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INTRODUCTION

On 5 December 1998, an F-16C, Serial Number 86-0316, assigned to the 401st Tactical Fighter Wing, Torrejon Air Base, Spain, crashed and was destroyed near the city of Chiloeches, Spain, approximately 15 nautical miles northeast of Torrejon Air Base. The aircraft was conducting a routine night air to air refueling mission in concert with three other F-16C aircraft from the 401st TFW. Approximately one minute after separating from the lead aircraft, during approach to an ILS final, the aircraft impacted the ground. The pilot was a fatality.

CLEAR REGULATORY COMMISSION

Docket No. _____ Official Exh. No. 10A
 in the matter of PFS
 Staff _____ IDENTIFIED
 Applicant RECEIVED
 Intervenor _____ REJECTED _____
 Other _____ WITHDRAWN _____
 DATE 7/1/02 Witness _____
 Clerk _____

PFS Exh. 104

56711

REPORT OF INVESTIGATING OFFICER

I. AUTHORITY AND PURPOSE.

A. Pursuant to Sixteenth Air Force Letter of Appointment, dated 9 December 1988 (Tab-Y), Colonel Ardie K. Smith, Headquarters United States Air Forces Europe, was appointed to conduct an investigation into the circumstances surrounding an aircraft accident occurring near Chiloeches, Spain, on 5 December 1988. The accident involved an F-16C aircraft, serial number 86-0316, assigned to the 401st Tactical Fighter Wing, Torrejon Air Base, Spain. Pursuant to a Sixteenth Air Force Letter of Appointment, dated 9 December 1988, Captain Paul W. Knoth, Office of the Staff Judge Advocate, 377th Combat Support Wing, Ramstein Air Base, Germany, was detailed as legal advisor for the investigation, excused for emergency leave, and replaced by Major Barry K. Simmons, 16th AF, Office of the Staff Judge Advocate.

B. Colonel Smith conducted the investigation in accordance with AFR 110-14, and was guided by the provisions of AFR 120-4. The objective of the investigation was to obtain and preserve all available relevant facts and evidence pertaining to the accident, and to investigate the circumstances leading to the accident and subsequent damage for use in claims, litigation, disciplinary actions, adverse administrative proceedings, or any other purpose deemed appropriate by competent authority.

II. SUMMARY OF FACTS.

A. History of Flight.

1. On Monday, 5 December 1988, four F-16C aircraft assigned to the 612th Tactical Fighter Squadron (TFS), 401st Tactical Fighter Wing (TFW), Torrejon Air Base, Spain, were scheduled to fly a local night air to air refueling training mission. The flight call sign was "Falcon" with pilots scheduled as follows: Falcon One - Captain Jeffrey B. Rochelle, 612 TFS; Falcon Two - Major General Winfield Scott Harpe, 16th Air Force Commander (mishap pilot); Falcon Three - Lt Col Harold Daniel Myers, II, 612 TFS; Falcon Four - Captain Marion Steele Mehl, 612 TFS. Total Instrument Flight Rules (IFR) filed flight time was one hour ten minutes (Tabs K-1-3).

2. The flight was scheduled to depart at 1730 Central European Standard Time on the Hostoles Departure to work in LFD 21 under control of Pegaso Ground Control Intercept (GCI), for a rendezvous and air to air refueling with a KC-10 aircraft. The return was by reverse routing to Torrejon Air Base, Spain. (NOTE: All times in this report will be Central European Standard).

3. The flight members started engines at approximately 1700. After a short delay in starting for Falcon Two (Tabs V-2-4), the flight taxied on time. At the end of runway (EOR), Falcon Two identified a problem with the Inertial Navigation System (INS) alignment. After an approximate seven minute delay to realign the system, the flight departed Torrejon Air Base at 1740:47 in a single ship 20 second radar trail departure (Tab 0-67).

4. After rejoining to route formation, the flight flew the planned route to a handoff to Pegaso and a tanker rendezvous at approximately 1807.

5. Refueling complete, the flight returned in formation to the Torrejon Air Base local area. After an element split, the briefed plan for approaches was for Falcon Two to recover single ship, first, for multiple instrument approaches. Falcons One, Three and Four intended to full stop from their first single ship approach.

6. Shortly after separating from Falcon One, at approximately 1851:40, Falcon Two impacted the ground at 2988 feet elevation/approximately 15 nautical miles (NM) northeast of Torrejon Air Base; 4 NM south of Guadalajara; and 1 1/2 NM east, northeast of Chiloeches (Tabs R-7-11).

7. The accident received extensive coverage in Spanish newspapers and television as well as the United States newspapers and television (Tab 0-80-109). Inquiries may be addressed to Headquarters Sixteenth Air Force, Torrejon Air Base, Spain, APO New York 09283-5000.

