Training**

The MMIP was a current and qualified pilot since 25 September 2009 and instructor pilot since 23 July 2010 in the MQ-9, and had accomplished a recurring flight evaluation on 8 March 2012 (Tab G-59).

**(2) Experience**

At the time of the mishap, the MMIP had a total of 387.6 hours flight time and 154 sorties in the MQ-9 (Tab G-25). The MMIP's flight time for the 30, 60, and 90 days prior to the mishap were as follows (Tab G-28):

| | Hours | Sorties |
|---|---|---|
| Last 30 Days | 2.0 | 2 |
| Last 60 Days | 4.7 | 6 |
| Last 90 Days | 11.9 | 10 |

**d. MCE Mishap Sensor Operator (MMSO)**

**(1) Training**

The MMSO was a current and qualified sensor operator in the MQ-9 since 2 July 2012 (Tab G-60).

**(2) Experience**

At the time of the mishap, the MMSO had a total of 76.7 hours flight time and 34 sorties in the MQ-9 (Tab G-35). The MMSO's flight time for the 30, 60, and 90 days prior to the mishap were as follows (Tab G-36):

| | Hours | Sorties |
|---|---|---|
| Last 30 Days | 21.4 | 8 |
| Last 60 Days | 46.9 | 20 |
| Last 90 Days | 58.6 | 26 |

## 9. MEDICAL

### a. Qualifications

Ops Sup 1 reviewed Patriot Excalibur (a program to track qualifications) for the MMC's Go/No-Go, currencies, flight authorization sign-out, ORM worksheets, and ensured that each aircrew member was medically qualified for duty prior to stepping to the aircraft on 5 December 2012 (Tabs V-10.1, V-10.4, V-11.1 and AA-9). The AAIB conducted interviews of the MMC (MMPP, MMP, MMSO, and MMIP) and reviewed each of their respective medical records and 72-hour and 14-day histories. Each mishap aircrew member was deemed medically qualified for duty at the time of the mishap (Tab EE-11).

### b. Health

A flight surgeon from the 99th Aerospace Medicine Squadron and the AAIB reviewed the medical and dental records and history of the MMC. There were no relevant medical waivers or profiles (Tabs EE-3 to EE-11). There was no evidence to suggest that the health of any of the MMC was relevant to the mishap.

### c. Pathology

Blood and urine samples were collected from the MMC and 432 AMXS maintenance technicians. The samples were submitted to the Armed Forces Institute of Pathology for toxicological analysis. All blood samples tested negative for elevated carbon monoxide levels or ethanol. The urine drug screening tests were negative for amphetamine, barbiturates, benzodiazepines, cannabinoids, cocaine, opiates and phencyclidine. No blood or urine samples were collected from the SAIC GCS technicians (Tab EE-11).

### d. Lifestyle

The AAIB conducted interviews and reviewed the 72-hour and 14-day histories of all aircrew members and no lifestyle factors were found to be relevant to the mishap. The AAIB conducted interviews of 432 AMXS and SAIC GCS maintainers involved in the mishap and no lifestyle factors were found to be relevant to the mishap (Tab EE-11).

### e. Crew Rest and Crew Duty Time

According to AFI 11-202, Volume 3 ACC Supplement, *General Flight Rules*, 28 November 2012, paragraphs 9.4.6 and 9.7.2, the flight duty period (FDP) begins when an aircrew member reports for mission, briefing, or other official duty and ends when engines are shut down at the end of the mission, mission leg, or a series of mission. The maximum FDP for an unmanned aircraft system single control is 12 hours. At the time of the mishap, the MMC was less than 5 hours into their FDP (Tabs V-4.2 and AA-7).

AFI 11-202, Volume 3 ACC Supplement, paragraph 9.8, states that the aircrew requires at least 10 continuous hours of restful activities (including an opportunity for at least 8 hours of uninterrupted sleep) during the 12 hours immediately prior to the FDP. All aircrew members were given 12 hours for crew rest between the 4 December 2012 mission planning and briefings and the 5 December 2012 mass briefing (Tab V-10.3). The AAIB reviewed the 72-hour and 14-day histories for all aircrew members and all members received the requisite time for crew rest (Tab EE-11).

