

## AFI 51-503 ACCIDENT INVESTIGATION REPORT

**AUTHORITY:** Under the provisions of Air Force Instruction (AFI) 51-503, the Ninth Air Force Commander, Lieutenant General Hal M. Hornburg appointed Colonel Lee J. Brundage on 27 September 1998 to conduct an aircraft accident investigation on the F-16D (serial number 86-040) accident that occurred on 12 September 1998 near Avon Park, Florida. The accident resulted in the death of the pilot, Captain Thomas M. Carr and the destruction the aircraft. The Accident Investigation Board—consisting of Lt Col John R. Torrent (flight surgeon), Capt Jimmy L. Bardin (legal), Capt Eric P. Soucy (pilot), and SMSgt Robert D. Beckford (maintenance)—conducted the investigation from 08 October 1998 through 23 October 1998 (Tab Y).

**PURPOSE:** An aircraft accident investigation was convened under AFI 51-503. This investigation is separate and apart from the safety investigation conducted under AFI 91-204. The purpose of this investigation is to find and preserve evidence to use for claims, litigation, disciplinary actions, adverse administrative proceedings, and for all other purposes. The report is available for public dissemination under the Freedom of Information Act (5 USC 522) and AFI 37-131.

## SUMMARY OF FACTS

1. History of Flight: On 12 Sep 98 Capt Carr was scheduled to fly a Surface Attack Tactics (SAT) sortie as number 3 in a 4 ship formation. This sortie was a Flight Lead Upgrade (FLUG) ride for the number 1 ship pilot, Capt Lansing, with number 2, Maj (now Lt Col Goodfellow) as the Instructor Pilot (IP). The second half of the ride was planned as a Basic Surface Attack (BSA) for a squadron Turkey Shoot (Bombing Competition) (AA-9). Lt Col Goodfellow is the Assistant Director of Operations for the 93<sup>rd</sup> Fighter Squadron, an IP, and a Standardization and Evaluation Flight Examiner (SEFE). Capt Carr was also an IP. Number 4 was Maj Lint, the Chief of Standardization and Evaluation (Stan Eval), a SEFE and an IP (T-45). Capt Carr arrived at the 93<sup>rd</sup> Fighter Squadron at approximately 0650L (V-2). The flight briefing started at approximately 1225L and lasted until approximately 1315. After a thorough mission brief where Capt Lansing spent the majority of his time briefing his SAT FLUG ride (V-34), Shark 1 flight (call sign for the mission) stepped from their pre-flight brief to fly the mission at 1325L. All members started on time at 1340L and were ready to taxi at 1350L. The flight was then delayed when they taxied to the End of Runway (EOR) due to the preceding Mako flight having a problem with one of their aircraft (V-3, V-34). Shark flight's takeoff time was scheduled for 1410L (T-56, 57, 58) but they didn't actually takeoff until 1429L (V-34). The takeoff was a single ship, afterburner takeoff with 15 seconds spacing between aircraft (V-22). The flight plan was a local profile 11C (AA-11) which includes the TOAD2 departure to the FUSZY intersection, then direct to point H on IR-34, then direct to Restricted Area 2901 (R-2901, Avon Park). The flight descended out of their block, Flight Level (FL) 210-230 (FL 210-230) approximately 10 miles from Rita Island (V-22, V-34). When they received clearance on range for their attack by the Range Control Officer (RCO), the flight descended to 500 feet for their Initial Point (IP) to target run (AB-13, 14). The attack planned and flown was a 10 degree Low

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Applicant  RECEIVED   
Intervenor \_\_\_\_\_ REJECTED \_\_\_\_\_  
Cont'r Off'r \_\_\_\_\_ DATE 2/1/02  
Contractor \_\_\_\_\_ Witness \_\_\_\_\_  
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Angle, High Drag attack for number 1 and a Dive Toss attack for numbers 2, 3 and 4 (AB-13, 14). Spacing between the two elements was briefed to be 2½ - 3 miles spacing with number 3 and 4 offset slightly to the east (V-3, V-22). Shark 1 and 2's attack went as planned with the exception that Shark 2 got closer to the target than planned when he accidentally selected a fusing option that would present a release solution for a high drag bomb instead of a low drag bomb (V-34). Shark 3 (mishap aircraft) and 4 accomplished their attack and during Shark 3's egress, after completing his fragment (frag) avoidance maneuver, at 14:54:01L, Capt Carr's aircraft impacted the ground at N 2733.56 Latitude and W 8113.25 Longitude (B-2). The aircraft was destroyed and the pilot fatally injured. The 482<sup>nd</sup> Fighter Wing office of Public Affairs handled all media inquiries. News media involvement was moderate.

