

SUMMARY OF FACTS

1. AUTHORITY, PURPOSE, AND CIRCUMSTANCES

A. Authority

On 08 June 2004, General Hal M. Hornburg, Commander Air Combat Command (ACC) appointed Brigadier General Frank Pontelandolfo Jr. to conduct an aircraft accident investigation of the 17 May 2004 mid-air collision involving two F-16C aircraft, serial numbers (S/N) 85-1555 and (S/N) 86-0260 in the Red Hills Military Operating Area (MOA). Brigadier General Pontelandolfo Jr. conducted the investigation at Hulman International Airport, Indiana Air National Guard, Terre Haute, Indiana from 21 June 2004 to 20 July 2004. Technical advisors were Lieutenant Colonel Patrick D. Bertlshofer, (Pilot), Lieutenant Colonel Steven H. Katz (Legal), Lieutenant Colonel Stephen B. Mehring (Maintenance), Captain Raymond J. Walsh (Fight Surgeon) and Chief Master Sergeant Loretta B. Kendall (paralegal). (Tab Y-3)

B. Purpose

This aircraft accident investigation was convened under Air Force Instruction (AFI) 51-503, *Aircraft, Missile, Nuclear, and Space Accident Investigations*. The primary purpose of the investigation is to preserve evidence for claims, litigation, disciplinary, and administrative actions. In addition to setting forth factual information concerning the accident, the board president is also required to state his opinion as to the cause of the accident or the existence of factors, if any, that substantially contributed to the accident. This investigation is separate and apart from the Safety Investigation Board (SIB), convened in accordance with AFI 91-204, *Safety Investigations and Reports*. This report is available for public dissemination under the Freedom of Information Act (5 United States Code (U.S.C.) S552) and the Air Force Supplement to Department of Defense Regulation 5400.7, *Department of Defense Freedom of Information Act Program*.

C. Circumstances

The accident board was convened to investigate the 17 May 2004 mid-air collision of two F-16C aircraft in the Red Hills MOA over the town of Oaktown, Indiana. (Tab BB-3) The Mishap Pilot, (MP 1) Major William E. Burchett (Rove 1) flying Mishap Aircraft (MA 1) F-16C, S/N 85-1555 did not survive the collision. (Tab B-3) The second Mishap Pilot (MP 2) Major Thomas R. Sims (Rove 2) flying MA 2 F-16C, S/N 86-0260 which struck Rove 1 safely ejected after the collision. The MAs and MPs were assigned to the 113th Fighter Squadron, 181st Fighter Wing, Indiana Air National Guard, Terre Haute, Indiana. (Tab B-3)

2. ACCIDENT SUMMARY

The mishap sortie was flown as an F-16 4 (ROVE Flight) vs. 2 (APEX Flight) (similar) Offensive Counter Air (OCA) sortie in the Red Hills MOA to be followed by a Basic Surface Attack (BSA) at Atterbury Range. (TAB K-4) The flight was a Continuation Training (CT) sortie for Rove flight. (TAB V 6-3) Rove 1 was qualified as a four-ship flight lead, Rove 2 was qualified as a four-ship flight lead, Rove 3 was qualified as a Squadron Supervisor and Flight Evaluator and Rove 4 was qualified as a wingman. (TAB T-9) After terminating the first scenario, Rove flight reformed, and requested the same scenario from Apex flight. (TAB N-5) Rove 1 called "fight's on" and called for a turn to the West. (TAB N-5) During this turn Rove 1 and Rove 2 collided. (TAB V 10-10) Rove 2 successfully ejected and was recovered after landing with minor injuries. (TAB H-6) Rove 1 did not survive the collision and his body was recovered during the search and rescue effort. (TAB H-6) Both aircraft were destroyed in the collision. (TAB H-7)

3. BACKGROUND

The 181st Fighter Wing is an Air National Guard unit located at Hulman International Airport, Terre Haute, Indiana. Its mission is to provide combat-ready citizen airmen, F-16C's, and aircraft equipment for worldwide deployment in support of United States military objectives. (Tab CC-63)

The F-16C Fighting Falcon is the updated version of the F-16A and is a compact, multi role fighter aircraft. It is highly maneuverable and has proven itself in air to air and air to surface attacks. It provides a relatively low-cost, high-performance weapon system for the United States and allied nations. (Tab EE-39)

4. SEQUENCE OF EVENTS

A. Mission

The mishap flight was a common mission flown by the unit consisting of an Air-to-Air (A/A) profile flown in the Red Hills MOA followed by a Basic Surface Attack (BSA) at Atterbury Range with recovery to Hulman Field (TAB V 6-3) The A/A portion consisted of the four-ship of ROVE flight acting as Blue Air (Allied Force) conducting an Offensive Counter Air (OCA) mission versus the two-ship of APEX flight acting as Red Air (Enemy). (TAB V 6-3) After completion of the A/A training ROVE flight planned to proceed to Atterbury Range and APEX flight would remain in Red Hills MOA to practice attacks for Air-to-Ground (A/G) CT. (TAB K-4)

B. Planning

MP-1 arrived the evening prior to the mishap day. (TAB EE-3) MP 1 was a Traditional Guardsman who also held a civilian job as a flight officer with a major air-carrier. (TAB DD-22) He had not flown the F-16 in 28 days. (TAB G-4) The morning of

the mishap he completed a Mission Emergency Procedures Evaluation (MEPE). The Standards and Evaluation Flight Examiner (SEFE) that administered the evaluation stated that MP 1 was well prepared and passed the evaluation with no problems noted. (TAB V 7-4) The evaluation was conducted "table-top"(verbally) due to the non-functional Unit Training Device (UTD). (TAB V 7-8) The SEFE did not observe any simulated aircraft handling during the MEPE. (TAB V 7-8) In statements made by the other flight members, MP-1 then completed the flight planning for the mission. (TAB V 6-10, V 10-6)

