

AIRCRAFT ACCIDENT INVESTIGATION

AUTHORITY; Under the provisions of Air Force Regulation (AFR) 110-14, the Ninth Air Force Commander appointed Lieutenant Colonel Stephen M. Delaney to conduct an Aircraft Accident Investigation of the F-16CG (SN 90-0761) accident which occurred one nautical mile northeast of Shaw AFB on 27 October 1992. The investigation was conducted from 2 December to 22 December 1992. Technical advisors were Captain Bryan T. Johnson (Operations), 2nd Lieutenant Patrick Bobko (Maintenance), Captain Nancy Ignasiak (Legal), Captain Barbara Bucknam (Flight Surgeon), and Senior Airman Michael A. Bushey (Administrative Support). (Y-2,3)

PURPOSE: An aircraft investigation is convened under AFR 110-14 to collect and preserve all evidence for possible use in claims, litigation, disciplinary actions, adverse administrative proceedings, or for any other purposes deemed appropriate by competent authority. The investigation is to obtain factual information and is not intended to determine the cause of the accident. In addition, the aircraft accident investigation board cannot draw conclusions nor make recommendations. This report is available for public dissemination under the Freedom of Information Act (5 U.S.C. 552) and AFR 4-33.

SUMMARY OF FACTS

1. History of Flight: On 27 October 1992, Captain Bradley S. Johnson was scheduled as number 5 (Titan 45) of a six-ship simulated deployment cell that was part of a 24-ship exercise launch. Other pilots in the flight were Major Henry B. Longino, First Lieutenant Luther M. Adams, Captain Mark A. Nichols, Captain Jeffrey C. Galbraith, and Captain Kevin R. Frisbie (Titan 41, 42, 43, 44, and 46) (K-4,5). Filed under callsign Titan 41, the flight departed Shaw AFB, SC at 0801 EST and proceeded to the AR-636 refueling track. After refueling, Titan 41 flight returned to the Shaw AFB vicinity. The flight split into 2-ship elements led by Titan 41, 43, and 45 for separate approaches to the field. The aircraft flew a modified Aircraft Surge Launch and Recovery (ASLAR) approach to runway 22L, transitioning to initial for overhead patterns and landings (V-2,3,4). During the holding and approach Titan 45 noted abnormal fuel quantity indications and instructed Titan 46 to position himself to land first. Titan 45 declared an emergency with the tower and flew an overhead traffic pattern behind 46. In the final turn for landing, Titan 45's aircraft appeared to lose power and developed a high sink rate. When it became apparent that the airplane could not reach the runway, Capt Johnson ejected safely. The aircraft crashed and was destroyed (V-4). The crash site was approximately one nautical mile northeast of Shaw AFB, coordinates 33 degrees 59.41 minutes north latitude, 80 degrees 27.25 minutes west longitude (A-2). The Shaw AFB Public Affairs office handled news inquiries (Z-2,3).

2. Mission: The mission was scheduled and planned as part of a

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24-ship simulated overseas deployment. The planned profile included single-ship afterburner (AB) takeoffs, rejoin for the cruise to the air refueling point, inflight refueling, return to Shaw AFB via the ASLAR approach transitioning to initial, then full-stop landings.

3. Briefing and Pre-Flight: All members of the flight reported for duty at approximately 0300 at the dining hall for a squadron breakfast. All reported being adequately rested. (V-2,3,4) A mass briefing began at 0330 in the squadron building. After the main briefing, separate 6-ship flight briefings and 2-ship element briefings were conducted. In addition to briefings from Titan 41 flight, Titan 45 and 46 also attended a briefing with Hazel 31 flight, for whom they would act as ground spares. All pilots interviewed reported that the briefings were comprehensive and that they had a clear understanding of the planned events and their responsibilities (V-2,3,4). Titan 45 and 46 left the building early and started shortly after Hazel 31 flight. Ground operations, taxi, and pre-takeoff procedures were conducted without significant events. Titan 45 and 46 watched Hazel 31 takeoff, then waited at the end of the runway for Titan 41 flight (V-4).