2. Mission: The mission was a pre-planned SAT mission on Echo range on Avon Park range for a First Run Attack (FRA) on target number 40 (Center truck, steerpoint number 4 on the mission card (T-56)), followed by BSA on the right conventional circle on Charlie range, out of the pop-up pattern (AB-11, AB-12) for the Turkey Shoot (V-3, 22, 34). The mission profile included a single ship, afterburner takeoff with 15 seconds spacing between aircraft. The rejoin out of traffic was to a 2 plus 2 offset container, standard formation, with the weapons systems check being accomplished on the rejoin. The flight plan included the TOAD2 departure to Point H on IR-34 in the block FL210-230 (V-22, 34). Let down was planned to the low level structure of the last portion of IR-34 to accomplish a FRA on the Center truck (AB-13, 14). Following the FRA, Shark flight would transition to the pop pattern to accomplish the Turkey Shoot, which consisted of two 10 degree Low Angle, Low Drag, two 10 degree Low Angle, High Drag and two Visual Level Delivery, Low Drag Attacks (AA-9). Upon the completion of these events, the flight would return to Homestead ARS for a 4 ship initial to a full stop landing (V-22, 34).

3. Briefing and Pre-flight: Captain Lansing accomplished all the planning for this mission due to it being his FLUG SAT ride. Prior to the flight briefing, he consulted with Major Hart (Chief of Weapons) (T-45) about the attack profile (V-15, 22). Lt Col Goodfellow, the IP for this sortie, flew another mission in the morning and was therefore not able to review the mission materials prior to the flight briefing (V-34). Capt Carr arrived at the squadron, along with the other pilots, shortly before 07:00L which was the UTA show time (V-2). He attended the squadron meeting which lasted until approximately 07:45L. Capt Carr apparently spent the rest of the morning preparing his academic lecture (to be given the next day) until such time as he accompanied others from his squadron to lunch (V-15). He returned to the squadron and showed up for the flight briefing about 10 minutes early (V-34). The flight briefing started at approximately 1225L and lasted until approximately 1315L. Capt Lansing spent most of his briefing on the SAT attack. All pilots stepped to their aircraft as scheduled and taxied out of the chocks on time. All aircraft appeared to be working normally (V-22, 34, 28).

4. Flight: Shark flight's mission proceeded essentially as outlined in the previous paragraphs. They flew the TOAD2 departure to point H on IR-34 into the FL210-230 block. Before passing Point H, Shark flight received clearance to descend out of their block to 1000 feet and to proceed with their planned attack. Prior to entering R-2901, Shark flight switched to the Charlie Ranger frequency and received final clearance for the FRA (V-22). Although one was required, a G-Awareness exercise was not accomplished (V-22, 34). They obtained their briefed formation

with approximately 3 miles separation between the elements. Shark 1 and 2 completed their respective 10 degree Low Angle, High Drag and Dive Toss attacks as planned (V-22, 34). Shark 2 pressed slightly inside the planned minimum release range due to erroneously setting the Stores Management System (SMS) to a high drag setting, instead of a low drag setting for the simulated weapon (V-34). This increased his actual ground track distance slightly from what was planned. Shark 3 and 4 flew fairly close to the ground track depicted on their attack map (AB-10). According to the flight data recorder from Shark 3, he actioned 20 degrees on his attack instead of the planned 30 degrees. Shark 3's simulated bomb release is estimated to have occurred in the 10,000 to 12,000 foot range (J-8, AB-10). Following the simulated bomb release, Shark 3 accomplished his egress profile according to plan. After the bomb release (approximately 17 degrees nose high, at 1700 feet, with about 440 knots, heading 310), Shark 3 started a left hand turn for his egress with the aircraft apexing at 2300 feet in 135 degrees of left bank, heading 285. Descending through approximately 1900 feet, he rolled out to 65 degrees of left bank with the nose 20 degrees nose low, heading 245. At that point, Shark 3 rolled back into 120 degrees of left bank and let the nose get to 42 degrees nose low with a heading of 195. He then apparently attempted to roll out of this maneuver, but was at approximately 22.7 - 30.7 degrees nose down range at the time of impact and the data recorder stopped recording. Roll attitude was in the 39.6 - 47.6 degrees left wing down range, angle of attack was slightly above 13 degrees, G was slightly above 4 and the aircraft was traveling at approximately 370 knots (J-9). Shark 4 was 1 second from simulated bomb release when Shark 1 called "Knock-it-off" for the mishap. Shark 4's attack up to that point had gone as planned. Following the impact, Shark 1 and 2 circled the site to look for a survivor while Shark 4 climbed up to 11,000 feet to act as a radio relay. After several passes, Shark 1 relayed the crash coordinates and described the crash site to the range tower crew (Charlie Ranger) (N-3, V-22, 34, AB-10). The Homestead Supervisor of Flying (SOF) directed Shark flight to return to base (N-3). Shark flight terminated their rescue efforts and flew back to Homestead ARS for an individual visual straight-in approach, to a full stop landing.