The aircraft were loaded with 2 external wing fuel tanks, 6 practice BDU 33's mounted on Triple Ejector Racks (TERs), one captive AIM 9 missile and one AMD POD, 30 chaff and 15 flares. MP-2's gun also carried 150 rounds of 20MM training practice (TP) rounds. MP 1's gun was not loaded with 20MM rounds. (TAB J 3-4)

The mission briefing included two parts: An A/A engagement in the Red Hills MOA, followed by a practice-bombing portion flown at Atterbury Range. ROVE flight members stated MP 1 completed the flight briefing (In Accordance With) IAW AFI-11-2F16V3 (TAB BB20). MP 1 started the briefing 1 hour and 35 minutes prior to takeoff and began the briefing with a coordination briefing with APEX flight covering required items and any thing pertinent to the mission that day. (TAB V 6-3) MP 1 dismissed the APEX flight members and finished the remainder of the brief with his flight. (TAB V10-6) ROVE flight members MP 2, Rove 3, and Rove 4 stated the briefing by MP 1 was complete and they had no questions about the mission or how it would be executed. (TAB V6-11, V 8-6, V 10-5) None of the ROVE flight members recall MP 1 briefing an expanded or elaborate marshalling plan. (TAB V 6-12) (Note: The 113th Squadron Standards call for FLUID 4 with turns accomplished at 350kts in MilPower using G to maintain airspeed.) (TAB O-27)

C. Preflight

All ground checks, engine start and taxi were uneventful. (TAB V 6-4)

D. Flight

APEX flight took off prior to ROVE flight and conducted a thorough weather check of the area and determined that the weather conditions met the requirements for the planned mission. (TAB's W & V 11-13) ROVE flight took off shortly after APEX and proceeded to the area uneventfully. (TAB V 6-4)

After entering Red Hills MOA ROVE flight completed a G-awareness exercise, operations checks, and standard administrative procedures IAW AFI 11-214(TAB V 6-5) and AFTTP 3-3V5. (TAB BB -21) The G-awareness exercise is a standard series of turns performed before any activity that may include high G forces. It allows the pilots an opportunity to practice their anti-G straining maneuvers and ensure that their anti-G equipment is operating properly. (TAB BB-21)

After the G-awareness exercise MP 1 directed the flight to Viper 4 (TAB-N-3) and turned to establish the flight in the east end of Red Hills MOA. MP 1 checked-in with APEX flight and called for the "fights on" initiating the simulated combat engagement. (TAB N-3) MP 1 directed a tactical 180- degree turn with the flight established in a Viper 4 formation. The flight executed the turn uneventfully and after rolling out on a westerly heading, continued the formation in Viper 4. (TAB N-3)

A tactical engagement with APEX ensued in the center of the Red Hills MOA. The tactical engagement terminated uneventfully with ROVE flight separated geographically. (TAB N-4) MP 1 directed reform of his flight and established an easterly heading. (TAB N-4)

ROVE flight reformed with MP 1 established on an east heading with Rove 4 on the north side of the formation and MP 2 on the south side of the formation. (TAB N-4 & EE-33) Initially Rove 3 was aft and low of the formation (Fluid 4) between MP 1 and Rove 4. (TAB V 6-7) Rove 3 made a radio call that he was dealing with a minor aircraft malfunction and quickly called that the problem was fixed. (TAB N-4) Rove 3 continued to close on the rest of the formation to his assigned position. As Rove 3 closed on the formation he reformed to the north side of MP 1 just aft of a line abreast position approximately 6000ft in range. (TAB V 6-7 & TAB EE-33)

MP 1 called for a 180 degree Tactical turn and directed the formation to Viper 4. (TAB N-5) All four of the ROVE flight members initiated a turn to the north from the position shown in (TAB EE-33)

MP 1 (MA 1) started the turn at approximately 350kts level flight and rolled his aircraft into a 70 degree banked turn to the left simultaneously initiating a gradual climb. (TAB EE-28)

MP 2 (MA 2) on the south side of the formation started the 180-degree left turn on the right side of MA 1, aft and approximately 4000-5000ft from Rove 1. (TAB EE-37) MP 2 mirrored MP 1's initial turn to approximately the 90 degree point of turn approaching a northerly heading maintaining approximately 380kts, a gradual climb, and maintained fairly consistent G-loading between 2-3 G's. (TAB EE 28-29)

Rove 3 initiated a turn to the left starting at approximately 400kts, slowed and maintained 380kts through the remainder of the 180 degree turn with minor variations in G-loading. (TAB EE 30 & 33)

Rove 4 on the far left of the formation started slightly ahead of the formation and approximately 6000ft from Rove 3 with an initial vector approximately 20 degrees away from the rest of the formation. (TAB EE 31 & 34)

After flying approximately 90 degrees of turn MP 1 initiated a weapons state check with the radio call, "Rove 1, 2 by 2."(TAB N-5) Rove flight responded in order

with their weapons status. (TAB N-5) MP 1's airspeed at this point decreased to approximately 314kts. (TAB EE 27) During the ensuing radio calls MP 1 initiated an increase in bank, combined with a descent and a momentary increase in G-loading. (TAB EE 27 & 28) MP 1 descended approximately 1400ft in the final 90 degrees of turn while maintaining approximately 300kts and a consistent 2 G's until the approximate time of the impact. (TAB EE 24-25, 27-28)

