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AIRCRAFT ACCIDENT INVESTIGATION REPORT

F-16CG, SN 89-2036

AVIANO AIR BASE, ITALY

WILLIAM F. RAKE, Lieutenant Colonel, USAF

Accident Investigation Officer

JAMES D. STEVENS, Lieutenant Colonel, USAF

Legal Advisor

RICHARD (NMI) PEEPLES, Senior Master Sergeant, USAF

Technical Advisor

NUCLEAR REGULATORY COMMISSION

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STATEMENT OF AUTHORITY

By letter dated 14 February 1995, the Commander, Headquarters Sixteenth Air Force, appointed Lieutenant Colonel William F. Rake, 52nd Fighter Wing, Operations Group Deputy Commander, Spangdahlem AB, Germany, to conduct an investigation into the crash of an F-16 aircraft. This accident occurred on 26 January 1995, with the flight originating from Aviano Air Base, Italy. Lieutenant Colonel James D. Stevens, 16th Air Force, Office of the Staff Judge Advocate, Aviano Air Base, Italy was detailed by the same letter as the Legal Advisor to assist Lieutenant Colonel Rake throughout the course of the investigation (Tab Y2). Senior Master Sergeant Richard (NMI) Peeples, 31st Fighter Wing, Quality Assurance, Aviano Air Base, Italy, was detailed as the maintenance Technical Advisor by the Commander, Headquarters Sixteenth Air Force letter dated 10 March 1995 (Tab Y3).

STATEMENT OF PURPOSE

This investigation was conducted under the authority of and in accordance with Air Force Instruction 51-503, *Aircraft, Missile, Nuclear, and Space Accident Investigation*. The purpose was to investigate an aircraft accident involving F-16CG, serial number 89-2036, assigned to the 31st Fighter Wing, Aviano Air Base, Italy, and to find and preserve evidence to use in claims, litigation, disciplinary actions, adverse administrative proceedings, and any other purpose that the authorities involved decide is proper. The aircraft crashed into the Adriatic Sea at approximately 0830 hrs, Central European Time, on 26 January 1995. The aircraft was destroyed and the pilot was a fatality. This report is releasable to the public.

SUMMARY OF FACTS

A. HISTORY OF FLIGHT

1. On 28 Jan 95, at 0816 CET, Capt Mark P. McCarthy, the mishap pilot, took off from Aviano Air Base (AB), Italy, as flight lead of a three-ship air combat maneuvering (ACM) mission flown in the SPEEDY area located over the Adriatic Sea. The flight executed a normal departure and entered SPEEDY area for their first air-to-air engagement. During this engagement, Capt McCarthy's aircraft, F-16CG, serial number 89-2036, crashed into the Adriatic Sea at approximately 0830 CET, destroying the aircraft and fatally injuring the pilot. (Tab A1)
2. The crash site was found by his wingmen who conducted a visual search for the mishap pilot following loss of radio contact. They initiated Search and Rescue (SAR) efforts through the ground controlled intercept (GCI) site (Tab N2), located at Aviano AB, IT, which monitored the flight. (Tabs N3, V5 4, and V6.5) and stayed until forced to return to Aviano AB, IT, due to low fuel. Timely notification to Fifth Allied Tactical Air Force (5ATAF) Consolidated Search and Rescue (CSAR) cell in Vicenza, Italy, was made and the cell accomplished overall coordination of the SAR until its termination at 1800 CET, 28 Jan 95. (Tab AA2-AA3)
3. The 31st Fighter Wing (FW), based at Aviano AB, Italy, made initial announcement of the accident and released updates of ongoing SAR efforts to national and international news medias. (Tabs BB70-BB76) The wing declared Capt McCarthy deceased at 1745 hrs, on 29 Jan 95. (Tab AA3)
4. No claims have been received to date and none are anticipated.

B. MISSION

1. During the week of the mishap, some pilots, including the mishap pilot, were required to report to the squadron for early sorties. (Tabs V5.1, V6.1, and V8.2) The mishap sortie was scheduled as a routine, continuation training ACM sortie for mission qualified pilots and there were no last-minute schedule changes to the mission or the pilots. (Tabs V4 1 and V10) The mishap mission was the first of the day for the squadron and the mishap pilot, callsign BANE 01, reported for duty about 0600 CET for a scheduled 0615 CET briefing. (Tab K4, V5.1, and V6.1)
2. The mission was scheduled to use the SPEEDY air-to-air training area located over the Adriatic Sea. SPEEDY was the primary air-to-air training area for the wing and all squadron pilots were familiar with it (Tabs V4, V5, V6, and V8)
3. The scheduled and actual aircraft configuration was typical for an air-to-air mission and included an external centerline fuel tank, empty underwing weapons pylons, a training heat-seeking missile (AIM-9M) on one wingtip and a dummy missile (AMD pod) on the other. (Tabs V5 and V6) The aircraft was authorized to pull +9 'G's in this configuration (Tab BB2), and all squadron pilots, including the mishap pilot, routinely flew air-to-air missions in this configuration. (Tabs V4, V5, V6, and V8)
4. The planned mission consisted of takeoff from Aviano AB, IT, departure to SPEEDY area, ACM training, and return to Aviano AB, IT, for landing. Two types of ACM engagements were briefed. The first were defensive 'perch' engagements where BANE 03 (the 'bandit') started in an offensive position behind BANE 01 and 02. The second were 'TAP the CAP' engagements, where the 'bandit' was to go beyond visual range to attack (TAP) BANE 01 and 02 while they performed combat air patrol (CAP). (Tabs V5.2 and V6.3)