5. Impact: At approximately 1454 EDT on 12 Sep 98, on Avon Park Bombing Range, Fl, , an F-16D, serial number 86-0040 impacted the ground at 2733.56 north latitude, 8113.25 west longitude and was destroyed (A-2). Crash Survival Flight Data Recorder (CSFDR) data indicates the aircraft was in the following conditions at time of impact: 22.7 to 30.7 degree nose low attitude; 39.6 to 47.6 degrees of left bank, 370 KCAS; 4.0 Gs; 13 AOA; engine operating at 83-84% RPM, an approximate heading of 160 degrees (A-2, J-2, 9, O-15) The aircraft impacted in an open, flat, marshy area creating a shallow crater that rapidly filled with water (S-2). Smoke and a fireball, estimated at 500 ft high, were observed at impact but post impact fire was virtually non-existent due primarily to the marshy nature of the impact site (V-3, 6, 9, S-2). The aircraft impacted the ground with such force that structural breakup was complete and parts were scattered on approximately a 160 degree orientation with some engine parts found as far as 3/4 of a mile away from the impact site (J-2, R-2). An ejection was not observed; however, an ejection attempt was made that was interrupted by ground impact (V-6, A-2, J-7).

6. Egress System: Both ejection seats and airframe escape system components were recovered for analysis. The results are as follow (J-6):

- a. Front seat JAU-8 initiators-Normal firing.
- b. Aft seat JAU-8 initiators-One fired from impact force and one not fired.
- c. Aircraft Canopy with all components fired.
- d. M99 initiators-not recovered.
- e. Time delays and M53 initiators-Normal firing.
- f. Inertia reel initiators-Normal firing.
- g. Rocket catapults-Front seat normal firing-Aft seat not fired.
- h. Both seat parachute mortar cartridges were not fired.
- i. Both seat STAPAC vernier rockets were not fired.

The following egress system T.C.T.O. were accomplished:

TCTO 1F-16C-1915  
13A5-56-552  
13A5-56-553  
13A5-56-548

No over-due T.C.T.O. were noted and all scheduled maintenance was current (U-38 through U-42). Analysis of the ejection seat assembly confirmed that the pilot initiated the ejection system before ground impact and the ejection sequence was commencing but was terminated by ground impact. The ejection system was functioning as designed prior to ground impact (J-5).

7. Personal and Survival Equipment: The mishap pilot did not use his survival equipment. Review of AFTO Forms 781A indicated the last survival kit inspection was accomplished on 3 Sept 98. All personal and survival equipment inspections were current (U-30, 31, 32).

8. Rescue/Crash Response: The ground impact was observed by two range controllers in Charlie Range Control Tower on Avon Park Gunnery Range as well as by Sharks 1 and 4 (V-3, 5, 9, 22, 34). Shark 1 made a "knock-it-off" call, instructed Shark 2 to join up to trail, informed Charlie Tower of the crash, and established an orbit over the target area (N-2, 3, V-22, 34). Shark 4 lost sight of lead and Shark 1 and 2 and elected to stay above the scattered clouds while lead and 2 orbited the range (N-2). The range controllers immediately notified Avon Park crash response forces, then called the 93rd Fighter Squadron Supervisor of Flying at Homestead Air Reserve Base (V-5, 9). Lead and 2 continued to orbit over the range at about 2000 ft MSL looking for signs of a parachute but did not observe any. They observed no fire or smoke, had difficulty keeping the impact area insight, and could not see any wreckage since the aircraft had broken up into numerous pieces. They were able to establish a best guess of the coordinates of the impact site, and Shark 1 relayed these coordinates and a description of the crash site to the range controllers (V-34, N-3). At about 1458, Charlie Range Control notified Shark flight that the SOF had instructed them to return to Homestead (N-2). Shark flight joined up as a three ship and returned to home station. The range controllers didn't observe an ejection and didn't believe that one had occurred, but they didn't rule out the possibility that the pilot may somehow have gotten out since, from their vantage point, they were unable to see the aircraft just before impact

(V-5, 9). Due to marshy conditions near the impact site, crash response vehicles were unable to drive to the crash site (V-7). Shortly after receiving the information about the crash, the 482 FW Command Post contacted the 301st Air Rescue Group at Patrick AFB, which was conducting a Unit Training Assembly (UTA) weekend at the time, to seek assistance in responding to the crash. Within one hour of the mishap, the 301st launched Air Force Rescue 230, an HH-60G, with a crew consisting of a pilot, co-pilot, flight engineer, pararescue-jumper, and flight surgeon (V-31). The HH-60G arrived on the scene about 20 minutes later and initiated a search of the mishap area (V-5, 9, 30). Some confusion existed over who was responsible for command and control of the mishap site (V-5, 9, 30). Word had come back from the 482nd Command Post that a Colonel with the 442nd didn't want anyone to enter the crash site area (V-7). This information was passed prior to the HH-60G coming onto the scene (V-5, 9). In addition, the Avon Park Range Control Officer arrived on the scene and stated that no one was to proceed to the crash site (V-5, V-9). A National Guard unit, which was conducting weekend training on Avon Park at the time, was asked by the range controllers to allow one of their tracked vehicles to be used to transport crash response personnel to the crash site (V-11). The Guard unit did agree to the use of their vehicle but were prevented from proceeding to the mishap site by the Range Control Officer (V-11). When the HH-60G did arrive, the aircraft commander was notified by Avon Park range personnel to remain clear of the mishap site (V-5, 9, 30). However, the HH-60G aircraft commander, aware that his rescue responsibilities superseded the need to preserve the mishap site for a future safety investigation, elected to proceed to the mishap site anyway and look for a possible survivor. The crew of the HH-60G surveyed the crash site from low altitude, then landed and dropped off the pararescue personnel and flight surgeon to look for a survivor (V-31). Search of the crash site revealed the mishap pilot had not survived impact (V-5, 9, 30). A second HH-60G from the 301<sup>st</sup> Rescue Squadron arrived a few hours later to help with the search and other support requirements such as transporting the Interim Safety Board from MacDill AFB to the crash site (V-31). Both helicopters finally departed Avon Park Range for Patrick AFB at about 2300 hours (V-31).