As ROVE flight passed through the 90 degree point of the 180-degree turn they were all lined up facing north with Rove 4 at the front. (TAB EE 23) During this time a combination of factors occurred: MP 1 initiated a radio call (TAB N-5) that was answered by the flight in turn, MP 1 started a steeper descent prior to MP 2 (TAB EE 28 & 29), and MP 1, Rove 3, & 4 were all lined up tail aspect to MP 2 transitioning through the front of his canopy and HUD. (TAB EE 22 & 35)

Possibly due to the flight dynamics at this point MP 2 transferred his focus on MP 1 to Rove 3 and was not situationally aware of the transfer of visual focus to the other flight member. (TAB EE-37)

Maintaining visual and judging distance & closure on an F-16 from directly behind is difficult due to the small size and aspect ratio of the aircraft, combined with aircraft blind spots and environmental issues like an adverse background. (TAB BB-5, BB-12) In addition empirical data and simulation indicates that MP 1 was possibly blocked from the view of MP 2 by a portion of the Heads Up Display (HUD) bracket or Air to Air Refueling (AAR) light fixture or was blocked from view by the front right quarter of the glare shield. (TAB EE-22)

Available data was used to reconstruct the profile in a 360-degree color, full visual, flight simulator at Luke AFB, AZ. (Tab EE-21) Experienced F-16 pilots flew the flight profile from the beginning of the 180-degree turn to the collision point. (Tab EE-21) Clearly at the 90 degree point of turn it became difficult to discern between MP 1 and Rove 3 as they nearly superimposed. Any deviation from focus at this point resulted in either aircraft becoming the primary focus. (TAB EE-22)

The issue of range becomes a factor. It is difficult to accurately judge range of an F-16 from directly behind (6 o'clock) due to reduced visual cues. (TAB BB-12)

Additionally the further aft the pilot is the more difficult it is to judge range and closure. MP 2 started the 180-degree turn from approximately 4000-5000ft back with minor over-take (closure) due to airspeed. (TAB EE-33) As the turn progressed and reached the 90-degree point MP 1 decreased airspeed from 349kts to 314kts while MP 2 maintained 384kts. (TAB EE 27 & 29) Rove 3 decreased from approximately 400kts to 380kts. (TAB EE 30) At this transition point when MP 1 and Rove 3 were close together visually from MP 2's view, it is possible to confuse the aircraft. Subsequently if MP 1 is obscured or a visual anomaly occurs where MP 2 redirects focus on Rove 3 and reinforces this by filling in gaps of information or visual cues, MP 2 continues the turn visually re-focused on Rove 3. (Tab BB-17, EE 22 & 35)

As this transition to north occurs MP 2 momentarily initiated afterburner (A/B) (TAB EE-29). MP 2 in testimony does not remember selecting A/B (TAB V 8-9). Data indicates that A/B was terminated quickly, approximately 5 seconds. (TAB EE-29) Accepting the premise that MP 2 transfers his focus from MP 1 to Rove 3 it is possible that MP 2 perceives he is further aft at the 90 degree point than anticipated and initially attempts to maintain or close distance with increased power. MP 2 testified he started approximately 3000ft from MP 1 at the beginning of the mishap turn. (TAB V 8-9) Reconstruction of the flight profile indicates MP 2 started the turn 4000-5000ft from MP-1. (TAB EE- 22 & 37) MP 2 testified that he judged he was approximately 3000ft aft of MP 1 at the 90 degree point of the turn. (TAB V 8-13)

MP 2 completes the remainder of the 180 turn closely matching Rove 3's altitude, radius, and rate of turn from this point. (TAB EE 32 & 37) In his testimony MP 2 stated he kept MP 1 in sight throughout the turn until approaching the westerly heading. (TAB V 8-10, 11, 13, 17) At this time his recollection was that his aircraft fuselage and that of MA 1 were aligned and he could see MA 1 in the right front quarter of his canopy approximately 30 degrees right of the centerline of his aircraft. (TAB V 8-12) Reconstruction from the available sources indicates that was the approximate position of Rove 3 NOT MA 1. (TAB EE-37)

Reconstruction of the collision indicates that MA 2 impacted MA 1 from above and from the left side. Analysis of the data indicates MP 1 is probably obstructed from the view of MP 2 by the front right quarter of the radome or the front right strake of his own aircraft. (TAB EE-22) MP 1 in relationship to MP 2 is probably blocked from a clear visual sight line from approximately the 90-degree point of turn. (TAB EE 22 & 37)

Furthermore reconstruction in a full-visual flight simulator with experienced pilots, flying the profile from available data, demonstrated that if MP 2 flew his formation focused on Rove 3, MP 1 quickly became difficult to see and either the pilot had to lean far right in the cockpit to see over the right strake or decrease bank to keep MP 1 in sight while simultaneously increasing the descent rate to match MP 1. Alternately, from the cockpit of MA 2, MP 2 could easily maintain Rove 3 in sight just above the right side canopy rail transitioning from the 10 degree position, just right of the HUD, to the 30 degree point approaching the anticipated roll-out. (TAB EE-22)

MP 2 testified that when APEX 1 transmitted the picture call he perceived to be approaching the roll-out point west bound and he redirected his attention to the radar display in his aircraft. (TAB N-5) (TAB V 8-10, V 8-11, V 11-5, V 11-7) The radar display is pilot selectable and can be displayed on the left or right Multi-Function Display (MFD) unit. (TAB BB-5) The display is positioned above the left knee or right knee. (TAB BB-5) Generally F-16 pilots fly with the display above the left knee and that is the position MP 2 indicated his radar was displayed. (TAB V 8-10) This brought MP 2's visual focus into his cockpit, down and left, at a Critical Phase of Flight in relationship to the actual position of (MA1), but not to Rove 3. MP 2 anticipated rolling-out west bound

and believed that he had “aligned fuselages” matching MA 1 (actually Rove 3). (TAB V 11-7)