B. Mission.

The mission of the mishap aircraft was to conduct a required night tactical training sortie by launching as part of a four-aircraft formation, conducting air to air refueling in LED 21, then concluding the mission with single-ship practice instrument approaches and full stop landing at Torrejon Air Base, Spain. (Tab V-1).

C. Briefing and Preflight.

1. The General returned from leave in the United States on 30 Nov 88, around 1100. He cancelled a scheduled flight for 1 Dec 88 due to weariness resulting from circadian rhythm changes. Testimony indicated that during the next several days he began to adjust back to the time change, he received balanced and normal amounts of food, rest and exercise (Tabs V-51-52). All pilots in the flight and other personnel making contact with him on 5 Dec 88 stated that he appeared rested, alert, and cheerful; and that he made no comments about nor did he visibly display any indication of physical or psychological stress (Tabs V-7,21,29,45,46).

2. On 5 Dec 88, Major General Harpe arrived at the 612 TFS around 1440-1450. He was required to attend a Situational Emergency Procedure (SEPT) training session and complete a Critical Action Procedures (CAP) test prior to flight. The SEPT was administered in the Emergency Cockpit Procedure Trainer (ECPT) by Capt Taylor Gates (Tabs V-45,46). Capt Gates also administered the CAP test. Capt Gates testified that the General was alert and knowledgeable during the SEPT, and made one minor error on the CAP test which the General noticed immediately and corrected himself. The SEPT covered all CAP and problems associated with night flying and losses of electrical power (Tab V-46).

3. The mission briefing started at 1515. It was conducted by Capt Rochelle, Falcon One, and was given in two phases - - night phase to all flyers that night; and then, the four-ship flight briefing was conducted separately by flights. The testimony indicates the night-phase briefing was comprehensive, covering normal night procedures for cockpit lighting, external lighting, and night-time emergency procedures (Tabs V-1,2,16,21,22).

4. The flight mission briefing was also given by Capt Rochelle, an F-16C instructor pilot. It was conducted in accordance with the briefing guides contained in USAFE Manual 55-116, F-16 Pilot Operational Procedures (Tabs O-68-73, V-1,2,16,21,22). Capt Rochelle specifically addressed some aspects of night flying already covered in the night-phase briefing, emphasizing formation lighting procedures, night tanker procedures and night cockpit lighting. The recovery was briefed as an element descent from the Initial Approach Fix (IAF) with a split into single ship upon contact with Ground Controlled Approach (GCA). An option was an en route descent with an element split by ground radar followed by the single aircraft split (Tab V-3,4). The briefing concluded approximately 20 minutes prior to briefed time to leave for the aircraft. Testimony indicated sufficient time from briefing conclusion to preflight to take care of gathering equipment, maps, et cetera, (Tab V-2).

5. All flight members had signed the Aircraft Commander Signature Block on the USAFE Form 406, and the flight was properly authorized by Major Donald E. Jones, 612 TFS Operations Officer (Tab K-2).

6. The mishap aircraft crew chief, SSgt Juarbe, testified that Major General Harpe arrived at the aircraft at about the normal pilot arrival time prior to engine start. SSgt Juarbe stated that the General did a normal exterior preflight using a checklist. Strap in was normal. The engine start was approximately on time but may have been delayed a small amount of time. The General indicated to the crew chief that he was having trouble getting the aircraft map light out of its retainer. The General told the flight lead on the Very High Frequency (VHF) radio that he would be delayed two minutes. The crew chief said that before he could assist the General with the map light, the General indicated the problem was taken care of. The flight lead

observed Falcon Two running, shortly after he himself had started (Tab V-2). After engine start, SSgt Juarbe noticed that a check of No Go Engine Monitoring System Fault Latch (bit balls) took longer to change to normal indications. He mentioned this to the pilot. SSgt Juarbe stated the General's response was inaudible, and then the indicators changed to normal. The remainder of the checks were normal up to taxi, which took place on time as a flight (Tabs V-53,56,59,60).

7. At EOR, the alignment problem on Falcon Two's INS was corrected by taking a Status 30 alignment using the coordinates at EOR. Falcon One verified the proper coordinates were inputted, verified proper heading of Falcon Two, and then requested takeoff clearance (Tabs V-2,16,22,23).

D. Flight Activity.

1. A canned flight plan was filed calling for a MOSTOLES standard instrument departure for transit to the LED 21 working area (Tab K-1). The working airspace is defined in international flight publication documents and the 401 TFW In-Flight Guide with airspace available for training from 1000 feet mean sea level (MSL) to FL 460 (Tab K-4). The flight took off at 1740:47, rejoined to a visual formation, and cruised to the tanker rendezvous in LED 21. The rendezvous occurred at approximately 1807.