9. Maintenance Documentation: A review of all Air Force Technical Order (AFTO) Forms 781, revealed no evidence of maintenance discrepancies contributing to the accident (H-2, U-7 through U-32). A review of the open Time Compliance Technical Orders (TCTO) does not reveal any evidence relating to the accident (H-2). All scheduled inspections were current and in order (Tab U). A review of all unscheduled maintenance performed during the 90 days prior to the accident revealed nothing pertinent to the accident (H-2, Tab U). Examination of the Equipment Review Report does not reveal any overdue maintenance actions. No discrepancies relating to this accident were noted in maintenance procedures or practices performed on this aircraft. Of only historical significance, this aircraft was involved in a mid-air collision in March 1997. The aircraft sustained only minor damage and all appropriate repairs were made to correct the damage. In over one hundred sorties flown since the March 1997 mishap, there have been no significant problems which were attributable to the mid-air collision and all maintenance and repair has been routine in nature. (V-20, Tab U)

10. Maintenance Personnel and Supervision: A review of the training records and currencies for the maintenance personnel involved in preflight, walk around, exceptional release, through-flight, launch, and end-of-runway inspection for the mishap aircraft indicate that all were

properly trained and had the level of experience required to perform their duties (Tab AC). Minor discrepancies in currencies existed for all personnel involved (i.e. Overdue for Recurring Training), but none were considered pertinent to this investigation (Tab AC). Maintenance personnel and supervision do not appear to be factors in this accident.

11. Engine, Fuel, Hydraulic, Liquid Oxygen (LOX), and Oil Inspection Analysis: Although the engine was destroyed, portions of the engine were recovered from the area of impact. There were three recognizable sections recovered from the site: the High-Pressure Compressor section; the High Pressure Turbine Module, and the Augmentor section. The fan blades and vanes exhibited sign of leading edge damage consistent with high rotational speed at the time of impact. Throughout the modules, blades and vanes were broken off at their bases and exhibited leading edge damage, again, consistent with rotation at impact. The liner and variable exhaust nozzle portion of the augmentor module was found closest to the impact site, approximately 100 yards down range. Three nozzle actuators (out of six) were recovered and were still attached. No sign of burn through was evident. (J-2). CSFDR data indicates the engine was operating in the 83-84% power range at impact, which is consistent with the visual signs of high rate of RPM at impact (J-2). Other recorded data reflects the engine was responding properly throughout the recorded period of the flight (J-8). No fuel samples were captured from the engine or mishap aircraft due to breakup of aircraft. Samples were drawn from each of the flight aircraft and the fuel truck used to service the mishap aircraft. Analysis of these samples showed them to have met the criteria for use and they were free from anomalies (J-3). Various components of the hydraulic system were recovered intact and were visually examined without tear down. A review of the Oil Analysis records reveals fluids were within technical data limits. The last oil analysis was accomplished on the 12 Sept 98, at 1335 HRS, and test results are within normal ranges (U-2). Hydraulic fluid samples were taken from home station service equipment but were not tested. Engine operation, serviceability of fuel, lox, and hydraulic fluid, and the oil analysis program do not appear to be factors in this accident.

12. Airframe and Aircraft Systems: The mishap aircraft flew a code 1 sortie in the morning of 12 Sept 98. (V-28). A one-year historical review of CAMS and pulled AFTO forms 781A did not reveal any unusual maintenance action or problem with the aircraft (H-2). CSFDR information confirmed that flight control surfaces were functioning at impact. (J-8, O-2 through O-22, O-33). Flight control analysis revealed the flight control systems were working properly prior to impact and were not causal of the accident (J-8).

13. Operations Personnel and Supervision: Lt Col Rydholm, as Squadron Operations Officer, signed the local Flight Clearance/Flight Order, authorizing the mission (K-2). Capt Lansing gave a thorough briefing to all members of the mishap flight using the briefing guides found in MCI 11-F-16, Volume 3, and in accordance with all applicable publications and current guidance (V-3, 15, 22, 34). Those attending the briefing were Lt Col Goodfellow (Assistant Director of Operations/ SEFE), and Maj Lint (Chief, Stan Eval/IP/SEFE). No other squadron leadership attended the briefing (V-22).