## 10. OPERATIONS AND SUPERVISION

### a. Operations

The MMC experienced a high operations tempo during the 26 WPS's five-and-a-half months of training and leading up to the Mission Employment Phase (Tab V-10.1 and V-14.3). This was mitigated by giving the students additional time to plan and implanting an Instructor Pilot to assist the crew (Tab V-11.1 to V-11.2). The Instructor Pilot can monitor the flight in two ways, from inside the Student Pilot's GCS or on intercom from an alternate GCS (Tab V-14.3). During the mishap sortie, the MMIP was seated inside MCE GCS 5029 (Tab AA-3). The MMC was very experienced (Tab V-14.2 to V-14.3). The MMP was qualified as an instructor pilot with 885.5 hours flight time in the MQ-9 (Tab G-8). The MMPP was also qualified as an instructor pilot with 1,190.6 hours flight time in the MQ-9 (Tab G-16). The MMIP was the previous Commander of 26 WPS and was a qualified instructor pilot with 387.6 hours flight time in the MQ-9 (Tabs G-25 and V-14.2). The MMSO was on the staff at the 26 WPS as an enlisted sensor operator and had 76.7 hours flight time in the MQ-9 (Tabs G-35 and V-14.2).

### b. Supervision

The mishap sortie was authorized by the 26 WPS/CC (Tab V-14.3). The day before the mishap sortie, the MMC participated in a full day (12 hours) of mission planning lead by the Mission Planning Cell Chief and the Mission Commander (Tab V-1.1 and V-4.2). The MMC was then given the opportunity to mission plan and determine how to best utilize and integrate resources in the IPOE scenario to meet the published Commander's intent (Tab V-4.2). On 5 December 2012, the MMC attended a mass briefing where all participating aircrew received the detailed mission plan (Tab V-4.2 and V-14.3).

After the mass briefing, Ops Sup 1 ensured all "26 WPS Top 3 Step Brief" checklist items were met and the MMC was mission ready prior to stepping to MCE GCS 5029 (Tab V-10.3 to V-10.4). Operations Supervision was determined to be IAW AFI 11-418, *Operations Supervision.*

## 11. HUMAN FACTORS

AFI 91-204, *Safety Investigations and Reports,* 24 September 2008, Attachment 5, contains the Department of Defense Human Factors Analysis and Classification System which lists potential human factors that can play a role in aircraft mishaps. The following human factors were relevant to this mishap:

### a. Skill-Based Errors

Skill-based errors are factors in a mishap when errors occur in the operator's execution of a routine, highly practiced task relating to procedure, training or proficiency and result in an unsafe situation. The following skill based errors were relevant to this mishap:

#### (1) Checklist Error

Checklist error is a factor when the individual, either through an act of commission or omission, makes a checklist error or fails to run an appropriate checklist and this failure results in an unsafe situation.

There were multiple exhibitions of checklist error in this mishap. The MGCST actively failed to properly execute the throttle quadrant assembly controls adjustment portion of TO 1Q-1(M)B-2-2 on the PSO1 (pilot seat) throttle quadrant when reconfiguring it for MQ-9 operations (Tabs J-12 and DD-6). The MMPP actively failed to properly execute all parts of the throttle detent check in step 17 of the rack configuration checklist in accordance with TO 1Q-9(M)A-1CL-1 during his preflight of MCE GCS 5029 (Tabs J-12 and V-4.5). Finally, the MMP only ran parts of his Presets checklist and did not execute, nor confirm, the PSO1 rack configuration (Tab V-1.3).

#### (2) 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. This also captures errors in navigation, calculation or operation of automated systems.

The throttle quadrant calibration is a fairly routine maintenance procedure for GCS technicians (Tab V-7.6). The MGCST actively failed to properly execute the calibration (Tabs J-12 and DD-6). GA testing showed that in order to set up the 100% detent command in full range of throttle motion, the MGCST would have to place the throttle fully forward during calibration steps that required the throttle to actually be fully in the aft position (Tabs D-6 to D-8 and J-12). The LGCST also actively failed to properly check the settings in the PSO1 throttle quadrant before signing off the release of MCE GCS 5029 (Tabs D-4 and J-12).

### b. Judgment and Decision-Making Errors

Judgment and decision-making errors are factors in a mishap when behavior or actions of the individual proceed as intended yet the chosen plan proves inadequate to achieve the desired end-state and results in an unsafe situation. The following judgment and decision-making error was relevant to this mishap:

#### Task Misprioritization

Task misprioritization is a factor when the individual does not organize, based on accepted prioritization techniques, the tasks needed to manage the immediate situation.