2. The air refueling activity was conducted routinely with the order being One, Three, Two and Four. Falcons One, Three and Four took on 500 pounds of fuel. Falcon Two took on 1000 pounds of fuel. Though not briefed, Falcon Two backed out to precontact position after his first hook up. Falcon One asked him if he wanted another hook up to which he stated he did. The 500 pounds extra fuel taken on by Falcon Two was to permit more instrument approach practice at Torrejon Air Base (Tab V-3). After Falcon Four refueled, the flight departed LED 21 for Torrejon. All flight members testified that the refueling was routine and normal for Falcon Two with no problems noted (Tabs V-3,16,23).

3. The flight cruised back at FL 150 to consume sufficient fuel to permit a normal landing weight for Falcons One, Three and Four, who were to full stop on the first approach. Falcon One told the flight during the cruise to set things up for the flight split up and instrument approach. He requested clearance from Madrid control for routing after Valencia to the Torrejon Tactical Air Navigation (TACAN) IAF. Although the TACAN and INS indications to all members of Falcon flight checked with bearing and range information provided by Madrid, the TACAN facility status was carried as unreliable (Tabs V-4,18,24). Consequently, Madrid cleared Falcon flight direct to Castejon at FL 150 to expect an en route descent into Torrejon airspace with an Ultra High Frequency (UHF) radio frequency change to Torrejon GCA arrival controller (Tabs N-14,15). Falcon One requested from Madrid center clearance to move Falcons Three and Four from right-hand route

formation to a five Nil trail position. This was approved by Madrid and accomplished at 1843:57 (Tab N-15). At 1844:21, Falcon One was assigned Selective Identification Feature (SIF) transponder code 0201. Falcon One was cleared direct to Castejon at FL 150; at Castejon a heading change to 310 degrees magnetic with a descent to FL 080. Falcon Three was assigned SIF code 0203, and cleared direct to Castejon at FL 150 with a turn at Castejon to 330 degrees magnetic. At 1845:06, Madrid passed information on the runway in use and weather conditions to both Falcons One and Three flights. The information was active runway at Torrejon, 23; wind calm; visibility 8 kilometers; altimeter 30.25 (Tab N-16). Upon arrival at Castejon at 1845:59, Falcons One and Two began a descent from FL 150 to FL 080. Falcons Three and Four called heading 330 degrees at 1846:31. At 1846:53, Falcons One and Two were given a turn to 290 degrees.

4. Falcons One and Two were handed over to GCA at 1847:31. They changed UHF frequency to Torrejon local UHF channel 5. The flight checked in on the new frequency at 1848. They were acknowledged by GCA and given the runway and weather information again. At 1848:18, Falcon One requested a flight split up with Falcon Two, on the left side of the formation, making the first instrument approach. This was acknowledged by GCA along with a heading directed of 300 degrees and a descent to 5200 feet MSL. At 1849:33, GCA separated Falcons One and Two by directing a heading for only Falcon One to 320 degrees. Falcon Two was given an SIF code to transmit of 0202 at 1849:47, which he acknowledged. At 1850:24, Madrid Air Traffic Control picked up Falcon Two's SIF code separating from Falcon One, and at an altitude of 5200 feet MSL (Tab O-67). All SIF code altitude data from Madrid indicated 300 feet lower than actual. This error showed up when Falcon One took the runway for takeoff with a reading of 1700 feet MSL (actual elevation was 1994). Throughout the flight, Madrid altitude was consistent at 300 feet lower than directed altitude testified as flown by the pilots (Tabs V-3,4,23, Tab O-67). This evidence was available by review of a video recording of Madrid radar picture during the mishap flight. All references in this summary to Madrid altitude are corrected to actual (Tab O-67). At 1850:31, Falcon Two was cleared a descent to 4400 feet MSL. Falcon Two acknowledged departing 5200 feet MSL for 4400 feet MSL.

5. At 1850:39, Falcon Two was radar identified by GCA at 5200 feet MSL, approximately one minute from impact. Madrid radar data showed Falcon Two in descent passing 4800 feet MSL at 1850:44. At 1850:46, Falcon Two made his last transmission requesting multiple low approaches. At 1850:56, Madrid radar data showed Falcon Two at 4400 feet MSL, and in an approximate 2400 feet per minute rate of descent. This descent rate remained constant through 1851:06, at a 4000 feet MSL altitude by Madrid radar. For the next ten seconds, Madrid radar data indicated an increased rate of descent to approximately 3600 feet per minute. At 1851:16, altitude was 3400 feet MSL, 412 feet above impact elevation. The last Seat Data Recorder (SDR) information corresponding to approximately 1851:31 (1 hour, 10 minutes and 24 seconds after lift off) indicated an altitude uncorrected for barometric

pressure of 2917 feet MSL (Tabs 0-1,2). Applying the correction error would mean actual altitude was closer to 3250 feet MSL. The last GCA transmission to Falcon Two was at 1851:39, about the time of impact. Approximately ten seconds later, Falcon One transmitted an emergency call after observing a fireball on the ground. Falcon One testified that he initially saw the explosion and wondered what it was. He estimated a nominal delay of five seconds before he said anything. Comparing times of GCA recorded voice transmissions with Madrid video recorded radar data and time, along with the Seat Data Recorder information, impact time can only be estimated at between 1851:25 and 1851:45. A plus or minus 15 second error is permitted in the GCA recording clock (Tabs N-4; 0-1,2,64,67).