14. Pilot Qualification: Capt Carr was a current and qualified F-16C Instructor Pilot. He fully met requirements to perform the scheduled mission (T-2 through T-45). His flying hours by type are as follows (G-8,9):

F-16C/D	1895.8(774.4 IP, 109.1 EP)
F-16A/B	178.3(20.7 IP)
AT-38A/B	32.2
<u>Student</u>	<u>181.9</u>
Total	2288.3

His recent flying experience as of 12 Sep 98, the mishap date, is as follows: (G-2)

Last 30 days	8 sorties(10.7 hours)
Last 60 days	18 sorties(21.2 hours)
Last 90 days	23 sorties(38.1 hours)

15. Medical: Captain Carr was medically qualified to perform flight duties at the time of the accident (X-9, 10, 11). He had a normal annual short flying class II physical performed on 7 Mar 98 (X-10, 11). Results of the autopsy report and death certificate were discussed with Dr Steve Nelson, Medical Examiner at Lakeland Regional Medical Center. They reveal that Capt Carr died of multiple blunt trauma injuries resulting from the accident. The postmortem toxicology report showed no presence of alcohol, excess carbon monoxide, or drugs (X-2). Capt Carr was beyond the requirements for adequate crew rest on the day of the mishap. He did not have twelve hours crew rest after ending his civilian Flight Engineer duties and he did not have the opportunity for eight hours uninterrupted sleep the night before the mishap (X-12, 13, 14). Post-accident toxicology reports on the air crew of the other aircraft in the four ship, as well as the crew chiefs involved, also indicated no presence of drugs or alcohol (X-3 through X-8).

16. Navigational Aids (NAVAIDS) and Facilities: There were no outstanding notices to airmen (NOTAMS) for Avon Park Range at the time of the accident and none that affected any of the mishap flight's mission (W-16, 17, 18). All relevant NAVAIDS and facilities were functional (K-2).

17. Weather: The forecast weather for Avon Park for the time of the accident was: Few clouds at 3000-5000 feet, scattered clouds from 12000-15000 feet and broken clouds from 25000-28000 feet with 7 miles visibility and a local altimeter of 29.90. The winds at 3000 feet were forecast 040 heading at 20 knots (W-5 through W-8). The actual weather was scattered clouds at 4000 ft with and overcast deck at 20,000 ft and 7 miles visibility (V-3, 34).

18. Governing Directives and Publications:

- a. Air Force Instruction 11-401, Flight Management, 1 Mar 96
- b. Air Force Instruction 11-401, Flight Management, 1 Mar 96, AFRES Supplement, 8 Nov 96
- c. Air Force Instruction 11-214, Flying Operations, 20 May 98
- d. Air Force Instruction 13-212, Volume 1, Space, Missile, Command, and Control - Weapons Ranges, Moody Supplement 2, 31 Jul 97
- e. Air Force Reserve Instruction 11-201, Flight Operations, 20 May 96
- d. Multi-Command Handbook 11 F-16, Vol 3, Pilot Operational Procedures, 21 Apr 95
- f. Multi-Command Handbook 11 F-16, Vol 5, F-16 Combat Aircraft Fundamentals, 10 May 96
- g. HQ 10 AF/CC, Msg, 10 AF Special Interest Item (SII) 98-1, Fighter Resource Management During Mission Planning and Debriefing
- h. Technical Order 1F-16C-1, 27 Feb 95, Flight Manual F-16 C/D, Blocks 25,30, and 32
- i. 93<sup>rd</sup> Fighter Squadron "Mako Pilot Aid"
- j. 93<sup>rd</sup> Fighter Squadron "Mako Standards"
- k. 93<sup>rd</sup> Fighter Squadron "Mako Briefing Guide"

## STATEMENT OF OPINION

Under 10 U.S.C. 2254(d), any opinion of the accident investigators as to the cause or causes of, or the factors contributing to the accident set forth in the accident investigation report may not be considered a evidence in any civil or criminal proceeding arising from an aircraft accident, nor may such information be considered an admission of liability by the United States or by any person referred to in those conclusions or statements.

In my opinion, there is clear and convincing evidence that this mishap is the result of the combined effects of several errors made by the mishap pilot. During a 4-ship dry SAT attack, the mishap pilot, Shark 3, did not maintain proper spacing from and visual contact with Shark 2, who had attacked a target just prior to him. This resulted in Shark 3 coming into close proximity to Shark 2 as they egressed from the target area. Shark 3 then executed an abrupt collision avoidance maneuver at low altitude that placed the mishap aircraft in a position where impact with the ground could not be avoided.

**The Machine:** Aircraft 86-0040, an F-16D that was on loan from the 419 Fighter Wing at Luke AFB, AZ, had previously been loaned to the 482 Fighter Wing when it was involved in a mid-air collision on 18 Mar 97. The aircraft suffered minor damage and was subsequently repaired and returned to service in May of 1997. During a twelve month period prior to again being loaned to the 482 FW, the aircraft was reported as to have been a good flyer with no flight control problems or trends noted. A review of aircraft maintenance records during this period verified this observation. In addition, no problems were encountered during the morning mission on the day of the mishap and none were reported during ground and airborne operations during the mishap flight prior to the mishap sequence. A review of CSFDR data indicates the aircraft was functioning normally throughout the mishap sequence. I do not believe that an aircraft malfunction was a factor in this mishap.