From available data and reconstruction of the events leading up to the collision, it is estimated that MP 1 was almost directly underneath MP 2 in a position not visible from MP 2’s cockpit 3-5 seconds prior to the collision. (TAB EE-33, EE-22)

Pilots in the simulator flying a reconstruction of the mishap flight determined from the position that MP 1 was in and the flight path of MP 2 just 3-5 seconds prior to impact MP 1 could only have prevented the impending collision if he had been focused on MP 2 over his left shoulder about the 7-8 o’clock position for the last several seconds of flight and maneuvered his aircraft out of the flight path of MP 2 or directed MP 2 to execute an evasive maneuver. He was not focused on MP 2 during this phase of flight anticipating the impending tactical engagement. In addition at this point in this formation it was not his responsibility. (TAB EE-22A)

E. Mid Air Impact

Available data indicates the impact of MP 1 and MP 2 occurred almost overhead a private airstrip west of Oaktown, IN. The collision occurred at approximately 20000ft and coordinates N 38°50’ W 087°30’. Both aircraft were extensively damaged and rendered unflyable from the collision. (TAB H-7)

MP 2 described the impact as totally disorienting and thinking the aircraft “had just exploded.” (TAB V 8-18) He was thrown forward probably striking the HUD or front glare-shield. He stated that he felt like there was a fireball in front of his face and frantically grabbed for the ejection handle. (TAB V 8-18)

F. Life Support

MP 1 sustained fatal injuries during impact and never attempted ejection. (TAB H-6) Post crash analysis indicates MP 1 separated from the ejection seat due to the impact and descended at a high rate of speed under a partially inflated chute. (TAB H-6)

MP 2 ejected and stated he didn’t realize he had been in a mid-air collision until after he was in the parachute and saw a grey cloud that resembled a bomb exploding. (TAB V 8-18) Post crash analysis indicates the ejection system functioned as designed. (TAB H-6) MP 2 landed with minor injuries northeast of Oaktown. Local residents were the first to reach him and subsequently an ambulance arrived and transported him to a local hospital. (TAB H- 7)

G. Search and Rescue (SAR)

The Search and Rescue (SAR) operation began immediately after the collision of MP 1 and MP 2 was observed. (TAB V 10-10) Rove 4 in the process of

rolling out on the westerly heading and adjusting his formation in relationship to Rove 3 stated he saw a flash (explosion) beyond Rove 3. (TAB V 10-10) He made a radio call initiating a "terminate." (TAB N-5) Rove 3 at this point in his testimony of the events stated he saw what appeared to be an explosion in the position of MP 1 and called a Knock-it-Off (KIO). (TAB V 6-8)

Rove 3 immediately assumed On-scene Commander (OSC) duties and began the rescue effort. (TAB V 6-8) Rove 3 called the KIO on the common safety of flight Ultra-High Frequency (UHF) channel shared by all the participating players in Red Hills MOA and called for all the aircraft to switch to UHF channel one and VHF channel 15. (TAB N-5) Subsequently Rove 3 re-directed the remaining aircraft to VHF channel 12. (TAB N-5) He established communications with the Supervisor of Flying (SOF) and established an orbit around the crash site. The remaining members of ROVE flight and APEX conducted inter-flight coordination and relayed information to the SOF for approximately 25 minutes until being recalled to Hulman Field by the SOF. (TAB V 6-9)

H. Recovery of MP 1

MP 1's body was recovered approximately one mile northeast of the MA crash site. (TAB S- 3)

5. MAINTENANCE

General Information.

Each individual Air Force aircraft has its own set of both written and electronic maintenance records used to record all flight discrepancies and/or maintenance performed. These records are called the Air Force Technical Order (AFTO) Form 781s and the Core Automated Maintenance System (CAMS). All existing aircraft 781 series forms were reviewed for accuracy and completeness. This information, along with information obtained from CAMS, was used to determine the condition of both mishap aircraft (MA), F-16C S/N's 85-1555 and 86-0260, during the 90 days prior to the mishap. The engine histories are included in the discussion on each MA.

a.1 Forms Documentation on MA 1

Aircraft – Serial Number 85-1555.

MA 1 had completed 25 sorties for a total of 33.2 hours in the 90-day period from 17 February 2004 through 17 May 2004. Of these sorties, 18 returned Code 1 (no significant maintenance problems noted and is ready to fly again). Three returned Code 2 (the aircraft can perform a portion of what may be required and is still flyable). Four sorties returned Code 3 (significant maintenance problems that require repair before the aircraft can fly again). (Tab U-11 through U-30)

MA 1 was Code 1 upon takeoff on the mishap sortie (the 26th sortie of this period) but did not receive a return Code due to the mishap. The hours flown on the mishap sortie (approximately 0.5 hours) are not included in the hourly total mentioned above. If the flying time during the mishap sortie is included, the total flying time this period amounted to 33.7 hours.

