

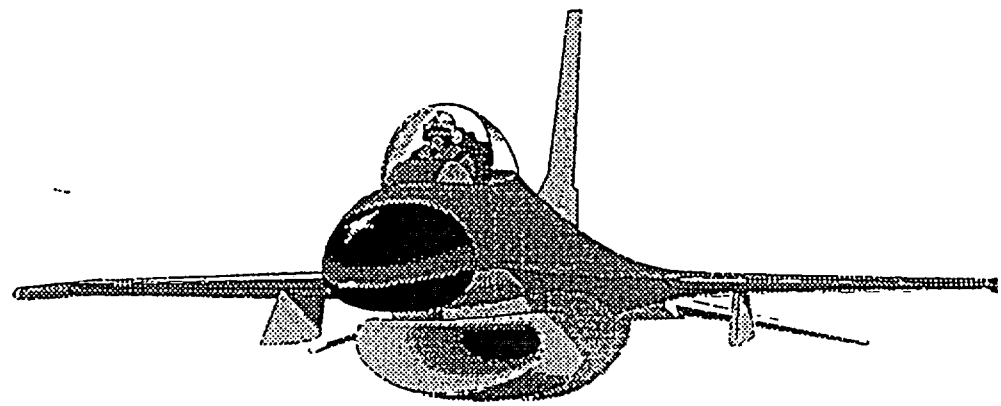
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UNITED STATES AIR FORCE OFFICE OF THE SECRETARY
AIRCRAFT ACCIDENT INVESTIGATION RULEMAKINGS AND
REPORT ADJUDICATIONS STAFF

F-16C 88-0455

56TH FIGHTER WING
LUKE AIR FORCE BASE, ARIZONA



21 August 1995

CONDUCTED LAW AIR FORCE INSTRUCTION 51-503

PFS Exh. 182
58236

NUCLEAR REGULATORY COMMISSION

182

Official Exh. No. _____

Docket No. PPS

In the matter of _____

IDENTIFIED ✓

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REJECTED _____

Staff _____

Applicant _____

Intervenor _____

Contractor _____

Other _____

DATE 7/1/62

Witness _____

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Reporter _____

EXECUTIVE SUMMARY

**Aircraft Investigation Report
F-16CG (SN 88-0455)
Luke AFB, AZ
21 August 1995**

During the afternoon of 21 August 1995, an F-16 assigned to the 308th Fighter Squadron, 56th Fighter Wing, Luke Air Force Base, Arizona, was conducting a three ship Air Combat Maneuvering (ACM) flight lead upgrade (FLUG) mission. At 1618 PST, at a position approximately 60 nautical miles northwest from Phoenix, the engine failed. The pilot ejected safely and the aircraft was destroyed upon impacting the ground in an unpopulated area on government land. There was no property damage or personal injury.

After extensive witness interviews, review of maintenance documents, engine records, and other data, the Accident Investigating Officer found that the engine experienced a failure of the low pressure turbine. This caused the accident.

AFI 51-503 ACCIDENT INVESTIGATION REPORT

AUTHORITY. In a letter dated 5 September 1995, Major General Nicholas B. Kehoe, Commander 19th Air Force, appointed Colonel James B. Smith, 325 OG/CC, Tyndall AFB, Florida, to conduct an investigation pursuant to Air Force Instruction (AFI) 51-503 into the circumstances surrounding an aircraft accident involving F-16CG, tail number 88-0455, assigned to the 308th Fighter Squadron, 56th Fighter Wing, Luke Air Force Base, Arizona. He also appointed Major Ronald E. Thompson, 550th Special Operations Squadron, 58th Special Operations Wing, Kirtland AFB, New Mexico, to act as the Aircraft Maintenance Technical Advisor. Captain Robert A. Paulukaitis, 56th Fighter Wing was appointed technical advisor in a letter dated 14 September 1995. Captain John McCarthy, 56 FW/JA, Luke AFB, Arizona, was appointed to act as Legal Advisor. (TAB Y).

PURPOSE. To preserve evidence for claims, litigation, disciplinary, and adverse actions, and for all other purposes.