**The Mission:** The mishap mission contained two main elements: a SAT portion, which consisted of a dry high threat attack against an interdiction target, and conventional weapons delivery, which was to be accomplished in conjunction with a squadron turkey shoot. The flight lead was on a 4-ship flight lead upgrade (FLUG) ride, and since a SAT attack was the syllabus requirement for this ride, most of the mission planning efforts and flight briefing time was spent on this attack. The objectives of the high threat SAT attack were to deliver maximum ordnance on a target in minimum time and to minimize exposure to enemy threats. To achieve these objectives, an attack plan was developed that called for 3 mile separation between elements, less than the norm for 4-ship attacks. The attack geometry drawn out by the flight lead showed about 1.5 mile spacing between Sharks 2 and 3 during their attacks, and the potential for conflict between these flight members was addressed during the flight briefing. In addition, Shark 3 was briefed to offset about 2000-3000 feet to the east during the ingress to generate more spacing between Sharks 2 and 3 and to reduce the possibility of conflict. Since radio silent procedures were to be used during this attack and since the air-to-air TACAN plan tied Sharks 1 and 3 together and not Sharks 2 and 3, Shark 3 had to rely primarily on the spacing built into the attack geometry and on maintaining visual contact on the preceding aircraft to insure flight path deconfliction during the attack. Due to the 1.5 mile spacing between Sharks 2 and 3 built into

the attack geometry, any deviation from the tactical plan that would reduce separation between Sharks 2 and 3 would increase the possibility of conflict in the target area. If this occurred, Shark 3's ability to maintain visual contact with Shark 2 would become even more critical to avoid a possible conflict.

**Tactical Execution:** Execution of the attack plan by Sharks 2 and 3 resulted in reduced separation between them to the point that Shark 3, while transitioning from his escape maneuver to maneuvering to regain mutual support with Shark 4 for target egress, came into close proximity to Shark 2. During roll out from his escape maneuver, Shark 3 appeared to have unexpectedly caught sight of Shark 2, recognized the potential for a mid-air collision, then made an abrupt maneuver to avoid him. Several actions led to this reduced separation. First, Shark 2 had inadvertently selected the wrong fusing option for his simulated weapon. Instead of selecting "nose", which would have provided the symbology for a low drag bomb, "nose/tail" was selected, which provided high drag release symbology. During his DTOS delivery, Shark 2 recognized his error just prior to getting a release solution and decided to abort his pass. In fact, he actually did get a release solution at about 5500 ft slant range from the target in a 20 degree climb and at 2200 ft MSL. Since the flight lead had briefed a desired release slant range of 9000 ft and a minimum of 7000 ft, Shark 2 was 3500 ft inside of the desired and 1500 ft inside of the minimum slant range when he achieved a release solution. Meanwhile, Shark 3 appeared to have achieved a release solution at a slant range outside of 9000 ft, most likely between 10,000 and 12,000 ft. This difference in release slant range alone would have reduced the separation between Sharks 2 and 3 during their escape and egress maneuvering by 4500 to 6500 ft. Another factor that most likely reduced spacing between Sharks 2 and 3 was that Shark 3 was probably not offset east of Shark 1 by the 2000-3000 ft that had been briefed. A review of Shark 4's radar tape shows that Shark 4 was actually offset slightly to the west of Shark 2 and not east as would be expected. If the line abreast spacing between Sharks 1 and 2 and between Sharks 3 and 4 can be assumed to have been roughly equivalent, then it's unlikely that Shark 3 was offset east of Shark 1 as much as expected, and possibly not at all. A final factor that reduced spacing was the way Shark 3 executed his "action" for his DTOS attack. Instead of making a 30 degree action turn to the right at 4.5 miles as briefed, Shark 3 made a 20 degree action turn at about 5.2 miles. Shark 3 may have elected to action early with a 20 degree instead of a 30 degree action turn to enable him to have a more direct run at the target so that he could get an earlier DTOS solution and a weapon release at a longer slant range than 9000 ft. The net effect was to cut off another 1000 to 1500 ft of spacing from Shark 2. The combination of these actions - the later than planned DTOS release by Shark 2, the earlier than planned release by Shark 3, the less than briefed offset to the east, and an earlier action point with 10 degrees less action turn - helps account for Sharks 2 and 3 coming into close proximity to each other during their respective recoveries from their DTOS passes. With this reduced separation, the need for Shark 3 to maintain visual contact with Shark 2 to insure conflict avoidance took on added importance. However, there's a strong possibility that Shark 3 did not have visual contact with Shark 2 from the time Shark 2 actioned five miles from the target until just a few seconds prior to ground impact. During ingress to the target area, Shark 1 stated that he was five miles from the target, the distance that Shark 2 would have initiated his action turn. Twenty seconds later, Shark 3 called out radar traffic that he was tracking 30 miles from the target area. Since this call suggests that Shark 3 was still focusing a considerable amount of attention on the radar display in his