The MMP's actions were consistent with a person who experienced task misprioritization in the moments just prior to stalling the aircraft. The first instance occurred at 03:08(Z) when the MMP had a discussion with the MMIP about his switch changes and seeing the BETA indication. During that discussion, the MMP attempted to level off the aircraft at 12,000 feet MSL but failed to set a level pitch trim. When the MMP pulled his attention away from his level off, the aircraft matched the previously set trim value of +3 degrees and began to climb. The second instance occurred as the MMP was attempting to establish a descent from 13,220 feet MSL down to his assigned altitude of 12,000 feet MSL. He initially set a nose low attitude of -6 degrees, but again failed to set pitch trim at this new attitude (Tab AA-6). As a result, the MRPA rapidly matched the current +3 degree pitch value and airspeed decreased at an accelerated rate. MCE pilots do not spend a lot of time hand flying the airplane due to the KU Band delay experienced while flying in that mode. A majority of their inputs are typically via the autopilot hold modes (Tab V-4.3). Analysis from the HUD video indicated that MMP was adjusting settings in the HDD during the time of the attitude change (Tab AA-6). This inputting of data likely drew his attention away from physically flying the airplane with all autopilot hold modes off and stall protection disabled.

**c. Technological Environment**

Technological environment is a factor in a mishap when cockpit/vehicle/control station/workspace design factors or automation affect the actions of individuals and result in human error or an unsafe situation. The following environmental factor was relevant to this mishap:

**Instrumentation and Sensory Feedback Systems**

Instrumentation and sensory feedback systems is a factor when instrument factors such as design, reliability, lighting, location, symbology or size are inadequate and create an unsafe situation. This includes items such as Night Vision Displays, HUDs, off-bore-site and helmet-mounted display systems and inadequacies in auditory or tactile situational awareness or warning systems such as aural voice warnings or stick shakers.

The MQ-9 currently does not have any type of indication in either the HUD or HDD that indicates transitory G loading, or acceleration/deceleration (Tab V-1.4 and V-14.5). The MQ-9 HUD currently does not have a warning displayed if the aircraft engine is in a reverse thrust mode (Tab J-11). The only indicator that is associated with a potential reverse thrust condition is the small white BETA text displayed on the right side of the HUD (Tab O-4). The BETA indication is not currently a warning in the MQ-9 because it is a common indication seen during certain ground, takeoff and landing phases (Tab J-11). Seeing BETA in the HUD is not a commonly displayed indication for MCE crews (Tab V-1.4, V-5.2 and V-14.5). The MQ-9 HDD status display area only shows forward thrust indication between 0% and 100%. It does not currently show reverse thrust indications or negative values. Finally, the HDD only shows pure numeric values and percentages for engine performance indications in a table-like format (Tab FF-3). This display makes it difficult for pilots to see trend analysis in the performance of their engine output.

**d. Cognitive and Psycho-Behavioral Factors**

Cognitive factors are factors in a mishap if cognitive or attention management conditions affect the perception or performance of individuals and result in human error or an unsafe situation. Psycho-behavioral factors are factors when an individual's personality traits, psychosocial problems, psychological disorders or inappropriate motivation creates an unsafe situation. The following cognitive and psycho-behavioral factors were relevant to this mishap:

**(1) Channelized Attention**

Channelized attention is a factor when the individual is focusing all conscious attention on a limited number of environmental cues to the exclusion of others of a subjectively equal or higher or more immediate priority, leading to an unsafe situation. This may be described as a tight focus of attention that leads to the exclusion of comprehensive situational information.

On two occasions the MMP's actions were consistent with a person who experienced channelized attention. The first of which occurred at 03:02(Z) when the MMP was attempting to level off the MRPA passing 12,800 feet MSL. At that time, the HUD video revealed that the MMP was inputting data into the HDD when the stall protect initiated and aggressively nosed the MRPA downward to keep the it from stalling. Shortly thereafter, the MMP activated the altitude hold and never noticed that he was in an approach to stall condition (Tab AA-4). The second instance was when the MMP executed the checklist for the "closed loop power – failed" warning that was displayed on the HDD. This indication was not one that was familiar to the MMP, MMSO, nor the MMIP (Tab V-1.4, V-3.3 and V-4.4). The MMP's focus on clearing the warning pulled his attention away from his airspeed while it was approaching stall speed. It also pulled his attention from the change in aircraft attitude that occurred on multiple occasions when the altitude hold mode of the autopilot was turned off (Tab AA-4 to AA-6).