4. Flight: Titan 41 flight took off at 0801 EST. The takeoffs were single-ship using afterburner. The flight rejoined into a 4-ship (Titan 41-44) followed by a 2-ship (45 and 46). Titan 45 came out of afterburner at 300 kts. Cruise altitude was Flight Level (FL) 230-250. The weather was good throughout the flight. Operations ("Ops") checks were conducted enroute to the tanker in accordance with (IAW) directives. All flight members confirmed centerline tanks dry, and all pilots interviewed recalled that everyone in the flight reported normal fuel readings during the check. Pre-refueling checks were normal, as was the refueling itself. After the refueling, post-refueling checks were acknowledged by all pilots. Cruise altitude for the return was FL 260. Ops checks were conducted as required on the return, and flight lead received acknowledgement of all external tanks dry from all wingmen (V-2,3,4). During this check, Titan 45 recalled seeing a zero reading in one of the external tank positions on the FUEL QTY SEL knob, but does not recall getting readings from all external tanks. He placed the FUEL QTY SEL knob in NORM at the end of this check (V-4-1). The flight proceeded normally to the arrival and holding fixes. Titan 41 told the flight to check their expected arrival fuel against the "RANGE" navigation mode and advised them to consider using AB and speedbrakes to burn off excess fuel to reduce landing weight (V-2,3,4). Titan 45 elected to use a small amount of afterburner (estimated fuel flow less than 20,000 pph). He terminated afterburner (AB) when RANGE showed 2500 lbs for arrival, but continued to use military power and speedbrakes during portions of the return for further weight reduction (V-4-2). Titan 41 split up the flight approaching the arrival and holding fixes. Titan 41/42 proceeded directly with the approach, 43-46 went to the holding fix for spacing. Titan 43/44 and 45/46 came out of the holding pattern as flights of two

in approximately 8-mile trail (V-2,3,4). As Titan 45 was proceeding to the holding fix, the AFT FUEL LOW caution light illuminated. He continued the planned routing and checked the fuel in all his tanks. He found 500/1500 lbs in the external wings, about 1000 lbs total in the fuselage, with FWD/AFT reservoirs showing 400/200. The mishap pilot (MP) then opened and closed the air refueling door and cycled the Tank Inerting switch in an effort to get the external fuel to transfer. Titan 45 continued the approach, and when it appeared the fuel was still not transferring he repeated the cycling of the air refueling and Tank Inerting switches. During the approach the FWD FUEL LOW light illuminated. Approaching approximately 8 miles on initial, MP directed Titan 46 to take the left wing and assume the tactical lead. His intent was to land Titan 46 first. Titan 45 contacted Shaw Tower and declared an emergency for "fuel imbalance." The flight then switched to UHF channel 14 for the single-frequency approach. During this time the MP continued checking the fuel in his tanks but made no further attempts to get transfer started. The tower asked him to confirm his intent to continue the overhead pattern, and he replied affirmatively (V-4-2). During this time, Titan 41 (on the ground) attempted to ascertain the problem and offer assistance over VHF. Titan 45 attempted to communicate that his real problem was low fuel. Titan 41 again attempted to offer assistance, but it became apparent that Titan 45 was otherwise occupied (V-2-2). Titan 46 pitched out, followed by 45. Titan 45 delayed his gear extension on the downwind, then lowered his gear and began a normal base turn ground track. Speedbrakes were closed. During the turn, a high sink rate developed and the engine appeared not to respond to the throttle. The pilot did not note cockpit indications of engine flameout, but it became apparent to him that he could not make the runway. He did not jettison external stores (V-4-3). At some altitude below 300' AGL (last seat-mounted data recorder reading was 547' MSL) the pilot ejected (O-35, V-9).

5. Impact: The aircraft initially impacted the edge of a wooded area, then slid approximately 300 feet down a short section of dirt road between a cotton field and a plowed field, before coming to rest on the edge of the cotton field approximately 4000 feet from the end of runway 22L at Shaw AFB (S-1, R-1,2,3). The aircraft was damaged beyond economical repair by the impact (M-2). Impact heading was approximately 235 degrees, and wreckage was scattered along a 650 x 160 foot area (R-4,5).

6. Ejection Seat: The ejection seat functioned normally (V-4-3).

7. Personal and Survival Equipment: All inspections of the mishap pilot's personal and survival equipment were current (U-2 through 10). The seat kit did deploy normally. Four-line-jettison was not performed (V-4-3). The locator beacon functioned normally (N-4). The pilot used the survival radio in his vest to attempt contact on 282.8, but there was no response

(V-4-3). Rescue parties arrived via ground transportation shortly thereafter. No other equipment used.