E. Impact.

1. Falcon Two, F-16C serial number 86-0316, piloted by Major General Harpe, impacted the ground at 40 degrees, 34 minutes, 7 seconds, north latitude; 3 degrees, 7 minutes, 9 seconds, west longitude at approximately 1851:40 on 5 Dec 88. Impact occurred in a sparsely populated area approximately 4 NM south, southeast of Guadalajara, Spain (Tab R-11).

2. There was one eye witness identified. Senor Sacristan was working at a nearby group of farm buildings approximately one and one-half kilometers from the impact point. The elevation at his location was approximately 100 feet above impact elevation. He indicated that he only saw the aircraft shortly before impact. It was close and low when he first noticed the sound of the engine. All he could see were the aircraft lights and silhouette. He said that the aircraft was in relatively shallow but descending flight. It disappeared behind terrain, then he saw the fireball. At sight of the fireball, he immediately went to the crash site, saw the burning wreckage, and then drove to the town of Horches to notify the Guardia Civil, Spanish Police (Tab V-88).

3. The Guardia Civil had already been notified by telephone that an explosion had occurred in the approximate area of the crash. They departed immediately and eventually met Senor Sacristan. Senor Sacristan led the Guardia Civil to the scene. The Guardia Civil put out some fires with a fire extinguisher while making a search for survivors. They located remains of the mishap pilot and determined that he was deceased. They informed their headquarters by radio, secured the area from any civilian spectators, and waited for United States officials to arrive. The Guardia Civil estimated their arrival time at the crash site to have been 1920. At approximately 2015, the initial U.S. Air Force crash response team from Torrejon Air Base arrived on scene. Shortly thereafter, the crash site control was turned over to U.S. forces by the Commander of the Guadalajara District of the Guardia Civil (Tab V-89).

4. Analysis of the crash site indicates that the aircraft impacted the ground in a shallow descent, approximately wings-level on a heading of approximately 300 degrees magnetic (Tabs R-7-9, S-1-4). Shrubs clipped off at a descending angle prior to the impact point indicated an impact angle of approximately 5 degrees negative to the horizon. Impact was on an upslope (10 degrees increasing to 20 degrees) approximately 30 feet below the top of a plateau. Wreckage was scattered in an elongated pattern approximately 800 meters long and 80 meters at the greatest width (Tab R-7-9).

5. Post-crash analysis of flight instruments revealed both confirmatory and non-conclusive readings. The magnetic compass showed an impact mark at 300 degrees magnetic. The altimeter read 2950 with an impact mark correlating to a 30.25 inches of mercury setting. These readings correlate with other data (Tabs J-1, J-2). However, the angle of attack indicator, the airspeed indicator, vertical velocity indicator, and Attitude Director Indicator showed final impact marks at readings that do not correlate with other data and are considered results of secondary impact (Tabs J-1, J-2). Seat Data Recorder (SDR) information taken seconds before impact showed 311 knots, 3247 feet altitude when corrected for barometric pressure, and an angle of attack of 4.5 degrees. The last radar plot from Madrid radar, approximately one NM from impact, showed Falcon Two at 3400 feet MSL. When considering the SDR airspeed and the proximity of the final radar data, indications are the impact airspeed was approximately 300 knots (Tabs O-1,2,67).

6. Flight control surfaces and actuators were analyzed for operation and information. Flight control actuators showed minor impact marks internally, indicating less than catastrophic initial impact. Hydraulic actuator indications of final flight control position were the result of secondary impact. Final flight control position data is at Section L of this report.

7. The Leading Edge Flap (LEF) Power Drive Unit Over Travel Stop Assembly showed a commanded 10.4 degree extension. Computer control of the LEFs is based on airspeed, pressure altitude, and angle of attack. Using 300 knots and 3000 feet pressure altitude, the 10.4 degree LEF extension indicated an angle of attack of approximately 7.5 degrees. Flight simulator duplication of this data yielded an approximate 2 G force acceleration. This indicated an attempt to decrease descent rate, level off, or initiate a climb. The 7.5 degree angle of attack of the aircraft at a 5 degree angle of descent correlated to an approximate 2.5 degree nose up impact attitude.

8. Cockpit warning and caution lights were analyzed for illumination at impact. Those found indicated normal operation (Tab J-3). Engine engineering evaluation indicated that the engine was operating normally at approximately 81 percent Revolutions Per Minute, slightly above flight idle (Tab J-5).

9. Flight control system, flight instruments, electrical power, and engine showed no abnormalities prior to impact (Section L, Tabs J-1-5).