C. BRIEFING AND PREFLIGHT

1. As flight lead, the mishap pilot was responsible for planning, briefing, and overall conduct of the mission Mission planning and setup of the briefing room were completed the evening prior to the mishap, using a squadron-common scenario familiar to all squadron pilots for that type of mission. (Tabs V5.2 and V6.2) He had the opportunity for required crewrest, leaving work at 1700 CET, going to bed at 1030 CET, awakening at 0430 CET. The morning of the mishap, Capt McCarthy arrived in sufficient time and insured all go/no-go items were completed. (Tabs K3, BB3-BB6, and BB8) He also checked all other required items, i.e., weather, Airfield Facilities, and Notices to Airmen (NOTAMs), and there were no significant negative factors to the flight (Tabs W2-W4 and BB10) The flight briefing covered all required items and was accomplished referencing MCM 55-116, *Adversary Coordination* briefing guide and a personal briefing guide. (Tabs V5.2, V6.2, BB12-BB14, and BB45) Planned starting parameters for the 'perch' engagements were: altitude, 17,000 ft and 19,000 ft; formation, 6,000 to 9,000 ft line abreast; airspeed, 425-450 knots calibrated airspeed (kts); and at least one of the pilots had to see the 'bandit.' (Tabs V5.3 and V6.4) The flight planned to use separate very high frequency (VHF) radio channels so BANE 01 and 02 could coordinate their maneuvers without the 'bandit' hearing and yet maintain a common ultra high frequency (UHF) radio channel for safety of flight or communications with controlling agencies. (Tabs V5.4 and V6.2) There were no questions by any flight member after the briefing. (Tabs V5.2 and V6 2) Capt McCarthy mentioned to the pilots of the mishap mission as well as pilots in the previous day's mission, that it had been a "long week" for them, that they were tired, and to use caution. (Tabs V5.1 and V7.1) In addition to his normal flying duties, the mishap pilot was an Assistant Operations Officer and performed operations supervision duties as one of the designated squadron supervisors. The night prior to the accident, he was completing masters degree course-work in preparation for an upcoming TDY. The morning of the accident he stated that he had not rested well, possibly due to disturbances caused by a sick child. (Tab V26.___) All witnesses interviewed stated that Capt McCarthy seemed normal and alert. (Tabs V4.1, V5.1, V6.2, and V10 1)
2. Wear of anti-exposure suits was required by the 31 FW Operations Group Commander effective 19 Jan 95, based on predicted water temperature. (Tab BB15) Due to the water temperature in the Adriatic Sea at that time of year, anti-exposure suits were worn by many squadron pilots, including the mishap pilot, even before they were required. (Tabs V5.2 and V10.2) The flight left the operations building for their assigned aircraft later than planned due to a delay encountered by the mishap pilot while donning his anti-exposure (poopy) suit. (Tab V5.2) The suit normally worn by the mishap pilot was torn and not repairable prior to the sortie. As an interim solution, he used an anti-exposure suit of a similar-sized pilot. (Tabs V5 2 and V18)
3. On the day of the mishap, the aircraft was ready for the pilot. (Tab U33) He seemed to be alert, and behaved normally, performed a pre-flight inspection, and found no discrepancies with the aircraft. (Tab V22 and V24.1) The crew chief helped strap him into the cockpit and connected his 'G' suit hose. (Tab V22) Capt McCarthy then started the engine and accomplished after engine start and before taxi checklists that required checks of all critical aircraft systems. (Tab BB16-BB18) Prior to taxi, all systems on the mishap aircraft were functioning properly except for the stores management system (SMS) and the mishap pilot requested maintenance to respond to fix the problem. Although this would normally be referred to a weapons maintenance specialist, an avionics maintenance specialist happened to be in the area and was first to respond. Upon initial hook-up on the ground communications cord, the pilot told him the problem had gone away and he no longer needed assistance. The specialist remained at the aircraft in case the problem returned and helped the crew chief launch the aircraft. (Tab V19.1) No other problems were reported by the pilot or noticed by the crew chief or specialist and the aircraft taxied on time. (Tabs V5.2, V6.3, V19, and V24.1)

4. The mishap pilot taxied to the end of the runway where normal last-chance inspection of his aircraft was performed by a maintenance crew. No aircraft problems were noted by the crew or reported by the pilot. (Tab V6.3, V10.2, and V15.1)