cockpit 20 seconds after Shark 2 had initiated his action turn, there's a strong possibility that Shark 3 no longer had Shark 2 in sight since Shark 3's attention was in the cockpit while Shark 2 was now more than 50 degrees to his right when this traffic call was made. Even if he did have Shark 2 in sight at this time, the technique used by Shark 3 to pop up to acquire and roll in on the target would have caused visual contact with Shark 2 to be broken. At about 5.2 miles from the target, Shark 3 turned 20 degrees to the right, abruptly pulled up to 20 degrees nose high, rolled over to 120 degrees of left bank to roll in, apexed at 2000 ft MSL, then rapidly rolled out at 1900 ft MSL. This roll in technique would undoubtedly have caused Shark 3 to lose visual contact with Shark 2. Once on final, attention would now be focused on the target and on the symbology in the HUD. Even if Shark 3 did have Shark 2 in sight once on final, visual contact would have been lost during Shark 3's escape maneuver in which he rolled into a 140 degree banked left turn to get the nose below the horizon from a climbing DTOS delivery that had apexed in a 20 degree nose high attitude.

**Mishap Sequence:** Based upon an analysis of information taken from witness testimonies, cockpit voice, HUD and MFD recorders, CSFDR data, and a recreation of the actual attack geometry, I believe the following mishap sequence occurred: (1) Shark 3 lost sight of Shark 2 prior to or during Shark 2's DTOS attack sequence or during Shark 3's DTOS attack - visual contact was not reestablished until just prior to this mishap. (2) Shark 3 may have had visual contact with Shark 1 either during his attack or during egress maneuvering and may mistakenly have believed this aircraft to be Shark 2, a perception that Shark 4 had. (3) Execution of the SAT attack by Sharks 2 and 3 reduced spacing outlined in the attack geometry from about 1.5 miles to less than 1000 ft. Neither pilot had situational awareness of the position and proximity of the other aircraft. (4) After Shark 3 achieved a release solution on a 310 degree heading in about a 17 degree climb, he initiated a left 140 degree pull down maneuver, apexed at 2250 ft MSL, then initiated a roll out toward a southwesterly heading at about 2000 ft MSL in a 20 degree nose low attitude. (5) A few seconds prior to this time, Shark 2 had apexed at 2700 ft. MSL and had initiated a descent and a turn to the south. (6) Sharks 3 and 4 were descending at about the same rate and were passing through approximately the same altitudes with Shark 2 initially higher, then 100 to 200 ft lower than Shark 3. (7) As Shark 3 started rolling out of his descending left turn toward the desired southwesterly heading, he was in about 65 degrees of left bank when he suddenly noticed Shark 2 out his right front windscreen or over his right canopy rail and within 1000 ft, possibly much closer. (8) Recognizing the possibility of a midair collision, Shark 3 abruptly increased bank and G's to avoid Shark 2. (9) Within 3 seconds, the aircraft ended up in a 120 degree left banked turn and a 40 degree nose low attitude at about 800 ft MSL. (10) Recognizing that ground collision was imminent, Shark 3 started a maximum AOA rolling pull out, then initiated an ejection sequence that was interrupted by ground impact.

**The Man:** Capt Carr, the mishap pilot, was a highly qualified and experienced F-16 pilot who was well respected by his superiors and peers for his flying skills, knowledge, attitude, and judgment. The unit thought highly enough of him to have selected him to attend F-16 Fighter Weapons Instructor Course (FWIC), an opportunity rarely afforded to part-time Reserve pilots. Capt Carr successfully graduated from FWIC in 1997. He was considered meticulous and thoroughly professional in his approach to all flying related duties and was regarded as a superior instructor pilot, especially since his return from FWIC. He was regarded as a pilot who flew in

accordance with regulations and unit guidance and was not known to have violated any flying regulations. However, on the day of the mishap, Capt Carr reported for duty without having received proper crew rest as defined in AFRES Supplement to AFI 11-401. He violated the provision which requires an opportunity for eight hours of uninterrupted rest. Capt Carr signed in at billeting at 2310 on 11 Sep and then signed in at the squadron the following morning at 0650. Realistically he would have had the opportunity for no more than 6 1/2 hours of uninterrupted rest. He also violated the provision that requires 12 hours of crew rest from the time military or civilian duty is completed until a pilot reports for duty on a day that flight-related duties are to be performed. Capt Carr was the flight engineer on a civilian airline flight that landed around 2200 on 11 Sep and he got off duty between 2215 to 2230. Therefore, he reported to the squadron less than 9 hours after completing his airline duties the evening before. Another situation that showed questionable judgment occurred 4 years prior when Capt Carr was assigned to the 926 Fighter Wing, an Air Force Reserve unit that was flying F-16C's at the time. Capt Carr experienced a G loss of consciousness (GLOC) episode during an air combat mission. After regaining consciousness and aircraft control, instead of informing the flight lead of his GLOC episode, terminating the mission, and making an emergency recovery, Capt Carr chose not to report his episode and continued with the mission. He also failed to report this incident after landing as required by regulation; however, he subsequently shared his experience, on a non-attribution basis, with the wing chief of safety so that it could be used for mishap prevention purposes. Capt Carr's most recent flying experience prior to the mishap flight occurred from 30 Aug 98 to 1 Sep 98 during a live weapons delivery deployment to Davis Monthan AFB, AZ. On one mission, he delivered live MK-84 low drags using a dive toss (DTOS) delivery. Due to the real world need to avoid the fragmentation pattern for this weapon, he released his bomb at 11,000 to 12,000 ft slant range. Capt Carr had expressed the opinion that most unit pilots should use longer release slant ranges for DTOS deliveries, and that the technique he used enabled him to achieve longer release slant ranges. The effect that the use of longer release slant ranges might have on other flight members, especially with respect to pattern spacing, was pointed out to Capt Carr during a discussion of DTOS techniques. Based on his recent experience dropping live MK-84 low drags from DTOS patterns and the technique he professed to use to insure longer DTOS release slant ranges, Capt Carr's use of a release slant range well outside the 9000 ft range drawn on the attack chart for the mishap mission would not be unexpected.