- (1) Open AFTO Form 781A (the basic aircraft maintenance record) discrepancies (Tab D-7) There were no unusual discrepancies listed in the AFTO Form 781A entries. The open items included:
 - a. Info note: Main fuel shutoff valve wired to the open position.
 - b. Info note: Breakers 3945CB13, 3945CB15, and 3945CB21 pulled and collared.
 - c. Info note: Fuel inert & halon heater circuit breakers pulled and locking collars installed to prevent halon from discharging.
 - d. Info note: Sequencer knob removed.
 - e. Info note: Munitions loaded, chaff RR-188, flares M206.
 - f. Red diagonal 5 May 2004: CMSP will not work with ECM Pod on stations 3 or 5.
- (2) Open AFTO Form 781A **Information Notes** (Tab D-7, D-9) Analysis of the notes carried with the aircraft showed nothing unusual.
- (3) Open AFTO 781K **Delayed Discrepancies** (Tab D-7 through D-15) Nothing unusual was noted.
- (4) **Time Change Items Not Complied With:**
 - a. Red diagonal: Angle gearbox due time change. Delayed until next 300 hour phase inspection. (Tab D-15)
- (5) **Time Compliance Technical Orders (TCTOs)** Periodically, after discovery of a design or maintenance defect in an aircraft or engine component, the Air Force issues fleet-wide orders to repair or replace potentially faulty aircraft or engine components. These fleet-wide directives are referred to as "Time Compliance Technical Orders, or TCTOs." None of the TCTOs mentioned here, if completed earlier, would have prevented the mishap. (Tab D-12 through D-15)

b.1 Inspections on MA 1

The major schedule inspection cycle for the F-16C is the 300-hour phase inspection program. The last phase for 85-1555 was 12 May – 16 June 2003. (Tab U-69) The aircraft went to phase with 3731.2 flying hours. Since the phase, the aircraft had accumulated 163.2 flying hours, was 136.8 hours away from the next phase inspection, and had accumulated 3894.4 total flight hours up to the time of impact with F-16C 86-0260 during the mishap flight.

- (1) There are no **Overdue Inspections**.

- (2) There are no **One Time Inspections (OTIs) Not Complied With**.

Engine Installed in F-16C 85-1555 – Engine Serial Number 545190.

The F110-GE-100 engine inspection program includes a 200-hour phase inspection and a 100-hour inspection, all based on flight hours. There are other inspections required depending on the engine cycles or operating hours on certain sub-assemblies. The engine inspection criteria and guidance was followed. (Tab U-81 through U-90)

The mishap engine, S/N 545190, had accumulated 159.1 hours since the last 200-hour phase inspection and 59.1 hours since the last 100-hour inspection, which includes flying time on the mishap sortie. (Tab U-81 through U-90)

The engine logged a total of 4071.7 operating hours and 2920.7 flight hours prior to the mishap. It was installed in the MA on 12 May 2004 after being removed from another aircraft in the fleet and having the High Pressure Turbine replaced. The first time this engine flew in 85-1555 was the morning sortie on 17 May 2004 (the sortie prior to the mishap sortie). No engine anomalies were reported for this flight and the aircraft was cleared for the second sortie of the day.

This data and all TCTO, TCI, and Engine Inspection data was verified using the Comprehensive Engine Management System (CEMS) database as well as from locally produced engine records.

- (1) There are no **Overdue Engine Inspections**.
- (2) There are no **Overdue Engine Time Change** items.
- (3) **Engine TCTOs Not Complied With** (Tab U-77 through U-82) Those TCTOs not complied with were programmed to be worked as the engine reached certain milestones and were also driven by kit/parts availability. None of the TCTOs, if completed earlier, would have prevented the mishap.
- (4) A comprehensive engine TCTO record indicated nothing unusual (Tab U-79)

a.2 Forms Documentation on MA 2

Aircraft – Serial Number 86-0260.

MA 2 had completed 40 sorties for a total of 58.6 hours in the 90-day period from 17 February 2004 through 17 May 2004. Of these sorties, 36 returned Code 1 (no significant maintenance problems noted and is ready to fly again). Three returned Code 2 (the aircraft can perform a portion of what may be required and is still flyable). One

sortie returned Code 3 (significant maintenance problems that require repair before the aircraft can fly again). (Tab U-31 through U-68)

MA 2 was Code 1 upon takeoff on the mishap sortie (the 41st sortie of this period) but did not receive a return Code due to the mishap. The hours flown on the mishap sortie (approximately 0.5 hours) are not included in the hourly total mentioned above. If the flying time during the mishap sortie is included, the total flying time this period amounted to 59.1 hours.

- (1) Open AFTO Form 781A (the basic aircraft maintenance record) discrepancies (Tab D-18) There were no unusual discrepancies listed in the AFTO Form 781A entries. The open items included:
 - a. Info note: Main fuel shutoff valve wired to the open position.
 - b. Info note: Breakers 3945CB13, 3945CB15, and 3945CB21 pulled and collared.
 - c. Info note: Fuel inert & halon heater circuit breakers pulled and locking collars installed to prevent halon from discharging.
 - d. Info note: Sequencer knob removed.
 - e. Info note: Munitions loaded, 20mm, chaff RR-188, flares MJU-7.
 - f. Red diagonal 17 May 2004: HSI To-From indicator is not visible.
 - g. Red dash 17 May 2004: 10-hour flame sensor inspection due.
- (2) Open AFTO Form 781A **Information Notes** (Tab D-18 and D-19) Analysis of the notes carried with the aircraft showed nothing unusual.
- (3) Open AFTO 781K **Delayed Discrepancies** (Tab D-23 through D-26) Nothing unusual was noted.
- (4) **Time Change Items Not Complied With:**
 - a. Red diagonal: Harness release cartridge. Awaiting parts, which were on order. (Tab D-26)
- (5) **Time Compliance Technical Orders (TCTOs)** Periodically, after discovery of a design or maintenance defect in an aircraft or engine component, the Air Force issues fleet-wide orders to repair or replace potentially faulty aircraft or engine components. These fleet-wide directives are referred to as "Time Compliance Technical Orders or TCTOs." None of the TCTOs mentioned here, if completed earlier, would have prevented the mishap. (Tab D-23 through D-26)

b.2 Inspections on MA 2

The major schedule inspection cycle for the F-16C is the 300-hour phase inspection program. The last phase for 86-0260 was 1 August – 11 September 2003. (Tab U-71 through U-72) The aircraft went to phase with 3737.8 flying hours. Since the phase, the aircraft had accumulated 194.7 flying hours, was 105.3 hours away from the next phase

inspection, and had accumulated 3932.5 total flight hours up to the time of impact with F-16C 85-1555 during the mishap flight.