D. FLIGHT ACTIVITY

1. The mishap pilot, callsign BANE 01, took off on-time and no significant deviations from the planned maneuvers were performed. All pilots in the flight accomplished a required 'G' awareness turn, a fuel check, switched BANE 03 to a separate VHF channel, contacted GCI, callsign 'MAROON,' on the common UHF channel and prepared for their first engagement. (Tabs N2, V5.3, V6.3, and BB39-BB41)
2. BANE 01's accident occurred during the first engagement. BANE 01 and 02 were established at their briefed parameters to start the engagement: altitudes, 19,000 ft and 18,000 ft respectively; airspeed, about 425 kts; formation, approximately 9,000 ft line abreast; on a heading of south with BANE 01 on the right, or west side. BANE 03, the 'bandit,' was directly behind BANE 01 and at BANE 02's right 5 o'clock position. Although he could not see the 'bandit' due to his relative position, BANE 01 called "Ready" because all briefed parameters were met and all flight members acknowledged. (Tabs V5.3 and V6.4) BANE 01 called "fight's on" to start the engagement. Since BANE 02 was the only one able to see the 'bandit,' he called, "Break right," and started a defensive turn to the right (west) into BANE 01. BANE 01 responded to the call and also turned to the right. (Tab V5.3) He called "Blind," meaning he did not see the 'bandit,' followed soon thereafter by a 'Tally" call, meaning he now saw the 'bandit.' (Tab N2) When BANE 01 and 02 initiated their defensive turn, the 'bandit' switched his attack from BANE 01 to BANE 02 and executed an easy left-hand turn to the Southeast to offset both BANE 01 and 02 to the East. (Tab V6.4) When BANE 02 recognized this, he called on the VHF radio that the 'bandit' had "switched" his attack to him. (Tab V5.3) BANE 01 made two separate "press" calls on the UHF radio to acknowledge the fact that he was no longer under attack and that his wingman was engaged defensively. (Tabs N2 and V5.3) During the initial turn, BANE 02 concentrated on the 'bandit' and lost sight of BANE 01 approximately 90° into the turn while passing an approximate heading of west. At that time, BANE 01 was in a slightly descending right hand turn, also passing a heading of approximately west. BANE 02 did not see BANE 01 again. (Tab V5.4) The 'bandit' maintained sight of both aircraft but could not turn inside of BANE 02's turn. After about 180° of turn, on an approximate heading of north, and with BANE 01 now directly in front of him, the 'bandit' attempted to shoot BANE 01 who was about 2 nautical miles north of him. The 'bandit' was not able to get a radar lockon and tried for a visual shot until forced to divert his attention from BANE 01 to engage BANE 02. At this time, the 'bandit' also lost sight of BANE 01 and the mishap aircraft was not seen for the remainder of the flight. (Tabs V6.5) When last observed, the bandit was about 17,000 ft and on a northern heading and BANE 01 was about 20° below the horizon and in a 20° nose-low, easy right-hand turn. (Tab V6.4) BANE 02 and the 'bandit' continued their fight in which BANE 02 made a number of positional and informative calls to BANE 01 on their discrete VHF radio channel. None of those calls were acknowledged by BANE 01. (Tabs N2 and V5.4) BANE 02 did not immediately stop the fight because he had never flown with BANE 01 and assumed the mishap pilot was busy and would answer when able. (Tab V5.4) Finally, after 1 minute and 25 seconds without communication with his leader, BANE 02 called, "Knock it off" to stop the fight. (Tabs N2 and V5.4) BANE 02 and the 'bandit' continued in a right-hand turn while trying to get BANE 01 to answer on VHF or UHF radio channels and visually looking for his

aircraft. BANE 02 was the first to report seeing a "splash" in the sea. Both BANE 02 and the 'bandit' stated that they did not actually see the "splash," but the foam and wake of the crash site. (Tabs V5.5 and V6.5)

E. IMPACT

Impact with the water occurred at approximately 0830 CET, on 26 Jan 95, at coordinates N4444.68 and E1306.40, in 125 feet of water. (Tabs BB19 and J4) The aircraft was destroyed and all wreckage was found within an approximate 100 yd radius of the impact coordinates. (Tab J4) Positive reconstruction of aircraft condition and operation was not possible due to size of recovered aircraft components and incomplete recovery of parts. (Tabs J4 and BB67) Impact was estimated to be in 60° or more of dive, at an airspeed of 500 kts or more, at low angle of attack (AOA), and pulling no more than +2.5 'G.' (Tab J15)

F. EGRESS SYSTEM

Canopy separation from the aircraft is the first event in the ejection sequence. The canopy initiator that starts the canopy separation sequence was designed to function 0.021 seconds after commanding ejection. The canopy was on the aircraft at impact and the canopy initiator was recovered and determined to be unfired. (Tab J16) There were no discrepancies found in the maintenance of the egress system and no attempt to eject was made. (Tab A1)

G. PERSONAL AND SURVIVAL EQUIPMENT

1 The mishap pilot was current in all life support training except for combat survival training and decontamination training. (Tab T2) Combat survival training taught escape and evasion techniques after successful ejection and decontamination training taught chemical warfare defense ensemble donning and doffing and survival techniques in a chemical environment. (Tab V16.1) Lack of training in either course was not a factor in this accident.

2. The mishap pilot possessed all required life support equipment and inspection of that equipment was current (Tabs BB20-23). The anti-exposure suit issued to the mishap pilot was not serviceable on the day of the mishap due to a tear. As an interim measure, another serviceable anti-exposure suit of the same size worn by the mishap pilot was fitted and worn. (Tabs V5 2 and V18.1)

H. RESCUE AND CRASH RECOVERY

1. The crash occurred at approximately 0830 CET and the SAR was initiated by BANE 03 through 'MAROON' GCI, three minutes later. Airborne SAR was initially performed by BANE 02 and 03 who visually searched for the pilot's parachute or raft until forced to return to Aviano AB, IT, due to low fuel. (Tab N2-N6) An Italian helicopter confirmed the fatal crash at 0910 CET. Except for a 1 hour period, from 1900 to 2000 CET, 26 Jan 95, when all aircraft were recalled and surface vessels had not yet arrived, continual SAR efforts were conducted in the area until 1800 CET 28, Jan 95. At that time it was terminated by the on-scene commander, the USS Yorktown. Airborne SAR efforts were suspended twice during the search--once, as previously mentioned, for all aircraft at 1900 CET, 26 Jan 95, due to poor visibility and once for helicopters only at 0845 CET,

27 Jan 95, due to high winds. In each case airborne SAR was resumed when conditions improved. The pilot was declared deceased by the 31 Fighter Wing at 1745 CET, on 29 Jan 95. (Tab AA2-AA3)