SUMMARY OF FACTS

1. HISTORY OF FLIGHT.

On 21 August 1995, an upgrading flight lead, his instructor pilot, and a designated bandit were scheduled to fly a three ship Air Combat Maneuvering (ACM) mission (Callsign Haggie 1) originating at Luke Air Force Base, Arizona, into an air-to-air training area (Gladden Military Operating Area (MOA)) that is located approximately 60 miles northwest of Phoenix, Arizona. (TAB K-2). Ground operations, takeoff at 1550 PST and flight enroute to the airspace were uneventful. While initiating the second planned ACM engagement, the instructor pilot's aircraft began heavy vibration and the engine failed. The pilot correctly performed Critical Action Procedures (CAPS) for engine failure, but was unable to gain a restart in three attempts. (TAB V-1; TAB N; TAB AA-7). The pilot then initiated a controlled ejection and landed safely via parachute. The aircraft crashed on government property; there was no damage to private property. (TAB S-1; TAB AA-8, AA-14) There were no deaths or injuries. The mishap occurred at 1618 PST. (TAB A).

The 56 FW Public Affairs sent out a news release at 1658 PST. This resulted in video and print media inquiries that lasted through the following day. Significantly, the local Channel 12 (KPNX) traffic helicopter was the first on scene at the crash site and secured an interview with the downed pilot. Local Arizona and Air Force Times coverage resulted. (TAB AA-2).

The mishap pilot was Captain Nathan E. Hill, Instructor Pilot, 308th Fighter Squadron, Luke AFB, Arizona.

2. MISSION.

The mishap aircraft (MA) was number two in a three-ship ACM flight lead upgrade mission. It is designed as an advanced tactics mission for the two ship element to practice defensive air combat maneuvering skills against a single adversary. This particular mission was designed to allow Mishap Pilot (MP) one to upgrade as a flight lead of the two ship element. MP 2, in the mishap aircraft, was performing instructor pilot duties for MP1; MP3 was serving as the designated bandit for the mission. (TAB A; TAB V-1, V-2, V-4).

The mission was not a syllabus sortie, although MP 1 was entering into the instructor pilot upgrade course. The squadron commander determined that since MP1 had very little opportunity to fly other than single ship missions during his last assignment, it was appropriate to provide him a limited flight lead checkout prior to entering the instructor pilot course. (TAB V-3). This decision was a prudent course of action; the mission was properly authorized and approved. (TAB K-2)

3. BRIEFING AND PREFLIGHT.

Crew rest was not a factor. The mishap pilot was returning from two weeks leave on the day of the mishap. (TAB V-1). Briefing and preflight were uneventful. Flight briefing began on time; MP1 conducted the flight briefing with MP2 serving in the instructor pilot role as the designated wingman. All appropriate items were briefed. (TAB V-1, V-2, V-3).

Ground operations proceeded without incident. The crew chief noticed a problem with one of the lights in the fuel flow proportioner (FFP); he isolated the problem to a burned out light bulb by swapping one of the illuminated bulbs with the one that had burned out. (TAB V-11). This same problem was noticed at the End-of-Runway check; the End-of-Runway crew screwed in the bad bulb and it illuminated properly. (TAB V-9, V-10). There were no other problems with any of the aircraft in the mishap flight.

4. FLIGHT ACTIVITY.

Haggle 1 Flight took off as scheduled at 1550 from Luke AFB, Arizona, on an Instrument Flight Rules flight plan to Gladden MOA. Takeoff, departure and flight enroute to the airspace were uneventful. Following a G-warmup exercise, the flight completed one ACM engagement with MP1 as flight lead, MP2 as the wingman (IP), and MP3 acting as the designated bandit. (TAB V-1, V-2, V-4).

At 1612:26, the mishap flight then set up for a second ACM engagement with the same parameters as the first engagement with the bandit attacking MP1. (Altitude was 16,800 MSL; airspeed was 420 KCAS; and heading was 306 degrees, 11 NM from steer point 11 (N34 24.00 W113 50.00) to the southeast.) (TAB N-2) MP2 called for a "break turn" to MP1 as the bandit was attacking MP1. (TAB V-1, V-2)

At the same time, MP2 initiated a break turn into the bandit. The bandit, as planned, switched his attack from MP1 to MP2. Almost immediately, MP2 called for a termination of the engagement (Knock-It-Off) because of heavy vibration on the aircraft. At this time, MP2 cleared his flight path and MP3 began a rejoin on him. MP2 then checked his engine instruments and noticed decreasing engine RPM; engine FTIT climbed to 970 degrees. (TAB A; TAB V-1, V-2, V-3).