8. Crash Response: Shaw Tower noted an Emergency Locator Transmitter (ELT) at 1035:58 EST and activated the crash net at 1036:24 EST (N-4). The base fire department responded with 3 control vehicles, 3 primary firefighting vehicles, and 1 rescue vehicle; and the 363 Medical Group responded with two ambulances and 6 personnel. They reached the scene at 1040 EST (N-8). The relatively small fire was under control shortly after arrival, although one large tree continued to smolder. Capt Johnson was found by the crash rescue vehicle approximately 100 yards north on a country road with no apparent injuries. He was transported to Frierson Road, transferred to the ambulance and taken to the base hospital (V-4-3, N-9,14). The hydrazine team arrived on scene at 1124 and at 1134 reported no leak of hydrazine (N-9).

9. Maintenance Documentation: A thorough review of maintenance records for air craft 90-0761 revealed no open discrepancies related to the accident. The aircraft had three pilot writeups on fuel transfer/indication problems since the last phase inspection on 2-4 Sep 92 (H-4). Completion of maintenance corrective actions for each instance is documented in the aircraft forms. These are detailed in subparagraphs a, b, and c below. There were no overdue time compliance technical order (TCTO) or time change items (TCI) on the aircraft or the engine (U-11,13). All scheduled inspections were satisfactorily completed with no discrepancies identified (U-11). Oil analysis records were reviewed and no abnormalities were noted (O-72). The equipment review report was reviewed with no overdue inspections noted (U-11).

a. 15 Sep 92. Discrepancy: Left and right external wing tank slow to feed, 1000 lb imbalance. Corrective action: Removed and replaced both external wing tanks. Performed transfer check of external and internal wing tanks. Ops checked good.

b. 13 Oct 92. Discrepancy: 200 lbs of fuel would not transfer from left external wing tank. Ran complete checklist and still would not feed. Corrective action: Left external tank indicated 200 lb when empty. Removed and replaced left external tank.

c. 23 Oct 92. Discrepancy: Trapped fuel in external wing and centerline tanks after a partial load from A/R (aerial refueling). Checklist run (inflight) to no avail. Corrected with 3.5 G's on jet. Corrective action: Lubricated vent and pressurization valve. Leak and transfer check good (H-5).

10. Maintenance Personnel and Supervision: The mishap flight was launched by 33 FS personnel rather than the usual 17 FS personnel (V-6). This is a normal occurrence in generation and

deployment operations. Preflight servicing of the aircraft was reviewed with no discrepancies identified (H-6). Individual training records were reviewed with no discrepancies noted (U-15).

11. Fluid Sample Analysis: A review of the aircraft's oil analysis revealed no abnormalities (O-72). Fuel, hydraulic fluid, and oil samples taken from the aircraft at the crash site also revealed no discrepancies (O-43,49,51).

12. Airframe and Aircraft Systems:

a. Engine: Pilot testimony and aircraft data recordings indicate normal operations up to the loss of power and throttle response in the final turn. Data from the Crash Survivable Flight Data Recorder (CSFDR) and analysis of engine and fuel system components from the crash site are consistent with engine flameout due to fuel starvation (J-5).

b. Fuel System: Pilot testimony and fuel burn patterns from the crash site indicate trapped fuel in the external wing tanks (J-11,12,13, V-4-2). The aircraft had a history of trapped fuel problems, the most recent being the previous flight. Analysis of fuel transfer system components likely to cause this problem follows:

(1) External Fuel Transfer Override Relay. Recovered from the wreckage; the only visible damage was two bent contacts. Bench check at Shaw AFB on 11 Dec 92 showed contacts functioned normally. (J-18)

(2) External Fuel Override Float Switch in the vent box. Recovered from the wreckage with no apparent damage. Bench check at Shaw AFB on 11 Dec 92 showed the float had freedom of movement and contacts functioned normally. (J-17)

(3) Internal Wing High Level Shutoff Float Valves. These were intact in the wreckage. The floats moved freely and both valves functioned to open/shut off flow as designed. (J-17)

(4) Negative Pressure Relief Valves in External Tanks and Fuselage. The valves in one 370 gal. wing tank and the 300 gal. centerline tank were intact and functioned normally when activated by hand. No evidence of mechanical failure was present. The other was destroyed by impact. The fuselage negative pressure relief valve was undamaged and functioned normally when actuated by hand. (J-17)

(5) Refuel/Transfer Override Control Valve. Recovered from the wreckage with no apparent damage. Bench check at Shaw AFB on 15 Dec 92 showed full mechanical function with 28 volt DC applied. (J-18)

(6) Internal Tank Vent and Pressurization Valve. This valve had been removed from the wreckage and disassembled during the safety investigation. No evidence of internal mechanical failure was present. Mechanical parts were submitted to Non-Destructive Inspection (NDI) at Shaw AFB with no defects noted.