2. Overall coordination of SAR efforts was performed by the 5ATAF CSAR cell using, to a large extent, SAR forces already in place for DENY FLIGHT. The first SAR helicopter arrived on-scene at 0930 CET and surface search was started at 2000 CET that night. Total SAR assets included USAF F-16s, A-10s, AWACS, ABCCC, and MH-53 helicopters; USA CH-47 helicopters; USN P-3C and 2 US naval vessels; NATO Airborne Early Warning aircraft; Italian helicopters and 1 naval vessel; and 1 German naval vessel. (Tabs AA2-AA3)
3. Crash recovery was begun at 1000 CET, 31 Jan 95, by USS Edenton. (Tab AA3)

I. MAINTENANCE DOCUMENTATION

1. Status of all Time Compliance Technical Orders (TCTOs). All TCTOs were current. The following non-accident related "Urgent Action," "Outstanding Routine Action," and "Delayed Discrepancies" were in the AFTO Form 781K:
   a. 1F-16-1790 Replacement of Have Quick Radio - held in abeyance.
   b. 1F-16-1711 Replacement Countermeasures Dispenser Set AN/ALE 40 -- held in abeyance.
   c. 1F-16-1912, Modification of Engine Air Inlet -- Awaiting Parts
   d. 1F-16-2000, Inspection of DTA Lines -- Awaiting Maintenance
   e 1F-16-1971, Inspection of JFS Reservoir -- Awaiting Maintenance
2. Status of All Scheduled Aircraft Inspections: The last 200 hour phase inspection number four was satisfactorily completed on 23 May 94, at 1184.6 hours airframe time. The aircraft flew 187.6 hours since the phase inspection and up to the mishap flight and was not over-due on phase inspection. The aircraft was scheduled for the next 200 hour phase during the first week of Feb 95 (Tab U2).
3. Oil Analysis: Three of the mishap aircraft's oil analysis samples were taken the day prior to the mishap and all were satisfactory. Eighteen samples were taken during the month of Jan 95 and all were satisfactory. (TAB U5)
4. Status of Time Change Requirements: All time change items were completed on time with the exception of the Seawars batteries. The batteries' expiration date was Dec 94, but a one year shelf/service life extension was given by Headquarters USAFE. (Tab U18) Failure of these batteries could not have caused this accident.
5. Equipment Review Report: The equipment review report was inspected. No significant dicrepancies or repairs were accomplished in the preceding 90-day period. No depot-level repairs were required during the history of the aircraft. (Tab U19)
6. Unscheduled Maintenance Performed on Aircraft:
   a. There was no major maintenance performed on the aircraft in the last 90 days. There were two open write-ups on the AFTO Form 781As and each had job control numbers (JCNs) assigned.
      (1) Door 2101--piece broken off at forward hinge. No Foreign Object.
      (2) Taxi light cracked at cooling fin.
   b. There were 8 delayed discrepancies in the AFTO Form 781 H and no pilot-reported discrepancies in the last 5 flights. There was only one minor write-up in last 20 flights--"FMT Nets wrong, HQ Radio worked fine otherwise." Corrective action was to load FMT nets.
   c. The main fuel shutoff valve was safety wired open IAW HQ USAFE Message 031747Z, Dec 93. (Tab BB51-55)

7. No maintenance procedures, practices, or performance factor, or other maintenance discrepancies were found that related to this mishap. There were no indicators of chronic maintenance problems. (Tab U13)

J. MAINTENANCE PERSONNEL AND SUPERVISION

Preflight and servicing requirements were properly documented prior to the mishap flight. (Tab 33) The aircraft was preflighted and serviced by qualified personnel on the night of 25 Jan 95, and the morning of 26 Jan 95. Inspection and servicing were accomplished IAW applicable technical orders. Training Records and Special Certification Rosters were reviewed and all personnel who accomplished the BPO/Preflight and launching of the mishap aircraft were interviewed. All personnel were properly trained and possessed the knowledge, experience, and skills required to complete the tasks. (Tabs V13.3, V15.1, and V19.1) There were no maintenance actions performed that were factors to the mishap. (Tab U33)

K. ENGINE, FUEL, HYDRAULIC, AND OIL INSPECTION ANALYSIS

1. Engine: All Engine documents were reviewed. The 100 hour engine borescope inspection was overflown by 87.6 hours. (Tab H3)
2. Fuel: Samples were submitted on 26 Jan 95, to the USAF Aerospace Fuels Laboratory and results of analysis were satisfactory. (Tab U29)
3. Hydraulic: Samples were submitted on 27 Feb 95, to the Aerospace Fuels Laboratory, 32 days after the mishap. Results of analysis were unreliable due to the time delay between the accident and collection of samples. The hydraulics of the mishap aircraft were serviced from a source also used to service a number of other aircraft. Testimony revealed no hydraulic problems on the day of the accident or the days immediately following it. (Tab U26)
4. Oil: Oil samples from the oil cart used to service the mishap aircraft were analyzed on 26 Jan 95, and results were satisfactory. (Tab U25)
5. Oxygen: Oxygen samples were taken from all oxygen tanks at the Cryogenics Laboratory at Aviano AB, Italy and results were satisfactory. The specific oxygen cart used to service the mishap aircraft on 25 Jan 95, was not identified, so no samples were taken. Testimony revealed that at least 14 aircraft were serviced by whatever cart serviced the mishap aircraft. No oxygen problems were experienced in those other aircraft the day of the accident or the days immediately following it. (Tabs U2 and V23.1)