**(2) Complacency**

Complacency is a factor when the individual's state of reduced conscious attention due to an attitude of overconfidence, undermotivation or the sense that others "have the situation under control" leads to an unsafe situation.

The MMPP exhibited actions consistent with complacency by improperly executing a routine preflight rack configuration checklist. As a result of his complacency, the MMPP did not notice the improper settings configured into the PSO1 throttle quadrant (Tabs J-12 and V-4.5).

**e. Perceptual Factors**

Perceptual factors are factors in a mishap when misperception of an object, threat or situation, (visual, auditory, proprioceptive, or vestibular conditions) creates an unsafe situation. The following perceptual factor was relevant in this mishap:

**Misperception of Operational Conditions**

Misperception of operational conditions is a factor when an individual misperceives or misjudges altitude, separation, speed, closure rate, road/sea conditions, aircraft/vehicle location within the performance envelope or other operational conditions and this leads to an unsafe situation.

The MMP exhibited this perceptual factor through his misperception of the rate of the MRPA's decreasing airspeed. The reverse thrust condition significantly enhanced the rate of deceleration that would normally be expected with the throttle settings commanded by the pilot (Tab V-4.5).

## 12. GOVERNING DIRECTIVES AND PUBLICATIONS

### a. Publically Available Directives and Publications Relevant to the Mishap

(1) AFI 11-202, Volume (Vol) 3, ACC Supplement, *General Flight Rules*, 28 November 2012*
(2) AFI 11-2MQ-9, Vol 1, *MQ-9 – Crew Training*, 3 June 2008*
(3) AFI 11-2MQ-9, Vol 2, *MQ-9 – Crew Evaluation Criteria*, 15 April 2008*
(4) AFI 11-2MQ-1 & 9, Vol 3, *MQ-1 and MQ-9 – Operations Procedures,* 1 November 2012*
(5) AFI 11-418, *Operations Supervision*, 15 September 2011*
(6) AFI 21-101, *Aircraft and Equipment Maintenance Management,* 26 July 2010*
(7) AFI 51-503, *Aerospace Accident Investigations*, 26 May 2010*
(8) AFI 91-204, *Safety Investigations and Reports,* 24 September 2008*
(9) TO 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures*, 15 June 2011**

***** Available digitally at: http://www.e-publishing.af.mil.
****** Available digitally at: http://www.tinker.af.mil/technicalorders/index.asp

### b. Other Directives and Publications Relevant to the Mishap

(1) *26th Weapons Squadron Standards*, 29 June 2011
(2) TO 1Q-9(M)A-1, *Flight Manual, MQ-9 Aircraft*, 19 September 2011, IC 1, 20 March 2012
(3) TO 1Q-9(M)A-1 CL-1, *Flight Crew Checklist*, 19 September 2011, IC 1, 20 March 2012
(4) TO 1Q-1(M)B-2-2, *Ground Control Station Maintenance Procedures,* 15 September 2006, Incorporating Change (IC) 7, 15 February 2011

### c. Known or Suspected Deviations from Directives or Publications

The SAIC GCS Technicians failed to properly execute the throttle quadrant assembly controls adjustment IAW TO 1Q-1(M)B-2-2, work package 005 00 and work package 009 02, paragraph 9.3 on the PSO1 (pilot seat) throttle quadrant when reconfiguring it for MQ-9 operations (Tabs J-12, V-7.5 to V-7.6, V-8.1 and DD-6).

The MMPP failed to properly execute the throttle detent – check and the throttle detent calibration IAW TO 1Q-9(M)A-1 CL-1, Rack Configuration checklist, step 17 and 18 requiring the pilot to verify the throttle detent and calibration (Tabs J-12 and V-2.2).

## 13. ADDITIONAL AREAS OF CONCERN

### a. Published Guidance and Standards for GCS Setup

The AAIB traveled to Creech AFB, NV, to observe an experienced crew conduct a GCS preflight and control of an MQ-9 in varying situations in the simulator. The preflight process involved multiple checklists in succession and took 13 minutes from the beginning of the first checklist until the MCE crew was ready to accept aircraft handover. Coordination between the pilot and sensor operator was crisp and without error. The crew did not have prior knowledge of this preflight task nor its timed nature. This task did not involve the extra steps that would be required to set up the mission board and the tactical products that may be specific to an MCE mission (Tab FF-3).