- (1) There are no **Overdue Inspections**.
- (2) There are no **One Time Inspections (OTIs) Not Complied With**.

Engine Installed in F-16C 86-0260 – Engine Serial Number 509211.

The F110-GE-100 engine inspection program includes a 200-hour phase inspection, and a 100-hour inspection, all based on flight hours. There are other inspections required depending on the engine cycles or operating hours on certain sub-assemblies. The engine inspection criteria and guidance was followed. (Tab U-91 through U-110)

The mishap engine, S/N 509211, had accumulated 160.7 hours since the last 200-hour phase inspection and 63.6 hours since the last 100-hour inspection, which includes flying time on the mishap sortie. (Tab U-91 through U-110)

The engine logged a total of 4998.3 operating hours and 3169.3 flight hours prior to the mishap. It was installed in the MA on 30 October 2003 after being removed from another aircraft in the fleet and having an oil leak repaired in the #5 bearing area.

This data and all TCTO, TCI, and Engine Inspection data was verified using the Comprehensive Engine Management System (CEMS) database as well as from locally produced engine records.

- (1) There are no **Overdue Engine Inspections**.
- (2) There are no **Overdue Engine Time Change** items.
- (3) **Engine TCTOs Not Complied With** (Tab U-93 through U-98) Those TCTOs not complied with were programmed to be worked as the engine reached certain milestones and were also driven by kit/parts availability. None of the TCTOs, if completed earlier, would have prevented the mishap.
- (4) A comprehensive engine TCTO record indicated nothing unusual. (Tab U-95)

c.1 Maintenance procedures on MA 1

Aircraft – Serial Number 85-1555.

All maintenance procedures were followed leading up to the mishap sortie and had no bearing on the mishap sequence of events. In the previous 90-days MA 1 had four Code 3 sorties.

On 8 April 2004, MA 1 was Code 3 for a hung bomb, which is on system 75B (External Stores); and Situational Awareness Data Link (SADL) radio problems, which is system 69A (Miscellaneous Communications Equipment). (Tab U-24)

On 18 April 2004 MA 1 returned Code 3 for a malfunctioning left main brake, which is on system 13E (Brake and Skid Control). (Tab U-23)

On 27 April 2004 MA 1 was Code 3 for uneven braking, which is on system 13E (Brake and Skid Control). (Tab U-21)

On 30 April 2004 MA 1 returned Code 3 for fire control radar malfunctions, which is system 74A (Fire Control Radar). (Tab U-19)

There were no engine in-flight anomalies reported during the 90-day period prior to the mishap.

The 181st Aircraft Maintenance Squadron (AMXS) Composite Tool Kits (CTK) used by the crew chiefs on the day of the mishap were impounded and inspected. Misplaced tools were not a factor in this mishap. (Tab U-5 through U-6)

Engine Installed in F-16C 85-1555 – Engine Serial Number 545190.

Engine 545190 was installed in Aircraft 85-1555 on 12 May 2004. Review of the AFTO Form 781K and automated reports revealed the last engine 200-hour phase was completed when the engine had 2861.6 engine flight hours. The 100-hour borescope, and 50-hour HPT borescope inspection was last completed when the engine had 2918.8 flight hours. At the time of the mishap a total of 2920.7 engine flight hours had been logged.

The engine was 48.1 hours away from the next 50-hour borescope inspection, 98.1 hours away from the next 100-hour borescope inspection, and 140.9 hours away from the next 200-hour phase inspection when the mishap occurred. (Tab U-81 through U-90)

c.2 Maintenance Procedures on MA 2

Aircraft – Serial Number 86-0260.

All maintenance procedures were followed leading up to the mishap sortie and had no bearing on the mishap sequence of events. In the previous 90-days MA 2 had only one Code 3 sortie.

On 15 April 2004, MA 2 was Code 3 for a “P-light”, which is on system 14A (flight control system). (Tab U-57)

There were no engine in-flight anomalies reported during the 90-day period prior to the mishap.

The 181st Aircraft Maintenance Squadron (AMXS) Composite Tool Kits (CTK) used by the crew chiefs on the day of the mishap were impounded and inspected. Misplaced tools were not a factor in this mishap. (Tab U-5 through U-6)

Engine Installed in F-16C 86-0260 – Engine Serial Number 509211.

Engine 509211 was installed in Aircraft 86-0260 on 30 October 2003. Review of the AFTO Form 781K and automated reports revealed the last engine 200-hour phase was completed when the engine had 3008.6 engine flight hours and was at the depot. The 100-hour inspection was last completed when the engine had 3105.7 flight hours. At the time of the mishap a total of 3169.3 engine flight hours had been logged. The engine was 36.4 hours away from the next 100-hour borescope inspection, and 39.3 hours away from the next 200-hour phase inspection when the mishap occurred. (Tab U-91 through U-110)

d. Maintenance Personnel and Supervision

AF Form 623, *Individual Training Record* of involved maintenance personnel were impounded by the 181st FW Quality Assurance (QA) personnel. In addition, all aircraft records and automated maintenance records were impounded, and in the case of automated records the databases were locked. Reviews of the records and subsequent interviews with maintenance supervisors and QA verified that there were no unqualified personnel performing maintenance tasks on either MA. (Tab U-5 through U-6)

e. Fuel, Hydraulic, and Oil Inspection Analysis

Samples were taken of JP-8 fuel from the refueling truck that serviced both MA as well as the source bulk tank. All fuel test results were nominal and not a factor in the mishap. Results from testing on liquid oxygen (LOX) were also nominal and not a factor in the mishap. Hydraulic fluid from all the servicing carts and mules were tested and the results were nominal and not a factor in the mishap. Engine oil servicing carts were tested and the results were nominal and not a factor in the mishap. Liquid nitrogen servicing carts were not sampled or tested. (Tab D-28)

Engine oil analysis records showed no anomalies and engine oil contamination was eliminated as a factor in the mishap.

f. Unscheduled Maintenance

Aircraft – Serial Number 85-1555.