L. AIRFRAME AND AIRCRAFT SYSTEMS

1. Condition of wreckage: The aircraft suffered extensive damage and not all parts were recovered. (Tab BB67) Some of the parts recovered, such as the warning, caution and advisory lights (Tab J5) and the fuel control panel (Tab J13) were not in condition to analyze. Other recovered parts, such as the throttle (Tab J13) and engine exhaust nozzle actuators (Tab BB69) did not produce reliable data. Additionally, the crash survivable memory unit was destroyed, further impeding reconstruction of aircraft flight conditions and operation at impact. (Tab J4) Therefore, exact operation of all aircraft systems at the time of the crash was not possible to determine. (Tab BB30)
2. Analysis of recovered components revealed the following:
   a. Hydraulics: Both hydraulic systems had fluid in the reservoirs and at least one system was pressurized to operate the flight controls. (Tab J16)

b. Electrics: Either the main or standby generator supplied power to the aircraft and flight control system and there was no evidence of flight control system malfunction (Tab J15)
c. Mechanical: The aircraft was structurally intact, with all flight controls surfaces attached when it crashed and there was no evidence of inflight fire. (Tab J15) The canopy, although not proven to be structurally intact at impact, was still attached to the aircraft and the canopy initiator had not been fired. (Tabs J3 and J15-J16) The speed brakes and landing gear were retracted. (Tabs J9 and J15)
d Engine. Actual operation of the engine was undetermined due to conflicting data, such as different exhaust nozzle areas commanded by each of four nozzle actuators and discrepancies between fuel flow and fuel pressure in the main engine control (MEC). (Tab BB30 and BB68-BB69) None the less, the engine appeared to be running, based on the facts that the engine boost pumps had fuel and were operating, one of the two primary generators was running, and the emergency power unit (EPU) and the jet fuel starter (JFS) were not running. (Tabs J11 and J15-16) The EPU is designed to operate automatically with engine failure and the JFS is a critical, pilot-initiated step in re-starting a failed engine inflight. (Tabs BB25 and BB28)

M. OPERATIONS PERSONNEL AND SUPERVISION

1. The mishap sortie was a routine training mission, properly authorized by Capt Sever, 510 FS Squadron Duty Supervisor the day of the accident and 'C' flight commander. (Tab K4) It was fully briefed IAW MCM 55-116 and a personal briefing guide. (Tabs V5.2 and V6.2)
2. An effective system insured the mishap pilot accomplished critical action procedures (CAPs) and Situational Emergency Procedures Training (SEPT) (Tabs BB4-BB6). It also insured he signed off items such as Flight Crew Information File (FCIF through 95-02), publications issue (PUBS through 22 Nov 94), and flight authorizations. (Tabs K4, BB3, and BB7)
3. The squadron provided adequate flying training and currency in the mission and aircraft configuration flown during the mishap mission. (Tabs V4, V5, V6, V8, and V10.2)

N. PILOT QUALIFICATIONS

1. The mishap pilot successfully completed all requisite training and was a current, qualified F-16 Instructor Pilot (IP). He had completed centrifuge training on 28 Nov 90, Lead-In Fighter Training (LIFT) on 30 Nov 90, earned Distinguished Graduate honors from the F-16 Basic Operational Training Course on 10 Jul 91, and attended altitude chamber (TARF) training on 13 Sep 94 (Tabs T3, T5, and T6) He completed F-16 IP training and was properly certified on 20 May 93. (Tab T7) He was an experienced pilot with 2763.8 hrs total flying time; 1075.6 hrs flying the F-16, and 467.6 hrs as an F-16 IP. (Tab G-2) He had current Mission Ready (MR) and Instrument Qualification (Instmt/Qual) checkrides and flew 10/22/39 sorties and 13.0/34.2/51.8 hours in the last 30/60/90 days respectively. (Tabs T8-T16) Directives required only 7 sorties in a 30-day period and 19 in a 90-day period for currency. (Tab BB37)
2. The mishap pilot was trained and current in the mission flown. Although he required a waiver for unaccomplished training events during the last half of training that ended 31 Dec 94, he was not deficient in any air-to-air training. (Tab T17) During that half year, he led the squadron in total number of ACM and BFM sorties, and was one of the squadron leaders in Air Combat (ACBT) sorties and total sorties flown. (Tabs 20-23) During the month of Jan 95, he flew a total of 10 sorties of which 6 were air-to-air sorties and one of an ACM sortie flown the day prior to the accident. (Tabs T14-15, and V9)

3. He was regarded as one of the best pilots and IPs in the squadron. He demonstrated remarkable ability in the air-to-air mission and adhered to the Rules of Engagement (ROE) (Tabs V4.1, V5.1, V6.1, and V8.1)

O. MEDICAL

The mishap pilot was medically qualified for flight and possessed a current and valid flight physical that was accomplished at Aviano AB, IT, which included a 'G' induced loss of consciousness evaluation. (Tabs T24 and V3) He had no significant abnormal medical history events. (Tab V3) No postmortum was performed.

P. NAVAIDS, FACILITIES, and NOTAMs

There were no navigational aids (NAVAIDs), airfield facility problems, or Notice to Airmen (NOTAMs) that had an effect on this accident. (Tab BB8)

Q. WEATHER

Weather was forecast for VFR conditions and actual weather was VFR with unlimited visibility, discernible horizon, calm sea, and a nigh cirrus cloud layer estimated at 25,000 ft. (Tabs W2-5, V5.3, and V6.3)