Interviews with MCE and LRE crews revealed that there are situations where crews may require or desire other crews to perform portions of their preflight checks in the GCS prior to the mission crew's arrival (Tab V-1.2, V-2.2, V-4.3, V-10.2 and V-14.4). This is commonly referred to as "running presets" for the incoming crew or "Hot-Cocking" the GCS and is done in order to enable rapid gaining of an aircraft (Tab V-14.4). Interviews and evidence suggest that this is practiced more among LRE crews due to the nature of having to potentially catch aircraft that are returning to base earlier than scheduled (Tabs O-5 to O-7 and FF-3). There are no AFIs that prevent this kind of crew-to-crew assistance. There also are no instructions, directives or standards that are documented MQ-9 community-wide that provide guidance on how this procedure should be performed and how the GCS should be identified once "presets" have been run. Interviews revealed that some units have Operations Read Files, memos, or squadron standards that fully outline this process while others do not (Tab O-5 and V-14.4).

### b. MCE Pilot Proficiency Using the Control Stick for Pitch and Roll Inputs

Interviews with MCE pilots revealed that the vast majority primarily fly the MQ-9 using autopilot inputs and varying hold modes versus controlling the aircraft "manually" while the aircraft is under Ku-band Satellite Communication control (Tab V-2.4, V-4.3 and V-14.5). Aircraft response time to control stick inputs can be somewhat delayed in this mode and the timing of the delay could seem like "a couple of seconds" before an input command takes effect. This is why the C-band, or line-of-sight connection, is utilized for takeoffs and landings. While it may be common to utilize the control stick to establish a new bank angle in order to initiate a turn under Ku-band control, most MCE pilots change altitude by inputting a new altitude hold value and ascent/descent rate into the autopilot (Tab FF-3).

Flying and weapons employment proficiencies are like all other skills in that they are perishable and require repetition in order to become second nature in execution (Tab FF-4). MCE crews have limited proficiency in this area when it comes to controlling the MQ-9 utilizing the control stick for simultaneous pitch and roll inputs (Tab V-2.4). Analysis of the HUD video revealed that the MMP twice failed to properly command a new trim attitude for his aircraft in the moments leading up to the stall. In both instances, the commanded pitch attitude that was directed by the MMP using the control stick was overridden by the previously set +3 degree nose high trim attitude (Tab AA-6). The abnormal depletion rate of MRPA's airspeed due to the reverse thrust condition magnified this execution error (Tab V-4.5). The steps required to command a new pitch trim attitude are not simply a "one-click" button actuation. It requires multiple button actuations and movements on the control stick, to include bringing the control stick back to neutral. If any one of those actions is not done in the proper sequence then the new pitch trim command will not be activated. This action must be second nature in a time critical situation, especially when multitasking is required (Tab FF-3 to FF-4).

**c. Loss of Control Prevent Analysis and Execution**

Loss of control may be indicated by complete failure of the aircraft to respond to pilot control commands. This could be caused by any number of issues to include airspeed or pitot-static failure, catastrophic AOA failure below 120 KIAS with stall protect on, stability augmentation system (SAS) failure, autopilot sensor failure, structural failure or airframe icing (Tab FF-4). In those instances where the pilot feels that the aircraft is not responding to commanded inputs, he/she will execute the Loss of Control Prevent boldface emergency procedure, where the first step to be conducted from memory is Landing Configuration – Command. This action immediately turns off all autopilot hold modes as well as disables the stall protection feature of the aircraft (Tab FF-4). LRE crews are accustomed to flying the MQ-9 with these features disabled for takeoff and landing (Tab V-5.1). MCE crews are accustomed to enabling these features when they take control of an aircraft, especially the stall protect (Tab FF-4). When the stall protect mode is on, the autopilot commands ruddervator inputs based on the aircraft's AOA indications. When it is off, these inputs will not be commanded to help prevent the aircraft from stalling (Tab FF-3). The remainder of the Loss of Control Prevent checklist steps the crew through isolating the system that is causing the loss of control. If the source of the loss of control is not tied to the AOA system, the checklists direct that the stall protect mode be turned back on (Tab FF-4). Because of the dangers of turning off the stall protect mode of the aircraft and then potentially losing link with the aircraft, it is absolutely critical for the pilot to identify the cause of control loss prior to executing this boldface emergency checklist (Tab FF-4).