**Human Factors:** Human factors were the primary cause of this mishap. Though Capt Carr was an experienced, talented and conscientious pilot, his actions on the mishap flight led to this mishap. Capt Carr most likely did not maintain visual contact with Shark 2 during the attack sequence and therefore did not have situational awareness of Shark 2's relative position during recovery from his DTOS delivery. When he unexpectedly caught sight of Shark 2 during his egress maneuvering, he most likely reacted instinctively by increasing bank and G's to avoid a midair. The surprise of seeing Shark 2 combined with the need to act immediately to avoid a collision left Capt Carr with virtually no time to evaluate his flight parameters before reacting. Since Shark 2 was descending on about the same descent angle as Shark 3 and with altitude only slightly lower, both aircraft were on essentially the same plane, and this may have induced Capt Carr to perceive that he was in more of a level flight attitude than in a 20 degree descent. In addition, by fixating on Shark 2 and maneuvering relative to him, Capt Carr may not have been aware that he was already in 65 degrees of bank and 20 degrees nose low when he increased bank

and G's to avoid him, and he may not have had a good horizon reference. Therefore, it's likely that Capt Carr was spatially misoriented when he initiated his collision avoidance maneuver. Leading up to the final sequence, Capt Carr's task prioritization during the final portion of his ingress and just prior to his action point was also a likely contributing factor. The minimum spacing designed into this attack plan, especially between Sharks 2 and 3, should have dictated that Shark 3 devote much of his attention to maintaining proper spacing and visual contact with Shark 2. However, this was not done. During the final portion of the ingress, Shark 3 was focusing much of his attention on using his radar to acquire and call out traffic to other flight members. His last traffic call occurred about 20 seconds after Shark 2 had reached his action point and less than 5 seconds prior to Shark 3 reaching his own action point. His energies at that time should have been directed toward preparing for his DTOS attack and on maintaining visual contact with Shark 2. Since Shark 3 was doing radar work nearly 20 seconds after Shark 2 had actioned, it's highly likely that visual contact with Shark 2 was lost about that time and was not regained until just prior to the collision avoidance maneuver. Additionally, by focusing on radar search tasks during the last portion of the ingress, the mishap pilot may have allowed himself to drift more aft of Shark 1 than planned thereby reducing his spacing from Shark 2. One factor that can't be discounted is the issue of crew rest. Capt Carr's failure to get the required amount of crew rest the evening before the mishap might have reduced his situational awareness, perception, or overall performance to some degree during the mishap sequence. In addition, the fact that he hadn't flown for 11 days prior to the mishap may also have had some negative impact on his proficiency and performance. The possibility of a G tolerance problem was also evaluated but was ruled out. Though Capt Carr had been involved in a GLOC incident 4 years prior, and though he hadn't flown in the 11 days prior to the mishap and hadn't performed a G warm up exercise prior to his SAT attack, CSFDR data clearly indicates that Capt Carr was controlling the aircraft right up to the time that he initiated ejection. Another human factor evaluated was the possibility of complacency. To the flight leader, the SAT attack was the most important part of the mission since this represented the meat of his flight lead upgrade ride. Shark 3 may not have placed as much importance on this aspect of the mission since he was essentially a training aid for the flight lead upgrade ride. Since a squadron turkey shoot was to be accomplished after the SAT attack, it's entirely possible that the mishap pilot was focused more on the turkey shoot and less on the dry SAT attack during the mishap mission. In summary, this mishap was caused by the mishap pilot executing his SAT attack in a manner that reduced separation between him and the aircraft preceding him, failing to maintain visual contact with this aircraft and situational awareness of its position, and executing a midair collision avoidance maneuver that placed the aircraft in a position where recovery was not possible.

**The Unit:** Based upon formal and informal interviews with unit pilots and other unit members as well as general observations and observations of unit flying activities, the 482 FW is a highly professional organization that possesses a positive attitude toward safety, training, mission accomplishment, and flying in accordance with regulations and standards. Unit pilots are well aware of crew rest requirements, which had been previously emphasized and were obviously readdressed after this mishap. I believe that the mishap pilot's crew rest violation uncovered during this accident investigation was an isolated incident.

  
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