R. GOVERNING DIRECTIVES AND PUBLICATIONS

1. AFI 11-215, Flight Manual Program (Supersedes AFR 60-9)
2. AFI 11-406, Aircrew Standardization Evaluation Program (Supersedes MCR 60-2, Vol I)
3. AFM 51-12, Vol I & II, Weather for Aircrews
4. AFM 51-37, Instrument Flying (Reprint includes Changes 1-4)
5. AFR 55-79, Aircrew/Weapons Controller Procedures for Air Operations
6. AFR 60-1, Flight Management
7. AFR 60-11, Aircraft Operations & Movement on Ground/Water
8. AFR 60-16, General Flight Rules
9. USAFER 51-17, Centrifuge Training for Fighter Aircrews
10. MCR 51-50, Vol 8, F-16 Tactical Pilot Training
11. USAFER 51-50, Vol 30, Tactical Pilot Training F-16
12. USAFER 55-116, F-16 Aircrew Operational Procedures
13. USAFER 60-2, Vol 1, Stan/Eval Program Organization/Administration
14. USAFER 60-2, Vol III, Aircrew Stan/Eval Program
15. USAFER 60-4, Supervisor of Flying Program
16. AABR 55-1, Air Traffic Control and Airfield Procedures
17. AABR 55-3, Aircrew Operational Procedures
18. 1F-16CG-1, F-16 Dash One
19. 1F-16CG-1-1, Supplemental Flight Manual
20. 1F-16-CG-1-2, Supplemental Flight Manual
21. 1F-16CG-2-12JG-001, Block 40-41 Servicing
22. 1F-16CG-6WC-1-11, Combined Preflight, Postflight, EOR, Thruflight, Launch and Recovery, Quick Turn, Basic Post Flight, and Walkaround Before First Flight of Day inspection
23. 1F-16CG-34-1-1, Avionics and Non-nuclear Weapons Delivery Man
24. 1F-16CG-34-1-1CL-1, Avionics and Non-nuclear Weapons Delivery Flight Crew Procedures Checklist

25. 31 FW Pilot Aid Vol I & II
26. 401 FW Pasta Tips, Local Pilot Aid - (OG Ref only)

WILLIAM F. RAKE, Lt Col, USAF
Accident Investigating Officer

STATEMENT OF OPINION

1 Under 10 U.S.C. 2254(d), any opinion of the accident investigator's 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 as 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.

2. There was no evidence of negligence on the part of any person involved with the mishap aircraft. Investigation of aircraft maintenance, pilot qualifications, and supervision indicates compliance with all Air Force directives.

3. A number of possible causes were considered and dismissed before developing an opinion. In each case, inconsistencies with known events or analytical data resulted in dismissal of the following factors as a probable cause for this mishap.

a. Flight-critical aircraft system failure(s): System analysis did not suggest total failure of a flight critical system as a cause. Due to designed redundancies in critical aircraft systems, total failure of a major system such as the hydraulic system, the electrical system, or the flight control computer system would be required to cause the loss of the aircraft. While total failures are extremely rare, in most cases failures would be gradual enough for a radio transmission or an attempted ejection. Neither action occurred.

b. Oxygen and hydraulic systems: No abnormalities in the oxygen or hydraulic systems of the F-16 fleet were evident. Therefore, despite the lack of reliable analytic data on oxygen and hydraulic samples, failure in one of these systems was remote.

c. Engine: Failure of the engine, by itself, would not cause an immediate crash. Although unable to determine exact operating parameters of the engine, supporting information showed the engine was operating in a normal range. First, the engine had fuel and fuel pressure. Second, the primary or backup generator was running which indicates the engine was operating at or above 60% RPM. Third, engine operation is further supported by the facts that neither the emergency power unit, (designed to operate automatically with this type of failure), or the jet fuel starter, (a critical pilot initiated step in re-starting an engine inflight), were running.

d. Channelized attention, distraction, and inattention: It is also unlikely that channelized attention, distraction, or inattention caused the accident. Fighter pilots routinely flying in flights of aircraft require skill in radio challenge and response. Radio calls by his wingman would normally bring either a response by the mishap pilot or trigger him to reprioritize his attention if it were focused elsewhere. It is also common practice to set the aircraft altitude warning system to alert the pilot of a selected minimum altitude. Given Capt McCarthy's experience, it is assumed he would have set this system warning at or above the area's minimum altitude (6000 ft). If this was the case, the warning should have given sufficient time for aircraft recovery. The aircraft was recoverable down to about 3000 ft. Therefore, channelized attention, distraction, and inatttention were not considered probable.

e. Disorientation: This possibility was also considered and rejected as a likely cause. The pilot was familiar with the area and the actual weather was as anticipated with a discernible horizon, land in sight, good visibility, dark blue water below, and bright clouds above. Although calm seas do not offer depth perception as good as other surfaces, there were sufficient references to keep the mishap pilot properly oriented.

f. 'G' suit malfunction: Although malfunction of the pilot's 'G' suit or associated aircraft systems cannot be ruled out, any malfunction in this system should have been detected in the 'G' awareness turn performed prior to the engagement.

4 It is my opinion, based on clear and convincing evidence, that the aircraft accident which occurred on 26 January 1995, was caused by pilot incapacitation. This opinion is based on the facts that Capt McCarthy crashed without a radio transmission and without an attempt to recover from the dive or eject. .This incapacitation occurred for unknown reasons, but because the mishap pilot had no medical history of abnormal physical conditions, it is likely due to incapacitation caused by 'G' induced loss of consciousness (GLOC). This hypothesis is developed on a number of significant contributing facts:

a. Last observed position versus crash site: Capt McCarthy was last observed in an extension maneuver which was consistent with the afterburner extension and high "G' pitch back maneuver he briefed. He was north of the fight on a northern heading, but crashed south of that position on an approximate heading of south. This indicates he accomplished approximately 180 degrees of turn and incapacitation probably occurred as he approached a southern heading.

b Simulation: Using briefed starting parameters, observed maneuvers, and widely practiced F-16 pilot techniques, a number of profiles were tested in the flight simulator. In each case, the flight controls were released while approaching a southern heading, as if the pilot were incapacitated. One of these profiles consistently replicated the estimated aircraft trajectory, airspeed, and relative crash location.

c. Aircraft capability: The extension maneuver he was observed performing was briefed to be in afterburner. The airspeed he could have reached in this maneuver, in that aircraft configuration and altitude could result in a maximum 'G' of +9 33, a sustained 'G' of +6.0, and a high 'G' onset rate capability. These could, if commanded by the pilot either individually or in combination with each other, cause him to experience GLOC as he turned back to the fight.

d. Characteristics of GLOC: GLOC is primarily a function of rapid 'G' onset. However, total 'G', length of time subjected to high 'G's, effectiveness of the pilot's anti-'G' straining maneuver and the pilot's physical condition are also factors in susceptibility to GLOC. Testimony indicated that Capt McCarthy was not well rested. Fatigue could have made the mishap pilot more susceptible to GLOC. The characteristics of GLOC include sudden total incapacitation of periods of time sufficient to cause this accident and would account for the lack of response to radio calls or attempts to recover from the dive or eject.