F. Ejection Seat.

1. Analysis of the wreckage indicates that the pilot did not actuate the ejection system (Tabs J-8, J-24).

2. No evidence was found during escape system component analysis and maintenance records review which revealed any maintenance discrepancies or equipment deficiencies which would have precluded a normal ejection. (Tabs J-24, U 9-21).

G. Personal and Survival Equipment.

1. A review of personal and survival equipment records indicates that all items had current inspections for serviceability (Tabs J-25; U-22-27).

2. Since no ejection was attempted, no personal or survival equipment were used during the mishap (Tab J-25).

H. Rescue and Crash Response.

The aircraft impacted the ground at approximately 1851:40 under the control of Torrejon Air Base GCA. Falcons One, Three, and Four all observed the impact explosion and subsequent fire (Tabs V-4, 17, 26). Falcon One made the initial emergency call to GCA at 1851:51. The GCA coordinator initiated the emergency checklist immediately (Tab V-69). The 401 TFW safety officer was informed by the command post and crash phone by 1855. Captain Robert M. Iludrinich, 401 TFW Flying Safety Officer, received the call. He began organizing response preparation to include maps, and a flight surgeon with necessary medical equipment. After a meeting with the wing commander at the command post he departed the base at approximately 1920 in the wing safety vehicle equipped with a UHF radio. Using information on crash location relayed from the 401 TFW Supervisor of Flying (SOF), he defined the general location. Falcon One initially circled the crash site and provided TACAN and INS data to the SOF (Tab V-4). Subsequent Torrejon aircraft replaced Falcon One and communicated directly with the wing safety vehicle. The safety officer eventually met a Guardia Civil vehicle on a primary road south of Chiloeches. The police vehicle led them to the site, with arrival at approximately 2015. The mishap pilot was confirmed a fatality at approximately 2030 (Tab V-87).

I. Maintenance Documentation.

1. A review was conducted of Air Force Technical Order (AFTO) Form 781 records group. Although several documentation errors were noted, no uncorrected maintenance discrepancies or procedural deviations were evident which would have contributed to the accident (Tabs J-17, J-20-24).

2. A review of all Time Compliance Technical Orders (TCTO) was conducted. There were a total of 14 TCTOs open against this aircraft and engine, none of which were overdue (Tabs J-18; U-7-8).

3. All scheduled inspections were satisfactorily completed (Tabs H-276-289).

4. A review of the Joint Oil Analysis Program (JOAP) records from 2 May 88 to 2 Dec 88 was accomplished. The review indicated normal oil readings (Tabs J-27; U-1-6).

5. A review of all computerized maintenance products revealed no overdue time change requirements (Tabs J-18,24).

6. The Equipment Review Report (ERR) was examined for timely component inspections and no discrepancies noted (Tab J-18).

7. The last scheduled inspection was a 150-hour phase inspection, accomplished on 17 Nov 88. AFTO Form 781 series forms, computerized products, and flight line and backshop work logs generated since that date were all reviewed for unscheduled maintenance that conceivably could relate to the mishap flight. Except as noted, all work was accomplished in accordance with current technical orders and reflected standard maintenance practices. (Tabs J-20-24). Major component replacements included an F-110 engine change on 28 Jun 88, and an aircraft canopy change on 15 Oct 88. The engine installed at the time of the mishap (S/N-509543) was manufactured by the General Electric Company, Cincinnati, Ohio, on 16 Dec 87. This engine was installed to swap an older engine with a new engine in another Aircraft Maintenance Unit (AMU). This was done to smooth out fleet engine time.

8. There were no incorrect maintenance procedures, practices, or performances that contributed to the accident (Tabs J-20-24).

J. Maintenance Personnel and Supervision.

1. Preflight servicing was accomplished on 5 Dec 88 by fully qualified personnel who were properly supervised. On 5 Dec 88, the aircraft preflight was accomplished in accordance with appropriate technical data by a fully qualified crew chief (Tab H-252). The mishap aircraft flew twice on 2 Dec 88 and returned from the first sortie with a Code 2 "Mode IV inop on IFF" discrepancy, which was cleared by setting the circuit breaker (Tab H-10). The aircraft returned from the second sortie with an info write-up "ALQ 131 fault in button 3; i.e., Band 0" (Tab H-11). Neither were considered significant to the mishap event. Basic post-flight inspection was accomplished following the last flight of the day on 2 Dec 88, by a fully qualified crew chief using appropriate technical data and properly documented (Tab H-253). The same crew chief that accomplished the preflight inspection on 5 Dec 88 also accomplished the launch of the mishap sortie using the appropriate technical order.

2. A thorough review of AF Forms 797, Job Qualification Standard Continuation Sheet; AF Forms 623, On-the-Job Training Record and Proficiency Level Progress Report; and certification of all aircraft servicing personnel revealed appropriate training and experience for tasks assigned and performed (Tabs J-14-16,19).

3. There was no evidence of any maintenance practice or procedure that could have been a contributing factor to the accident (Tabs J-23,24).