MP2 initiated three engine restart attempts without success, the position of the throttle to "off" during the restart attempts is confirmed by the MA's flight data recorder (CSFDR) which was recovered from the wreckage (TAB N-2; TAB O). Throughout the attempted restart attempts, both MP1 and MP3 noticed a 10-15 ft yellow-orange flame coming out of the afterburner section of the aircraft. This prompted MP1 to call for MP2 to "pull it out of afterburner." At this point, MP2 had the throttle in idle or in the off position attempting his first restart attempt for a total of 30 seconds; indeed, at no time during or after the engagement did he initiate afterburner use. (TAB N-2; TAB O; TAB V-1).

Prior to the third and final restart attempt, MP2 left the throttle in the off position for a full minute, though the flame never extinguished. With no response from the engine and reaching his controlled bailout minimums, MP2 pulled the ejection handle; total time spent attempting a restart was five minutes, eight seconds (TAB N-2; TAB V-1).

5. IMPACT.

The aircraft impact on government land (Bureau of Land Management) approximately 60 miles Northwest of Luke AFB, Arizona (coordinates 34 degrees 9' 36" north, 113 degrees 13' 12" west) Time of the crash was 1618 PST, 21 August 1995. (TAB A; TAB C) No structures were nearby. The aircraft was destroyed on impact, and much of the wreckage came to rest on Arizona state land after crossing the BLM property boundary. There was no private property damage. (TAB S-1; TAB AA-8, AA-14).

6. EGRESS SYSTEMS.

The ejection was initiated at the following parameters (TAB N; TAB O):

- 6250 feet MSL (4500 AGL)
- 220 KCAS
- 120 degree heading (toward Luke AFB)

Owing to the controlled nature of the ejection, the MP had sufficient time to stow all loose articles and attain a proper body position prior to ejection. The canopy and seat departed the aircraft in sequence, which was normal. Parachute opening, as well as survival kit and raft deployment were automatic; the parachute fully deployed. (TAB V-1).

7. PERSONAL AND SURVIVAL EQUIPMENT.

The parachute landing fall and post landing sequences were uneventful, indeed textbook. Captain Hill commented that he had been trained as a Squadron Life Support Officer; this training prepared him well for the ejection and post ejection sequence of events. He drank canned water from the seat kit and used the flares and AN/PRC-90 radio; all worked properly (TAB V-1).

8. RESCUE.

Haggle 1 and Haggle 3 remained on the scene during the ejection and monitored the mishap pilot's descent in the parachute. Radio contact to 56FW Supervisor of Flying (SOF) was established by Haggle 3. (TAB V-6).

An in-flight emergency was declared at 1616 PST and the aircraft crashed at 1618. 56 FW/CC and Battle Staff were notified at 1620. (TAB AA-3). A decision was made immediately to dispatch two security police vehicles to the crash scene, though owing to the terrain, they did not arrive until approximately nightfall. At the same time, a request was made for local helicopter support which was secured through the Arizona Department of Public Safety (DPS). Confirmation was received at 1728 that DPS would fly choppers out to pick up the pilot. At 1805, one DPS helicopter (Fox 1) departed Luke AFB with security police personnel on board. At 1830, a second DPS helicopter (Ranger 1), landed at Luke AFB with the pilot. (TAB AA-3)

First to arrive on the scene was a Channel 12 News helicopter; the crew checked on the status of the mishap pilot and secured a news interview. (TAB V-1). Shortly thereafter, the DPS helicopters arrived and transported the pilot to Luke AFB. The extraction occurred approximately two hours after the mishap. (TAB AA-3)

9. CRASH RESPONSE

Coordination was accomplished by 56 FW Command Post and Security Police. 56 FW Security Police secured the crash site. There was no civilian involvement in the crash response other than the helicopter support and interim security provided by approximately 4 local sheriff's deputies (TAB AA-3, AA-14). A list of equipment sent to the crash site is contained in Tab AA-13.