The stall protect feature of the MRPA prevented the aircraft from stalling on the initial level off attempt at 12,000 feet MSL unbeknownst to the MMP (Tab AA-4). On the second pitch transient noticed by the MMP, he executed the loss of control prevent boldface (Tab AA-5). Once he had the aircraft responding normally again, he needed to go back into the HDD menu and turn on the stall protect mode. Had the MMP enabled stall protect mode as he initiated the return to base he would not have stalled the aircraft and may have been able to buy some time to analyze that the altitude hold autopilot feature of the aircraft was still fully functional when enabled (Tab FF-4).

14 February 2012

ERIC C. GRACE, Lt Col, USAF
President, Abbreviated Accident Investigation Board

# STATEMENT OF OPINION

## MQ-9, T/N 09-004065
## Douglas County, Nevada
## 5 December 2012

*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 5 December 2012, at approximately 03:10:30 Zulu time (Z) (19:10:30 Pacific Standard Time), MQ-9 Reaper Remotely Piloted Aircraft, tail number (T/N) 09-004065, assigned to the 57th Wing, Nellis Air Force Base (AFB), crashed in an unpopulated area three miles northeast of Mount Irish, Douglas County, Nevada, following a stall induced by an unrecognized reverse thrust condition that caused the aircraft to impact the ground after link to the aircraft was lost.

I find, by clear and convincing evidence that the causes of the mishap were 1) the Pilot/Sensor Operator station 1 (PSO1) (pilot seat) throttle quadrant settings of the controlling Ground Control Station (GCS) were improperly configured during the preflight reconfiguration from MQ-1 to MQ-9 operations prior to sortie execution, 2) this throttle anomaly went unrecognized because the Mission Control Element (MCE) mishap pilot (MMP) did not execute the Rack Configuration and Presets checklists on his control rack prior to gaining control of the Mishap Remotely Piloted Aircraft (MRPA), and 3) the MMP stalled the MRPA due to an unrecognized, commanded reverse thrust condition that existed whenever the pilot's throttle was at any position except full forward. Additionally, I find by a preponderance of evidence that MCE Mishap Preflight Pilot's (MMPP) failure to execute his GCS preflight in accordance with (IAW) the technical order procedures substantially contributed to the mishap.

## 2. DISCUSSION OF OPINION

### a. Causes

#### (1) PSO1 throttle quadrant settings were improperly configured during the preflight reconfiguration of the controlling GCS

Investigation and testing revealed that the PSO1 throttle quadrant settings were improperly configured during GCS set up the day prior to the accident. Due to mission requirements the mishap GCS required a reconfiguration from MQ-1 operations to MQ-9 operations prior to the mishap mission. This reconfiguration was performed by two Science Applications International Corporation (SAIC) GCS maintenance technicians on 4 December 2012. The Mishap GCS Technician (MGCST) configured PSO1 while the Lead GCS Technician (LGCST), shift supervisor, configured PSO2 (sensor operator seat). Both SAIC technicians used TO 1Q-1(M)B-2-2, work packages 005 00 and 009 02, to perform this maintenance but had different configuration settings as a result. Analysis of the data log revealed that PSO2 was configured correctly when compared to all other MQ-9 technical data. PSO1's throttle configuration was set up incorrectly. General Atomics (GA) testing revealed that placing the throttle in either full forward or full reverse positions yielded proper results for what was expected to be set in those positions. However, placing the throttle in intermediate positions did not yield proper results. All intermediate positions showed a 100% detent command (full reverse) which should be a setting only seen in the full reverse position. This maintenance error caused the improper throttle command to be sent to the MRPA ultimately creating the reoccurring thrust deficiency.

**(2) MMP did not execute the Rack Configuration and Presets checklists on PSO1 prior to gaining control of aircraft**

Investigation revealed that the MMP did not run his own GCS set up checklists prior to gaining control of the mishap aircraft. The MMP had another current and qualified pilot run the Rack Configuration and Presets checklists, as well as set up some tactical mission displays, prior to the MMP arriving at the GCS for the mission. This was not a common practice in the squadron nor were there any directives outlining how this be performed. Had the MMP run his own Rack Configuration checklist, or at least confirmed his throttle settings, he would have been able to identify that the throttle settings on PSO1 were significantly out of tolerance for flight operations. Failure of the MMP to perform these checklist items himself allowed the improper throttle calibration to go unnoticed. As a result, the improper throttle commands were sent to the MRPA ultimately creating the reoccurring thrust deficiency.