K. Engine Fuel, Hydraulic, and Oil Inspection Analysis.

1. Engine inspection data was normal (Tabs J-4-6).

2. Fuel samples taken from hydrant sources, the other three aircraft in the mishap flight, and fuel on-loaded and off-loaded by the aerial tanker revealed normal readings (Tabs O-42-45). A fuel sample taken from the mishap aircraft was analyzed by the laboratory at RAF Mildenhall, UK, with inconclusive results, due to its having been involved in the impact and resulting aircraft fire (Tabs O-48-52).

3. Post-crash analysis of mishap aircraft hydraulic fluid is pending. Eighteen samples of hydraulic test stands and servicing carts revealed normal results (Tabs O-24-41).

4. Insufficient oil was recovered for a post-crash analysis. Thirteen oil-servicing carts used on the Torrejon Air Base flightline on 5 Dec 88 were tested with normal results (Tabs O-8-20). Also, three oil-servicing carts used to service aircraft 86-0316 were further analyzed by a regional laboratory with normal results (Tabs O-21-23). Pre-accident JOAP analysis of engine 9543 indicated normal results (Tabs J-27; U-1-6).

L. Airframe and Aircraft Systems.

1. Post-accident analysis was limited by the degree of destruction of the aircraft. Analysis of flight control actuators indicated the following control positions at final impact (Tab J-13):

rudder:	0 degree streamlined
left horizontal tail:	+ 17 degrees trailing edge down
right horizontal tail:	- 2 degrees trailing edge up
left flaperon:	0 degrees streamlined
right flaperon:	0 degrees streamlined
speed brakes:	closed
leading edge flaps:	10.4 degrees commanded LEF position
wheels:	up

2. Both hydraulic reservoir accumulators were examined:
No indications noted of any contamination prior to impact (Tab J-8).

3. Examination of the emergency power unit components indicated that it was not running at the time of impact (Tab J-9).

4. Analyses of the Seat Data Recorder (electronic component assembly and flight control computer) and electronic component assembly memories revealed no abnormalities in the last flight of 86-0316 (Tab J-7).

5. Examination of the aircraft engine indicated that it was functioning on impact (Tabs J-4-6,10-12).

6. Analysis of the aircraft instruments indicated that there was no instrument or instrument system failure prior to impact. Electrical power appeared to have been available at time of impact (Tabs J-1-3).

M. Operations Personnel and Supervision.

1. The mishap mission was properly authorized on USAFC Form 406 and signed by the appropriate authority, the 612 TFS Operations Officer (Tab K-2).

2. The mission was briefed and led by an experienced F-16 instructor pilot. The briefing was complete and in-depth, and accomplished in accordance with USAFC Regulation 55-116 briefing guides (Tab O-68). The briefing was understood by all participants (Tabs V-5,6,17,21,22). Since the mission was to be flown at night, the night-phase briefing, also conducted by the mishap flight lead, addressed the specific problems associated with night flying in the F-16 (Tab O-74).

N. Crew Qualification.

1. All flight members were qualified for the mission and current in accordance with USAFC Manual 51-50 requirements (Tabs G-1,3,13,25,31,35). Falcon One, the flight lead, was an instructor pilot. Falcons Three and Four were both flight lead qualified (Tab T-1).

2. Major General Harpe, Falcon Two, the mishap pilot, was a mission support pilot qualified for all phases of the planned mission (Tabs G-13; T-1). He had 181.1 F-16 hours and 4730.7 total flying hours. He had 1589.0 hours fighter time (Tabs G-1,2). During the last 30, 60 and 90-day periods preceding the mishap, he had logged 3.3, 10.5, and 19.5 hours, respectively (Tab G-5). He had completed the F-16A conversion course in June 1987, at MacDill Air Force Base, Florida (Tabs T-91-114). He completed a formal instrument and qualification flight evaluation on 17 Jun 87. The rating was qualified with flight examiner comments, "General Harpe's basic instrument,

TACAN, and PAR approaches were commendable." (Tab G-17). General Harpe completed his mission qualification upgrade at Torrejon Air Base on 24 Nov 87. His checkout did not identify any problem areas (Tab G-15). The General completed the conversion to the F-16C model at Torrejon Air Base in June 1988, with no recurring problems (Tabs T-2-28). He completed an instrument/qualification flight evaluation in September 1988, without discrepancies and 100 percent scores on all tests (Tab G-13). Throughout his checkouts, Major General Harpe had no apparent proficiency problems and flew instruments well. During continuation training missions, he impressed those with whom he flew with his knowledge of aircraft systems and his instrument flying ability (Tabs V-14,35,38,45,45).