WILLIAM F. RAKE, Lt Col, USAF
Accident Investigating Officer

CERTIFICATION

As the Investigating Officer appointed to conduct this aircraft accident investigation I certify that I have conducted a complete investigation into the facts of this accident under AFI 51-503.

1. The following originals were not included in the accident investigation report:
   a. AF Form 711b
   b. Materiel Deficiency Report
   c. 510 FS Letter of Xs 01 Jan 95--on file with 31FW
   d. Operational Training Course Certificate. 16 Jul 95
   e 'Buzzard' Training Squares sheets. Nov 94-Jan 95
   f. Chronology of Events for Search for BANE 01--on file with HQ 5ATAF
   g. Personal briefing guide of Capt McCarthy
   h. Aviano Base Operations events log. 26 Jan 95--on file with 31FW Base Operations
   i Letter appointing Safety Investigation Board--on file with HQ USAFE/SE
   j Letter appointing Accident Investigation Board. 14 Feb 95--on file with 16 AF/CCE
   k Letter extending Accident Investigation Board. 5 Apr 95--on file with 16 AF/CCE
   l 31 FW/PA News releases--on file with 31 FW/PA

2. All maintenance documents of aircraft F-16CG. serial number 89-2036. not included in the original copy of this report. all photos provided to the Investigating Officer. and all other photocopied original documents can be located at the Office of the Staff Judge Advocate. 16th Air Force. Aviano Air Base. Italy

WILLIAM F RAKE. Lt Col. USAF
Investigating Officer

I have reviewed the above referenced originals and certify that the copies contained herein are true and correct copies of the originals.

JAMES D. STEVENS. Lt Col. USAF
Legal Advisor

LEGAL SUFFICIENCY REVIEW

I have observed and reviewed all aspects of this investigation and find it was conducted in a legally sufficient manner in accordance with AFI 51-503 and other applicable directives. Any information from the documents included in this report which would not be appropriate for release under the provisions of the Privacy Act has been deleted.

JAMES D. STEVENS Lt Col, USAF
Legal Advisor

GLOSSARY OF TERMS

5 ATAF—Fifth Allied Tactical Air Force
ABCCC—Airborne command and control. C-130 aircraft specially equipped for mission
ACBT—Air Combat Training: a general term that includes (D)BFM. (D)ACM. (D)ACT (D) denotes use of dissimilar type aircraft.
ACT—Air Combat Tactics: training in the application of BFM. ACM. and intercept skills to achieve a tactical air-to-air objective.
ACM—Air combat maneuvers: training designed to achieve proficiency in element formation maneuvering and the coordinated application of BFM to achieve a simulated kill or effectively defend against one or more aircraft from a preplanned starting position.
ADG—Accessory drive group. A shaft-driven group of equipment consisting of: the main fuel pump the engine fuel boost pump the A/B fuel pump, the engine alternator. the engine hydraulic pump the MEC. and the PTO shaft.
Aircraft Launch—The process of preparing, assisting and initiating the departure of an aircraft for its mission
Afterburner—F-16's highest throttle setting and produces maximum thrust
AIM-9—Standard USAF heat-seeking missile generally carried on wingtips of F-16
AMD pod—Dummy AIM-9 missile carried on opposite wingtip for weight/drag symmetry
AWACS—Airborne warning and control system.
BFM—Basic fighter maneuvers: Training designed to apply aircraft handling skills to gain proficiency in recognizing and solving range. closure. aspect. angle off. and turning room problems in relation to another aircraft to either attain a position from which weapons may be launched. or defeat weapons employed by an adversary.
BPO—Basic Postflight Operation. Aircraft inspection performed at the end of the flying day
'Blind'—Terminology used to state that the friendly aircraft is not in sight.
'Break' turn—Hard as possible turn to defeat adversary and possible weapons he has employed
CAPs—Critical Action Procedures. A list of pilot reactions to certain critical aircraft emergencies that must be accomplished from memory
Centerline tank—External fuel tank located below belly of aircraft
Code 1—An aircraft has no known discrepancies
Code 2—An aircraft has one or more minor discrepancies
Code 3—An aircraft has at least one major discrepancy that requires correction before aircraft can fly again
Combat Edge—A positive-pressure breathing system that provides additional protection against high positive 'G' accelerations experienced during flight. The system consists of pilot equipment (high-pressure mask, counter-pressure suit. and 'G' suit) and aircraft equipment (oxygen regulator, 'G' valve. and interfacing sense line). The system was not completely fielded at Aviano AB. IT., at the time of the accident.
Continuation Training—Training to maintain proficiency and improve pilot capabilities to perform unit missions.
CSAR—Combined search and recovery. Division of 5 ATAF
CSMU—Crash Survivable Memory Unit. 'Black box' in aircraft that records aircraft engine. flight control and flight condition data
DTA—Detonation Transfer Assembly - Sends a charge from one area to the other (like a fuse)
ECIU—Expandable Central interface unit
Engaged—Offensive or defensive maneuvering flown in relation to an adversary
Engine Borescope—An internal engine inspection using a fiber optic insertion tool (periscope) to detect internal parts defects.
EPU—Emergency power unit. Activated automatically for main or standby generator failure. dual hydraulic system failure. PTO shaft failure (a shaft that drives the ADG) or ADG failure. and engine flameout or if the