(7) External Tank Vent and Pressurization Valve. This valve had been removed from the wreckage and disassembled during the safety investigation. No evidence of internal mechanical failure was apparent. Mechanical parts were submitted to NDI at Shaw AFB. The only defect noted was some "porosity" (surface pitting caused by corrosion or electrochemical reaction) on the main spring base plate. Deposits on the main cylinder pressure were analyzed at San Antonio Air Logistics Center as scale deposits similar to those from evaporation of hard water. (J-16)

c. Hydraulic, Avionics, Flight Control, and Electrical Systems functioned normally. The pilot reported that he did not hear the EPU fire. Flight control authority was available up to the point of ejection; Fire Department transcripts (N-9) and examination of the EPU gas generator poppet valve indicated it did fire.

13. Operations Personnel and Supervision: The mission was conducted under the authority of the 363 FW and the 17 FS (K-4). The briefing was conducted by Lt Col Utterback using the wing briefing guide and was thorough and comprehensive (V-2,3,4).

14. Pilot Qualifications: Captain Johnson was current and fully qualified to conduct the mission. His flying experience follows:

<u>Aircraft</u>	<u>Hours</u>
F-16	758.5
AT-38	26.7

30/60/90 Day Summary

Last 30 days: 17 sorties/37.3 hours
Last 60 days: 27 sorties/50.2 hours
Last 90 days: 32 sorties/57.1 hours

15. Medical: Capt Johnson was medically qualified to fly. He suffered only superficial injuries from the ejection. The toxicology report showed no alcohol, carbon monoxide, medications, or illegal substances (X-2,3).

16. Navigation Aids and Facilities: All applicable navigation aids were operational (O-71).

17. Weather: The Shaw AFB and enroute weather was clear and presented no problem for the flight. Forecast outside air temperature for the enroute portion was -25 degrees centigrade (W-2,3).

18. Directives and Publications:

a. Directives and publications applicable to the mishap were:


- (1) TACR 55-116, F-16 Pilot Operational Procedures
- (2) TACR 55-116/SAFB Sup 1, Local Operating Procedures
- (3) TO 1F-16CG-1, Flight Manual
- (4) TO 1F-16CG-1CL-1, Flight Manual Checklist
- (5) TO 1F-16CG-2-28FI, Fuel System Fault Isolation Guide
- (6) TO 1F-16CG-2-28-10-1, Checkout of 370-Gallon Wing External Tanks and 300-Gallon Centerline External Tank

b. IAW AFR 110-14, the investigation found evidence of deviations from the following directives:

(1) TACR 55-116, para 3-14c, requirement to monitor fuel in each internal and external tank to verify proper transfer and distribution. (O-63)

(2) TO 1F-16CG-1CL-1, "Fuel Low" procedures, step 4, "Land as soon as possible." (O-67)

(3) TO 1F-16CG-1CL-1, "Trapped External Fuel" procedures, step 5, "EXT FUEL TRANS sw - WINGS FIRST." (O-68)


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AFR 110-14 Aircraft Accident Investigation Officer

GLOSSARY

Note: Acronyms, jargon, and terms are explained in the context in which they appear in this report. The application of these definitions is not universal and may be limited to this report.

AAR	- Air-to-Air Refueling
AB	- Afterburner
ACC	- Air Combat Command
ACCR	- Air Combat Command Regulation
ACCR Sup	- A supplement to an Air Combat Command Regulation.
AF	- Air Force
AF-623	- Air Force Form documenting individual training
AFB	- Air Force Base
AFISC	- Air Force Inspection Safety Center
AFR	- Air Force Regulation
AFTO	- Air Force Technical Order
AGL	- Above Ground Level: altitude measured between the aircraft and the ground.
Air Spares	- Reserve aircraft in the air, ready to replace any abort aircraft.
ALC	- Air Logistics Center
ALC/MMET, MMIRIA	- Air Logistics Center/Office Symbols
AR	- Air Refueling
ASLAR	- Aircraft Surge Launch and Recovery: an established procedure and routing that allows a large number of aircraft to depart or arrive at the airfield with little assistance from ground radar.
ATC	- Air Traffic Control
Base Turn	- See overhead pattern
Base Turn Ground Track	- Position of the base turn over the terrain.
BDU	- Bomb, Dummy Unit (BDU)-33: 251b practice bombs.
Break	- Pitch-out: see overhead pattern.
CAMS	- Core Automated Maintenance System: a computer system tracking aircraft maintenance actions.