A comprehensive review of all unscheduled maintenance actions documented in the AFTO 781 Forms during the previous 90-days revealed no evidence that any maintenance action contributed to this mishap (Tab U-11 through U-30).

Engine Installed in F-16C 85-1555 – Engine Serial Number 545190.

The only unscheduled maintenance performed on this engine in the past 90 days was on 24 March 2004 when a 1st stage fan blade nick was repaired (blended) while the engine was undergoing scheduled maintenance in the engine shop. (Tab U-73 through U-76)

Aircraft – Serial Number 86-0260.

A comprehensive review of all unscheduled maintenance actions documented in the AFTO 781 Forms during the previous 90-days revealed no evidence that any maintenance action contributed to this mishap. (Tab U-31 through U-68)

Engine Installed in F-16C 86-0260 – Engine Serial Number 509135.

There was no unscheduled maintenance performed on this engine in the past 90 days.

6. AIRCRAFT AND AIRFRAME SYSTEMS

a. Condition of Systems.

Aircraft – Serial Number 85-1555.

The mishap aircraft was destroyed upon impact with F-16C 86-0260. There was no indication of any aircraft system failure that would have contributed to the mishap. An assessment of the condition and functioning of several systems is contained in the Lockheed Martin technical assessment. (Tab J) The Crash Survivable Flight Data Recorder (CSFDR) was found to have failed sometime prior to the mishap flight and the data recovered was of no value to this investigation. (Tab J-13) The inability of the CSFDR to record flight data had no bearing on the mishap.

MA 1 had flown a total of 3894.4 hours up to the time of the mishap.

The aircraft was in an approved configuration for an air to surface mission as noted in the Form F. (Tab U-7)

Aircraft – Serial Number 86-0260.

The mishap aircraft was destroyed upon impact with F-16C 85-1555. There was no indication of any aircraft system failure that would have contributed to the mishap. An assessment of the condition and functioning of several systems is contained in the Lockheed Martin technical assessment. (Tab J) The Data Transfer Cartridge (DTC) was found to have failed sometime during the mishap sortie. Further explanation of the condition and attempts to recover data by technical experts show that the internal battery was below the voltage necessary to maintain the DTC volatile memory. (Tab U-3 through U-4) The loss of volatile memory in the DTC due to inadequate internal battery voltage was not a factor in the mishap.

MA 2 had flown a total of 3932.5 hours up to the time of the mishap.

The aircraft was in an approved configuration for an air to surface mission as noted in the Form F. (Tab U-9)

7. WEATHER

A. Forecast Weather

Forecast weather for the flight beginning at 1800 Z prior to takeoff of the MF, predicted winds from the South Southwest at 12-25kts. The forecast weather for the Red Hills range was a broken cloud deck at 4-5000 feet with isolated Thunderstorms in the area, winds at altitude 220 at 30kts. (Tab W)

B. Observed Weather

The observed weather conditions at the Red Hills MOA was a broken cloud deck at 4000 ft and scattered clouds at 11,000 ft with a Thunderstorm on the southeast corner of the area most of which was outside the airspace boundary. (Tab V6-5) Flight members indicated that there was a thin cloud deck above their altitude blocks that eliminated sun glare. (Tab V 11-13)

C. Conclusions

The flight was conducted during the day in visual flying conditions. Weather conditions were favorable, and there is no indication that weather was a factor in this mishap.

8. CREW QUALIFICATIONS

MP-1 was a Traditional Guardsman current in the F-16, Flight Lead qualified and fully capable of executing the mission. (TAB T-9 & V 6-11) Additionally he was actively employed as a flight officer by a civilian air carrier. (TAB DD-22)

AIRCRAFT	HOURS
F-16	978.1
TRAINER/T-37/AT-38B	1818.6
TOTAL	2796.7

TABLE DATA (TAB G-12)

MP-1's last sortie prior to the mishap flight was a similar mission scenario flown as the flight lead 28 days prior. (TAB G-10)

	SORTIES	HOURS
30 Days	1	1.5
60 Days	7	9.4
90 Days	13	17.5

TABLE DATA (TAB G-7)

MP-2 is a Traditional Guardsmen current in the F-16, Flight Lead qualified and fully capable of executing the mission. (TAB T-9 & V 6-12) He is currently on temporary Active Guard Reserve (AGR) orders. He is currently on a military leave of absence from a major civilian air carrier where he is employed as a flight officer (TAB 8-3)

AIRCRAFT	HOURS
F-16	552.4
NAVY/MARINE TRAINER/F-18	1707.7
TOTAL	2260.1

TABLE DATA (TAB G-18)

	SORTIE	HOURS
30 Days	14	17.1
60 Days	24	31.6
90 Days	28	36.7

TABLE DATA (TAB G-16)

MP 2 was current in the F-16 and had flown a sortie the morning of the mishap. (TAB V 8-3) It is not uncommon for pilots to fly more than one sortie in a day.

9. MEDICAL

a. Qualifications.