10. MAINTENANCE DOCUMENTATION.

Aircraft documentation was accomplished in a highly effective manner. There were no deficiencies related to the mishap against either the aircraft or the engine recorded in the aircraft AFTO Forms 781 series (TAB H-2). There were no overdue Time Compliance Technical Orders (TCTO's) (TAB H-2). Scheduled aircraft inspections were up to date. One TCTO, 1F-16-2041, Inspection of the Leading Edge (LE) Flaps Drive Torque Box was scheduled for the end of August. (TAB H-2)

The engine was current in all TCTO (workable or received)--no trends were evident throughout the engine history. (TAB H-2) The mishap engine was installed in aircraft 88-0455, F-16C, on 18 Jul 95. (TAB J-16; TAB H-2) The last inspection of the engine was accomplished 15 Aug 95. It was a 25-hour borescope of the fourth-stage blade roots IAW 1F-16C-6. No discrepancy was noted during the inspection. (TAB H-2) The status of oil analysis reflects no adverse trends or sudden spike in any element related to the engine. (TAB H-2)

There were no overdue items found on the equipment review report (TAB H-2).

The unscheduled maintenance performed on the aircraft was not related to the mishap; i.e., radar altimeter, cabin pressure would not dump, uncommanded flight input under 6-8 G's (aircraft was impound for this deficiency and then a successful functional check flight was flown) (TAB H-2).

11. MAINTENANCE PERSONNEL AND SUPERVISION.

A review of individual training records (AF Form 623, STS 797) indicated that personnel were trained in accordance with the squadron's master CFETP. Personnel using the Flex borescope were trained. Squadron manning provided for proper supervision for shift coverage. No maintenance practice or procedure was a factor in the accident. (TAB H; TAB AA-11)

12. POST MISHAP AIRFRAME AND AIRCRAFT SYSTEM ANALYSIS.

A review of the CSFDR recorded data combined with the timed sequence in MP 1's heads up display (HUD) tape substantiated the mishap pilot's account of the probable conditions of the airframe and aircraft systems during repeated restart attempts and ejection (TAB N; TAB O; TAB V-1)

There were no indicators that the mishap aircraft was other than intact with all systems functional, except the engine, at the time of impact.

13. POST MISHAP FUEL, HYDRAULIC, OIL, AND ENGINE INSPECTION ANALYSIS.

The engine was found to have no overdue inspections. Additionally, engine data reflected appropriate parameters for engine operation during engine test cell runs. (TAB H-2; TAB U-8 to 34).

All fluid samplings to include Lox samples, were well within the established standards. (TAB D; TAB U-35 to 43).

Engine Analysis: San Antonio Air Logistic Center (SA-ALC) determined that the engine experienced a failure of the Low Pressure Turbine (LPT) (TAB J-17). The exact cause of the turbine failure could not be determined locally, so key components of the LPT were shipped to Pratt and Whitney, West Palm Beach, Florida, for further investigation. (TAB AA-12).

- The number 5 bearing housing remained connected to the turbine exhaust case by the two support rods and the threads on the retaining nut appeared undamaged. The bearing was covered with soot, but the rollers were shiny when wiped clean. This indicates that the bearing was receiving oil at the time of the mishap. (TAB J-10 to 11; TAB S-22).
- All 68 third stage blades were fractured above the platform, with the roots remaining in the third disk. All 60 fourth stage blades stayed on the fourth disks. These blades all had fracture surfaces of varying degree and all exhibited an overstress failure mode. All fourth stage vanes exhibited major damage to both leading and trailing edges. All third stage vanes stayed intact in the LPT case; the leading edges of the vanes were in good condition while the trailing edge of all the third vanes exhibited major damage. (TAB J-8, J-9).