3. Major General Harpe had logged four hours instrument time in the past six months. His last night time logged was in May 1989 (Tabs G-37,38). In the Jul 88 through Nov 88 training cycle, he had logged 9 penetrations, 12 precision approaches, 7 non-precision approaches, and two instrument proficiency sorties in Sep 88 (Tabs I-127-135). Physiological training was last accomplished in Jun 87, and centrifuge training was accomplished in Apr 88 (Tab G 9). Major General Harpe had completed semi-annual egress training in Jul 88 (Tab T-126). He accomplished the Instrument Refresher Course in Sep 88 (Tab G-13).

O. Medical.

1. All members of Falcon flight were medically qualified for flight duties at the time of the mishap (Tabs G-7,20,22,24; O-110).

2. The post-accident toxicology report indicated the presence of no drug, alcohol, or other foreign substance affecting the mishap pilot (Tab X-3).

3. Major General Harpe's last flight physical was accomplished 17 Dec 87. The General was flying with a waiver requiring him to wear glasses during flight. The temple supports for a pair of glasses were found in the mishap aircraft wreckage (Tab S-1).

P. Nav aids and Facilities.

1. All navigation aids and facilities were reported as operational on 5 Dec 88, with the exception of the Torrejon TACAN. There was a Notice to Airman (NOTAM) published indicating it was for use by local aircraft flying outside of 10 NM. The TACAN checked good by airborne aircraft, but was not authorized for use as an instrument approach aid (Tabs O-57,58).

2. The GCA's Low Altitude Alerting System (LAAS) was in operation during the mishap, but testimony from on-duty controllers indicated it did not function during Falcon Two's descent below the minimum vectoring altitude (MVA) (Tabs V-67-70,77,84). A close review of the GCA voice recording did not reveal the presence of the three aural warning tones (Tab N-2; Section R). Testimony was contradictory that on 5 Dec 88, subsequent to the mishap, other aircraft flying below the LAAS warning altitude triggered the system (Tabs V-70,79). Testimony was contradictory as to whether the system had been specifically checked for operation that day (Tabs V-77,81,82,85). Indications are that the system was functional as designed. This is addressed in Section R of this report.

Q. Weather.

1. The closest meteorological reporting station was at Torrejon Air Base. The weather forecast provided to the mishap flight called for two-eighths of stratocumulus clouds at 2500 feet above ground level (AGL), visibility unrestricted, winds 260 degrees at 8 knots, altimeter setting 30.18 inches of mercury. Sunset was at 1746. There was no moon illumination (Tab W-1).

2. An observation taken at 1855 showed 9000 meters visibility with fog, four-eighths altocumulus at 10,000 feet AGL, winds calm, altimeter 30.24 inches of mercury (Tabs W-5,6). Pilot testimony indicated that the night was relatively clear with a haze below 5000 feet MSL (Tabs V-11,16,24).

R. Air Traffic Control.

1. Regulations, technical orders, and procedures were reviewed thoroughly for impact to the mishap flight. On-duty controllers at Torrejon GCA, plus the non-commissioned officer in charge, were interviewed. Although testimony revealed different opinions on the Low Altitude Alerting System operation, and voice phraseology to be used for warning, procedures relative to handling of Falcon flight complied with regulations (Tabs V-62-86).

2. The LAAS is designed to trigger an alert 100 feet below the minimum altitude set in the computer. The initial warning is a flashing symbology associated with the radar target and the words "Low Alt" flashing in the center of the radar scope. The second radar sweep across the target, if it is still 100 feet below set altitude, causes three aural tones to occur. The aural warning happens only once, although the flashing symbology and the visual low altitude warning remain until the aircraft climbs above the set altitude. The aural warning tones will not trigger again on a second aircraft or the original aircraft until after both aircraft are radar painted above the warning altitude. The sweep rate of the radar beam is approximately 4.9 seconds for 360 degrees, clockwise (Tab O-79).

3. In the Torrejon GCA map sector corresponding to the mishap location, the minimum vectoring altitude (MVA) is 4400 feet MSL. The LAAS altitude was set at 4000 feet MSL. This altitude was selected to preclude continuous alerting on aircraft departing out a Visual Flight Rules (VFR) corridor at 4000 feet MSL. With the altitude set at 4000 feet, the visual warning would occur as an aircraft SIF and Mode C altitude was received at 3900 feet MSL or below. The aural warning would activate on the second SIF and altitude reception of the aircraft below 3900 feet MSL (approximately 4.9 seconds later) (Tabs O-60,79). Madrid radar video showed Falcon Two holding a constant approximate 2400 feet per minute rate of descent to the next to last radar paint at 4000 feet MSL. Ten seconds later, Madrid picked up its last paint at 3400 feet MSL, indicating an increase to an average 3600 feet per minute rate of descent, or 60 feet per second (Tab O-67). With the altitude for warning at 3900 feet MSL, the sweep rate of 4.9 degrees per second on the Torrejon radar, and the 60 feet per second descent rate of Falcon Two, it is technically possible that the LAAS system operating within its design capability would not have activated prior to the radar return being lost due to obstacles in the Torrejon GCA radar line of sight (Tab O-79). An additional complicating factor is that the GCA computer will only process radar interrogation replies as a result of its own transmission. There are two other radars in the area that potentially could have interrogated Falcon Two an instant prior to GCA and caused a negative SIF to be displayed to Torrejon GCA. Madrid Radar did retain contact down to 3400 feet MSL, but the Madrid Radar is at approximately 400 feet higher elevation and has a better line of sight view over the mishap area (Tab O-79).