Atch 1-1

CC	- Commander
CENC	- Convergent Exhaust Nozzle Control
CIVV	- Compressor Inlet Variable Vane
DEEC	- Digital Electronic Engine Control
DME	- Distance Measuring Equipment (slang use: miles from station).
Downwind	- See overhead pattern.
ELT	- Emergency Locator Transmitter (also "locator beacon"); automatically activated transmitter to locate downed pilots.
EPU	- Emergency Power Unit; a self contained source of emergency hydraulic and electrical power.
ER	- Exceptional Release: A signature releasing the aircraft to fly.
EST	- Eastern Standard Time.
Final Turn	- See overhead pattern.
FL	- Flight Level: Altitude in hundreds of feet (FL200=20,000').
Four Line Jettison	- A modification to the parachute canopy which can be performed by the pilot during descent.
FS	- Fighter Squadron
FTIT	- Fan Turbine Inlet Temperature
GCA	- Ground Controlled Approach: A method of recovering aircraft in marginal weather condition in which the pilot is given height and direction information by a controller watching the aircraft progress on radar.
Generation	- Preparing large numbers of aircraft for launch.
G-SUIT	- Pilot's anti-gravity garment.
Ground Spares	- Aircraft held in ready reserve on the ground to replace aircraft aborting for malfunctions.
Holding Fix	- Designated point for aircraft to hold until arrival time.
HPT	- High Pressure Turbine
IFE	- In-Flight Emergency
IFR	- In-Flight Refueling (See also AAR, AR).

Atch 1-2

Initial	- See overhead pattern
INS	- Inertial Navigation System
JFS	- Jet Fuel Starter
KTS	- Knots
JOAP (SOAP)	- Joint (Spectrometric) Oil Analysis Program
LOX	- Liquid Oxygen
LPU	- Life Preserver Unit
MAU-12	- Miscellaneous Armament Unit (MAU)-12: attaches stores to aircraft stations.
MDR	- Materiel Deficiency Report
Military Power	- Operating the engine at its highest RPM without using the afterburner.
MSL	- Mean Sea Level: altitude measured from standard sea level read on the cockpit altimeter.
NM	- Nautical Mile
NOTAMS	- Notice(s) to Airmen: A notice containing information on establishment, condition, or change in an aeronautical facility, service, or procedure that may be a hazard to flight.
Operations (Ops) Checks	- Recurring in-flight checks of critical aircraft systems, especially fuel and engines.
Overhead Pattern	- Sequence of maneuvers to a landing. Aircraft first flies directly to the field and over the landing runway in the landing direction at 2000' AGL: this is called "initial." At the appropriate point, the aircraft executes a 180 degree turn called the "pitch-out", or "break" to "downwind." Downwind is flown at about 2000' AGL, opposite direction to initial. At the appropriate point, the aircraft makes a 180 degree descending turn towards the runway called the "base" or "final" turn. At the completion of this turn the aircraft is on final approach for landing.
Pitched Out	- See overhead pattern.
PPH	- Pounds Per Hour (Flow rate).
PSI	- Pounds per Square Inch
RANGE Mode	- A function of the navigation computer that displays fuel at a selected point.

Atch 1-3

RAPCON - Radar Approach Control: the facility containing radar equipment and controllers.

RCVV - Rear Compressor Variable Vanes.

Refueling Track - Designated airspace for aerial refueling: tracks are numbered AR-xxx.

RPM - Revolutions Per Minute

SA-ALC - San Antonio - Air Logistics Center (Texas).

SFO - Simulated Flame Out: common pilot usage, any practice or real flameout landing pattern.

Single Frequency Approach - A procedure established for emergencies, in which all communications for approach, landing and emergency actions are on the same radio frequency.

SOF - Supervisor of Flying: A senior wing pilot positioned in the control tower.

Speedbrakes - Hydraulically actuated surfaces that extend into the airstream to increase aerodynamic drag.

TAC - Tactical Air Command

TACAN - Tactical Air Navigation

TACM - Tactical Air Command Manual

Tank Inerting - Forces halon into the fuel system and decreases internal fuel system pressure.

TCTO - Time Compliance Technical Order

TO - Technical Order - a manual or reference document

UPC - Unified Fuel Control

UHF - Ultra High Frequency Radio

VHF - Very High Frequency Radio

VTR - Video Tape Recorder