The mishap engine, PWOE705036 was installed in aircraft 88-0455, F-16C, on 18 July 95. (TAB H-2; TAB J-16) There was one delayed discrepancy for one engine core fuel clamp that had a 1/4 inch crack on material at 12 o'clock position: monitor on each 25 hour inspection. (TAB H-2, H-7). The last 25 hour inspection was accomplished 15 Aug 95. (TAB H-2) Additionally, during this inspection a borescope of the fourth stage blade roots was accomplished in accordance with TO 1F-16c-6. No discrepancy was found. (TAB J-16)

There have been 17 Engine Diagnostic Units (EDU) changed since 30 May 92. Seven have been changed since the 28 Dec 94. (TAB H-11; TAB J-15, J-16)

Engine history:

- 30 May 92 - The LPT was installed on engine PWOE705036. At the same time the engine was upgraded to an F220E. (TAB J-15).
- 8 July 94 - Engine PWOE705036 was received from Mt. Home AFB. (TAB J-15).
- 11 July 94 - Engine was installed in aircraft 84-1230, F16C, Luke AFB. (TAB J-15).
- 26 Aug 94 - Augmentor section removed and replaced. (TAB J-15).
- 27 Oct 94 - TCTO 2J-F100-887, fourth stage turbine blade root inspection. (TAB J-15).
- 27 Dec 94 - Installed in aircraft 83-1126 (TAB J-15).
- 11 July 95 - 50 hour inspection (borescope) of the 4th stage turbine blade root (TAB J-16)
- 13 July 95 - Engine was removed for TCTO 2J-F100-7-585, 3rd stage disk lug inspection. (TAB J-16).
- 18 July 95 - Engine was installed in aircraft 88-0455, F-16C. (TAB J-16).

14. OPERATIONS PERSONNEL AND SUPERVISION.

There is no evidence that the 56 FW Supervisor of Flying, Command Post, squadron supervision, or others in the operations and supervisory chain performed their duties in other than a thorough, responsible manner

on the day and time of the mishap. The mission was properly authorized by the Assistant Operations Officer. (TAB K-2) There is no evidence that any operational directives were violated in the course of the mishap flight.

15. CREW QUALIFICATIONS.

Captain Hill, an experienced instructor pilot in the 308th Fighter Squadron, was highly qualified to perform the Air Combat Maneuvering mission on the day of the mishap. (TAB T). At the time of the accident, Captain Hill had 885.0 hours total time, of which 852.4 were in the F-16. His 30/60/90 day totals were 11.7/24/49.7 hours. (TAB G-2; TAB T). His squadron commander lauded his instructor capabilities, and commented that Captain Hill had recently received an Exceptionally Qualified score on a recent emergency procedures simulator mission. (TAB V-3).

16. MEDICAL.

The mishap pilot was medically qualified for flight. (TAB T). There is no evidence in the medical records or toxicology studies that would have contributed to this accident. He received no injuries except for slight bruises to the chest area due to parachute opening shock; these were gone in approximately 10 days (TAB V-1). There were no spinal injuries nor injuries during the parachute landing fall. (TAB X).

17. NAVAIDS AND FACILITIES.

Nav aids and airfield facilities were not a factor in this accident.

18. WEATHER.

Weather was not a factor in this accident. The weather at Luke AF was 5000 scattered, 15000 scattered, with visibility 35 miles. (TAB W).

The sky condition in Gladden MOA in the vicinity of the incident was reported to be 500 scattered and 15,000 scattered. (TAB K-8). The scattered deck of clouds was not factor throughout the ACM engagement, the restart attempts, ejection sequence or recovery. (TAB V-1).

19. GOVERNING DIRECTIVES AND PUBLICATIONS

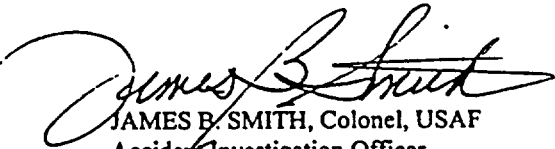
The following publications were applicable to the mission:

AFI 11-206.....	General Flight Rules	25 Jul 1994
	AETC Sup 1.....	10 Dec 1993
	HQ AETC MSG.....	20 Jan 1994
	Luke Sup 1.....	9 Jun 1992
AFI 11-401.....	Flight Management.....	11 Jun 1994
	LAFB Sup 1.....	15 Jun 1994
AFPAM 11-404.....	G Awareness for Aircrews	19 Aug 1994
MCI 11-F-16 Vol 1.....	Pilot Training F-16.....	1 Oct 1994
MCI 11-F-16 Vol 3.....	Pilot Training Procedures F-16.....	21 Apr 1995
	Luke AFB Chapter 8.....	30 Jun 1995
AETCI 11-405.....	Flying Training Supervision.....	11 Aug 1995
	LAFB SUP 1.....	28 Apr 1994
ACCR 55-2.....	Life Support Program.....	1 Jun 1992
AETCR 60-2.....	Aircrew Stan/Eval Program.....	1 Jul 1993
	LAFB Sup 1.....	13 Oct 1993
MCR 60-2 Vol 3.....	Aircrew Stan/Eval Program.....	10 Nov 1992
	Change 1.....	20 Dec 1993
LAFB 55-2 Vol 1.....	Local Operating Procedures.....	29 Oct 1993
	Change 2.....	9 Sep 1994
LAFB 55-2 Vol 2.....	Local Operating Procedures.....	29 Oct 1993
	Change 1.....	9 Sep 1994
OPORD 56-94.....	Operations Order (Luke Almanac).....	Apr 1994
	Change 2.....	17 May 1994
Inflight Guide.....	Falcon Facts.....	Aug 1995
T.O. 1F-16CG-1.....	F-16 C/D Flight Manual.....	24 Jun 1994
	Change 1.....	9 Jan 1995
	ISS-91.....	8 May 1995
T.O. 1F-16CG-1CL-1.....	F-16 C/D Flight Manual Supplement... ..	24 Jun 1994
	FCIF 94-20.....	14 Jun 1994
	Change 1.....	9 Jan 1995
	ISS-89.....	23 Mar 1995
T.O. 1F-16CG-1-1.....	F-16 C/D Flight Manual Supplement.....	16 May 1988
	Change 11.....	17 Apr 1995
T.O. 1F-16CG-1-2.....	F-16 C/D Flight Manual Supplement.....	12 Jun 1995
T.O. 1F-16CG-34-1-1.....	F-16 C/D Avionics and Nonnuclear.....	2 Dec 1991
	WeaponsDelivery Flight Manual	
	Change 2.....	6 Mar 1995
T.O. 1F-16CG-6.....	Scheduled Inspections and Maintenance	13 Mar 1989
	Requirements	
	Change 21.....	17 Jul 1995
T.O. 1F-16CG-6S-85.....	Interim Supplement.....	7 Jul 1995

20. DEFICIENCIES.

There were no operations or maintenance deficiencies that contributed to this accident.

22 September 1995



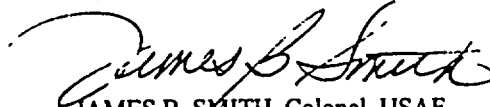
JAMES B. SMITH, Colonel, USAF
Accident Investigation Officer

STATEMENT OF OPINION

UNDER 10 U.S.C. 2254(d) ANY OPINION OF THE ACCIDENT INVESTIGATORS AS TO THE CAUSE 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 PROCEEDINGS 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.

1. In my opinion, this accident was caused by a mechanical malfunction. It was determined by Logistics Center analysts that the engine experienced a failure of the low pressure turbine. (TAB J-17, TAB S-4). The engine failed without possibility of airstart. There is no evidence that any action by the individual operating the aircraft or supervising the operation contributed to this mishap.
2. The underlying cause of the low pressure turbine failure is yet to be determined. The Safety Board transferred all key elements of the turbine to Pratt and Whitney for analysis. This study is part of a broader initiative whereby Air Force officials directed the study of turbine failures in two other F-16 mishaps as well as five F-15E engine failures at Seymour-Johnson AFB, North Carolina. (TAB AA-12). As a result, no opinion is issued as to the cause of the turbine failure.
3. In summary, it is my opinion that the accident was caused by a mechanical failure of the low pressure turbine which occurred in a manner that was not preventable by operations or maintenance supervision.

22 September 1995


JAMES B. SMITH, Colonel, USAF
325 OG/CC
Accident Investigation Officer