engine is shut down inflight. Can also be started manually by the pilot depending on aircraft system failure. Powers emergency electrical system and one hydraulic system
Expediter--Flightline Coordinator for all unit aircraft maintenance
Extend--To execute an extension
Extension--Low 'G', generally nose low maneuver in afterburner used to rapidly increase airspeed
'Fights on'--Terminology used to commence an air-to-air engagement
FCIF--Flight crew information file. An information file for information so critical, it must be acknowledged (signed off) prior to flying.
Flight level (FL)--Altitude expressed in thousands of feet (FL 060 = 6,000' FL 300 = 30,000' etc.)
Flight plan--A form used to notify air traffic control of intended takeoff time, route, number aircraft etc
FMT nets--Frequency Management Tables. Data loaded into HQ radios.
GLOC-- 'G' induced loss of consciousness
GCI--Ground controlled intercept. Radar site used to vector/monitor military aircraft
'G'-The force of gravity (6 'G' = 6 times the normal force of gravity)
'G' awareness turn--Required maneuver to determine if equipment is functioning and to prepare pilot's body for anticipated high 'G' turns
'G' onset--The rate at which 'Gs' are applied
'G' suit--Chaps-type garment which inflates to help pilot withstand high 'G' forces
Harness--Heavy web vest used to attach pilot to ejection seat and parachute
HAHRDB--High altitude, high release dive bomb. Bombing event using 30° or more of dive and release to recover above 10,000 ft
Have Quick (HQ) radio--Radio transmitter receiver that is resistant to communications jamming techniques
IAW-- In accordance with
JFS--Jet Fuel Starter - Small gas turbine engine used to start or re-start an aircraft engine
JOAP--Joint Oil Analysis Program Department of Defense oil analysis program used to identify possible engine problems.
'Knock it off'--Terminology used to cease an air-to-air engagement
LFE--Large Force Employment. Employing 8 or more aircraft to achieve single objective
Line abreast-Flying with another aircraft but laterally offset
LOX converter--Liquid oxygen converter. Steel containers used to store liquid oxygen and service aircraft with oxygen.
LPU-Life preserver unit. Automatic inflating floatation device: fits around neck like a horse collar
MAROON--Call sign of radar site monitoring Bane flight
MAU-12--Under-wing pylons for carrying weapons
MFD--Multi Function Display
Mission Ready--Ready to perform the unit's primary mission and may be called upon to participate in combat without further training.
Mission Qualification Training--Training required to achieve a basic level of competence in the unit's primary tasked missions. This training is a prerequisite for mission ready status.
MEC--Mechanical Engine Control
MOC--Maintenance Operations Center
MQT--Mission qualification training. In-unit training to gain combat-ready status
'No Joy'--Terminology used to state that the enemy aircraft is not in sight.
NOTAMs--Notice to airmen. Lists limits (if any) to operations at various airfield
OTI--One Time Inspection. An inspection used to identify possible defects
PAA--Primary Assigned Aircraft. Aircraft authorized for performance of the operational mission
PFLD--Pilot Fault List Display
Poopy suit--Slang for an 'anti-exposure' suit. Suit helps withstand cold water temperatures
Power on--Applying aircraft power to check lox, gas and other indications
Preflight--An inspection completed before the first aircraft flight
Proficiency--Demonstrated ability to successfully accomplish tasked event safety and effectively.

PTO--Power Takeoff shaft. Shaft from engine that powers the ADG
Qualified--Pilot has demonstrated capability according to established criteria.
Quickcheck--Last chance inspection by maintenance personnel at end of runway
ROE--Rules of Engagement. Rules established to provide a certain margin of safety
Red Ball--Request for rapid maintenance response
RWR--Radar warning receiver. Aircraft equipment to alert the pilot of radar lockon
SAR--Search and recovery
Scissors--Air-to-air maneuvering where each fighter attempts to pull behind the other, generally at slow speed and produces opposing S'-turn ground tracks.
Seawars--System to release the pilot from his parachute upon contact with sea water
SII--Special interest item. Higher headquarters determined mandatory briefing items
SEPT--Situational emergency procedures training--discussion and review of abnormal/emergency procedures and aircraft systems operations/limitations based on realistic scenarios
SMS--Stores management system. System which tells other aircraft computers where and what type external stores are loaded
Sortie--An aircraft scheduled flight
Special Certification Rosters--Used to document selected task qualifications of a critical nature and production inspection authorization
Speedbrakes--Extendible devices used to slow the aircraft down
SPEEDY area--Primary 31FW air-to-air training area: over the Adriatic sea
Squadron Supervisor--Squadron commander, Operations/Assistant Operations Officer, Flight commanders
Step--Leaving the operations building to go to an assigned jet
Stick Transducer assembly--Interface between the pilot's stick grip and the flight control system
Sustained 'G'--The constant 'G' force that the aircraft is able to maintain over a period of time
'Tally'-- Terminology used to state that the enemy aircraft is in sight.
Targeting Pods--Target acquisition laser designator range finder
TCTO--Time Compliance Technical Orders - Instructions for modifications on aircraft and other relative equipment
'Visual'--Terminology used to state that the friendly aircraft is in sight.
WAPS--Weighted Airman Promotion System