The medical and dental records of the MPs' involved in the collision were thoroughly reviewed. Both were worldwide and medically qualified for flight duties at the time of the mishap. (Tab DD-3)

b. Health.

Health was not a contributing factor in this mishap for either of the MPs' involved in the collision. (Tab DD-3)

c. Pathology.

Autopsy reports concluded that the cause of death was multiple blunt force trauma injuries. (Tab X) Toxicology of MP1's remains was negative. The MP2 suffered minor bruises and abrasions following a successful ejection. ER evaluation at Good Samaritan Hospital included blood tests, urine samples, drug screen, multiple spinal x-rays, and a head CT, all of which were normal. (Tab X)

d. Lifestyle.

There is no evidence that unusual habits, behavior, or stress on the part of MP 1 or MP2 contributed to the accident. (TAB DD)

e. Crew Rest and Crew Duty Time.

MP1 and MP2 met all requirements for crew rest as outlined in AFI 11-202, Vol. 3, Paragraph 9.7.1. (TAB BB-13)

10. OPERATIONS AND SUPERVISION

a. Operations

The squadron flying schedule on the day of the flight mishap was normal consisting of 8 sorties in the morning and then an additional 8 sorties in the afternoon. (TAB K-4) There were no exercises, unusual missions, or tasking on the day of the mishap. (TAB K-4)

The Board President concluded that squadron operations tempo was not a factor.

b. Supervision

There were minor changes to the flying schedule the day of the mishap and squadron supervision was aware of the changes. (TAB K-4) MP-2 was originally scheduled to fly in the morning and perform Supervisor of Flying (SOF) duties in the afternoon. (TAB K-4) Sometime prior to MP-2's sortie in the morning he was asked to fly an additional sortie in the afternoon. He was notified of the additional sortie upon completion of his morning flight and in testimony he stated that he completed his morning mission with enough time to debrief and make his afternoon sortie brief. (TAB V 8-5) The Squadron Operations Officer performed SOF duties the morning of the mishap day and was aware of the changes; in addition he was a member of the mishap flight flying in the number 3 position. (TAB K-4)

When questioned about any issues MP 1 may have had with performing flight lead duties after not flying an F-16 in 28 days, the Squadron Operations Officer stated that MP 1 was the type of pilot who wanted to lead and would prefer to lead. (TAB V 6-11)

The Board President concluded that supervision was not a factor in this accident.

11. HUMAN FACTORS ANALYSIS

Numerous studies have validated the belief that approximately 80 percent of Class A mishaps involve human factors. In fact, over 90 percent of fatal Class A mishaps are directly related to human factors. Human factors are divided into two categories: environmental and individual. Environmental factors include operational issues, logistic or maintenance factors, matters pertaining to egress and survival, and issues associated with facilities and services essential to mission accomplishment. Individual factors can range from physiological or biodynamic issues to psychological and psychosocial concerns.

The Board considered the Environmental and Individual Human Factors Elements contained in Air Force Pamphlet (AFPAM) 91-211, Attachment 8, Human Factors Terms, and concluded, based on physical evidence and witness testimony that loss of situational awareness was relevant to this investigation.

LOSS OF SITUATIONAL AWARENESS

According to AFTTP 3-3.5, Chapter 2.2.1.1 on Situation Awareness (SA) the cornerstone to formation success is SA. (TAB BB-3) SA is the continuous perception of self and aircraft in relation to the dynamic environment of flight, threats, and mission, and the ability to forecast, then execute tasks based on that perception. It is gained through assimilating information obtained through visual cueing and perceptions. (TAB BB-3)

Analysis of the flight parameters of the ROVE flight reveals that at some point 15 to 20 seconds prior to the collision MP 2's parameters began to deviate from MP 1 and began to match Rove 3 suggesting a loss of situational awareness. (TAB EE-27) MP 2 may have been distracted by a radio call requesting a weapons check at approximately 18 seconds prior to impact. (Tab N-5) Concurrently, MP 2 was 90 degrees into the 180-degree turn and would have viewed the other aircraft from behind, a view presenting the smallest visual silhouette, and this may have contributed to the loss of situational awareness. (Tab EE-35)

Finally, re-creation of the final turn in the F-16 flight simulator suggests that MP 1 may have dropped out of MP 2's field of view (during this same time frame) while Rove 3 remained in his field of view. (TAB EE-37) Based on this visual cue, it is likely, that MP 2 perceived that Rove 3 was MP 1 when MP 2 lost sight of MP 1.

Discussions of pertinent human factors are incorporated in the mishap sequence and maintenance section above. (Tabs X and DD)

12. GOVERNING DIRECTIVES AND PUBLICATIONS

Primary Operations Directives and Publications.

a. Primary Operations Directives and Publications

- 1) AFTTP 3-3 Vol 5, Combat Fundamentals, F-16 (Tab BB-3)
- 2) AFI 11-202 Vol 3, Flying Operations, General Flight Rules (Tab BB-13)
- 3) AFPAM 91-211, USAF Guide Aviation Safety Investigation (TAB BB-17)
- 4) AFI 11-2F-16 Vol 3, F-16 Operations Procedures (TAB BB-19)

b. Maintenance Directives and Publications.

None applicable to this mishap.

c. Known or Suspected Deviations from Directives or Publications.

There were no known or suspected deviations from directives or publications

13. NEWS MEDIA INVOLVEMENT

Media interest was very high at the time of the mishap. The 181st FW Public Affairs office received approximately twenty-five media queries and issued four press releases regarding the mishap. Additionally there were two regional television news broadcasts and four print news stories and 4 Internet news stories about the mishap. No media visits were authorized to the crash site (Tab DD 3-9).