4. Testimony of MSgt Gonzales, GCA coordinator during the mishap, indicated that he saw Falcon Two on radar descending from 5200 feet MSL and, shortly thereafter, the altitude readout changed to three parallel "diagonals" (or dashes) and then went into a "frenzy" (V-68). The three dashes appear when the altitude of the aircraft is not determined by the receiving radar computer (Tabs O-79; V-68,69).

5. The LAAS has the ability to ignore a preset transponder code, meaning that it will not alert on any aircraft transmitting the set code. The Torrejon GCA ignore code was set at 0001, a code placed in the equipment for factory distribution. The code was adjustable to the VFR aircraft code of 7000. Setting the code to 7000 would have eliminated the need to set alert altitude below the 4000 feet VFR corridor altitude. The altitude could have been set higher to provide more warning time to controllers and pilots. This capability was known by the 2186th Communications Squadron radar maintenance personnel, but not by operations personnel at the squadron (Tabs V-62,86; O-79).

6. The investigation revealed a limited availability of any operations-oriented publications on the LAAS system. T.O. 31P5-2G-22, used and maintained primarily by maintenance, was the only source of information on the system. There was no guidance on what altitude to set in the alerting

system. LAAS operations checks were not specifically required, but were an implied requirement only as part of the facility equipment check. No specific guidance was provided operations personnel on how to check the system. Several Torrejon AB controllers interviewed during the investigation did not think it could be checked, or thought that a check of 7700 and 7600 codes on the TPX 42 Beacon System verified LAAS operation (Tabs V-62-86).

7. An extensive review of Air Traffic Control procedures at Torrejon GCA, both general procedures and specific procedural execution during the mishap flight, revealed nothing of personnel performance that contributed to the mishap. The primary arrival controller misunderstood a request from Falcon Three which took up additional UHF air time to resolve and caused the controller to focus his attention primarily on Falcons Three and Four, but this was not a violation of regulation or procedures.

8. The LAAS was set to activate at 3900 feet MSL. Falcon Two's descent rate was 60 feet per second. His aircraft passed through the alerting altitude all the way to ground impact without activating the system. With no LAAS warning alarm, the GCA controller was not aware of Falcon Two's low altitude and transmission to alert him was not made.

S. Directives and Publications.

The following directives and publications were applicable to the operation of the mission:

1. Regulations and Manuals:

- a. FAAH 7110.65, Air Traffic Control;
- b. DOD Flight Information Publication, General Planning;
- c. DOD Flight Information Publication, Area Planning, Special Use Airspace, Europe-Africa-Middle East;
- d. AFR 60-1, Flight Management;
- e. AFR 60-5, Air Traffic Control Management;
- f. AFR 60-16, General Flight Rules;
- g. USAFER 51-1, Aircrew Ground Training;
- h. USAFEM 51-50, Vols I and III, Tactical Fighter and F-16 Training;
- i. USAFER 55-27, Air Force Life Support Systems Program.
- j. USAFER 55-79, Aircrew/Weapons Controller Procedures for Air Operations;
- k. USAFER 55-116, F-16 Pilot Operational Procedures;
- l. USAFER 60-2, Aircrew Standardization/Evaluation Program;
- m. USAFER 66-5, Combat Oriented Maintenance Organizations;
- n. AFCCR 60-5, Air Traffic Control;
- o. Torrejon Air Base Regulation 55-1, Air Operations Procedures;
- p. 401 TFW In-Flight Guide;
- q. 401 TFW D00I 55-15, "Creek Falcon," F-16 Flying Operations.

2. Technical Orders:

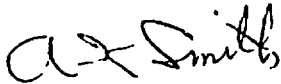
- a. 1F-16C-1, F-16 C/D Flight Manual;
- b. 1F-16C-1CL-1, F-16 C/D Checklist;
- c. 1F-16C-6, Scheduled Inspection and Maintenance Workcards;
- d. T.O. 33-1-37, Joint Oil Analysis Program Laboratory Manual;
- e. T.O. 31P5-2G-22, Maintenance and Operating Instructions--Data

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3. An extensive review of all applicable directives revealed no known or suspected deviations by flying operations supervisors or by the pilots of the mishap flight.

4. Aircraft maintenance documentation errors were identified (Tabs J-17, J-20-24). However, these had no affect on the mishap flight. Procedures used by servicing personnel and the on-duty crew chief complied with requirements.

5. GCA controllers on duty were all certified in accordance with regulations.



A. K. SMITH, Colonel, USAF
Accident Investigating Officer