**(3) MMP Stalled Aircraft 09-004065 due to an Unrecognized, Commanded Reverse Thrust Condition**

Analysis revealed that 100% detent command (full reverse thrust) was issued from MCE GCS 5029 whenever the PSO1 throttle was at any position aft of full forward and the altitude hold autopilot mode was disabled. With the altitude hold mode on, by design, the digital flight control software ignored the GCS PSO1 throttle commands. When altitude hold mode was turned off, the aircraft executed the detent command, resulting in full reverse thrust in flight whenever the throttle was not in the full forward position. The MMP disabled and enabled both airspeed and altitude hold modes on multiple occasions but the reverse thrust condition went unrecognized. On three occasions during the instances of commanded reverse thrust, the airspeed hold pitched the nose of the aircraft down in order to maintain commanded airspeed. On the second occasion, the MMP misinterpreted the autopilot actions as an uncommanded input, so he executed the first step of the loss of control prevent checklist, **LANDING CONFIGURATION – Command**, which in turn disabled autopilot hold modes and turned off the stall warning protection feature of the aircraft. On the final instance where the MMP pulled his throttle aft to set cruise airspeed, the aircraft exhibited the same reverse thrust characteristics that it displayed earlier. With the throttle aft of the full forward position, all hold modes off, and the stall protect disabled, the MMP allowed the aircraft to establish a climbing attitude and decelerate below stall speed while attempting to analyze the problem. As a result, the MRPA's left wing stalled. This stall put the aircraft in a position where it was no longer able to maintain link contact with the GCS and into an unrecoverable flight regime. Approximately one minute later, MRPA impacted the ground in an unpopulated area. Failure of the MMP to recognize the MRPA's thrust deficiency, its approach to stall conditions and failure to push the nose of the aircraft over to maintain airspeed above stall ultimately led to the loss of the aircraft.

**b. Substantially Contributing Factor**

**MMPP did not execute his GCS preflight in accordance with Technical Order procedures**

The MMPP went to the mishap GCS approximately two and half hours prior to the mishap crew's arrival in order to set up the mission data displays as well as run the Rack Configuration and Presets checklist items. Technical Order 1Q-9(M)A-1 directs that checklist procedures are to be performed in a challenge/response format and require both a pilot and sensor operator. Investigation showed that the MMPP could not have performed his preflight procedures in accordance with TO 1Q-9(M)A-1 because he was alone while performing these checklist items. Investigation and test results reveal that it is not possible that the MMPP properly executed the THROTTLE DETENT – Check (P) portion of the Rack Configuration checklist. Had the MMPP properly executed this step of the checklist he would have noticed the improper configuration set on the PSO1 throttle quadrant and he would have had to execute step 18 of the checklist, THROTTLE DETENT – Calibrate as required (P). That step of the checklist would have required maintenance technician intervention in order to adjust the improper settings. Failure of the MMPP to properly execute THROTTLE DETENT – Check (P) portion of the Rack Configuration checklist contributed to the improper setting continuing to go unnoticed prior to the mishap.

## 3. CONCLUSION

I arrived at my opinion by examining the records regarding crew and maintenance personnel qualifications, maintenance records regarding the MRPA, the GA Report regarding analysis of the GCS data logs, witness testimony, video and audio from the MCE and LRE GCSs, applicable technical data and consulting with subject matter experts. I find, by clear and convincing evidence, that the causes of the mishap were 1) the PSO1 throttle quadrant settings of the controlling GCS were improperly configured during the preflight reconfiguration from MQ-1 operations to MQ-9 operations prior to sortie execution, 2) this throttle anomaly went unrecognized because the MMP did not execute the Rack Configuration and Presets checklists on his control rack prior to gaining control of aircraft 09-004065, and 3) the MMP stalled aircraft 09-004065 due to an unrecognized, commanded reverse thrust condition that existed whenever the pilot's throttle was at any position except full forward. Additionally, I find by a preponderance of evidence that MMPP's failure to execute his GCS preflight IAW the technical order procedures substantially contributed to the mishap.

14 February 2013

ERIC C. GRACE, Lt Col, USAF
President, Abbreviated Accident Investigation Board

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