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AFR 110-14 USAF AIRCRAFT ACCIDENT INVESTIGATION REPORT

**13 JANUARY 1991
HANCOCK FLD, NY**

**F-16A
SN 79-0400**

**174 TFW
138 TFS
(DEPLOYED)**

INVESTIGATING OFFICER

LT COL KENNETH R. REES, JR.

HEADQUARTERS NINTH AIR FORCE (TAC)

SHAW AFB SC

PFS Exh. 118

COPY NUMBER

7 OF 12

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SUMMARY OF FACTS

1. History of Flight: On 13 January 1991, [REDACTED] was scheduled to lead [REDACTED] on a two ship formation tactical surface attack mission. The two ship formation was part of a larger fourteen ship formation, which included eight F-16 aircraft from the 169th Tactical Fighter Group (TFG) and six F-16 aircraft from the 174th Tactical Fighter Wing (TFW). They were the last two aircraft within the fourteen ship formation package. Filed under call sign Migraine 01 (wingmen 02, 03, 04, 05, 06, 07, 08) and Polio 01 (wingmen Polio 02, 03, 04, 05, 06), the flight of fourteen departed Al Kharj Air Base, Saudi Arabia at 1345 local enroute to the training area located approximately 70 to 80 nautical miles southwest of the Al Kharj Air Base. After the second simulated dive bomb attack, Polio 06 experienced smoke and fumes in the cockpit and zero engine oil pressure. Shortly afterwards the engine failed, the emergency power unit (EPU) failed to start normally and the aircraft departed controlled flight. The pilot ejected, the aircraft crashed and was destroyed (A-1, J-4, K-1, V-2, V-5, V-14, V-17). The crash site was 31.5 nautical miles south southwest of Al Kharj Air Base, Saudi Arabia, coordinates 23 degrees 37.2 minutes north latitude, 47 degrees 24.9 minutes east longitude (R-3). The 174 TFW, Hancock Field, Syracuse, New York, Public Affairs Office handled news inquiries (Z-1).

2. Mission: The mission was scheduled and planned as a fourteen ship formation surface attack tactics mission in preparation of the possible

outbreak of hostilities (V-2, V-5, V-17). The fourteen ship formation was composed of eight F-16 aircraft (two four ship formations) from the 169 TFG and six F-16 aircraft (one four ship and one two ship formation) from the 174 TFW. The mission was specifically designed to familiarize the pilots from both units with large formation surface attack tactics and coordination. Both units were located at Al Kharj Base. The trailing two ship (Polio 05, 06) contained the mishap pilot [REDACTED] (Polio 06) (V-2, V-5, V-20). The planned profile included single ship afterburner takeoffs, rejoin in three four ship formations and one two ship formation elements, descent to a tactical low-level formation navigation segment southwest of Al Kharj Air Base toward Area 24, a fly-up to medium altitude (25,000 to 28,000 feet), ingress for simulated 45 degree dive bomb attacks on four specific targets by element, egress, reform the formation, ingress, execute a second simulated attack, egress, and return to Al Kharj Air Base for landing (V-5, V-17).

3. Briefing and Pre-flight: Members of the flight arrived for duty between 0500 and 0600. All members had adequate crew rest. All members participated in a 0645 mass briefing conducted by the 169 TFG utilizing squadron standard and Al Kharj local area procedures. Particular emphasis was placed on large formation procedures, coordination, and techniques. The scheduled 0915 takeoff was delayed for one hour due to unsatisfactory weather. The unsatisfactory weather continued and the takeoff was later rescheduled for 1345. All members of the flight reassembled at approximately 1200 for an updated mass briefing. The planned mission remained the same and all previous contingencies were rebriefed. During ground operations [REDACTED] assigned aircraft (tail number 394) had not been refueled from a previous flight; therefore, he was reassigned to a spare aircraft (tail number 400). The remainder of ground operations, taxi, and pre-takeoff procedures were conducted without significant events (V-5, V-15, V-17, V-20).

4. Flight: The fourteen ship formation took off to the north on runway 35 at 1345 local. The formation rejoined after takeoff and proceeded south on a three segment tactical low level navigation leg toward Area 24 (K-1, V-5, V-17). At point three on the tactical low level navigation leg, the fourteen ship formation started a climb to medium altitude (25,000 to 28,000 feet) and continued navigation to the simulated target area. Upon arrival in the target area, a each formation element ingressed to their specific target and conducted a 45 degree dive bomb attack utilizing simulated MK 84 general purpose bomb ordnance with a 18,000 feet release altitude. Once the attack was completed, each formation element egressed to a specific navigation point and reformed the fourteen ship formation. The flight ingressed the target area once again for another simulated attack. The attack and targets remained the same as the first attack (V-5, V-17). As Polio 06 egressed the target area, [REDACTED] noticed a greying condition within [REDACTED] cockpit. [REDACTED] initial thought was that [REDACTED] was greying out due to high G conditions. [REDACTED] looked at the G meter in the HUD and discovered that [REDACTED] was only pulling about 5 Gs, not enough to normally grey out. [REDACTED] turned [REDACTED] head to look for [REDACTED] flight lead (Polio 05) and smoke and fumes entered under [REDACTED] helmet visor

and oxygen mask. [REDACTED] eyes began to water and [REDACTED] started to choke. [REDACTED] continued to climb and immediately selected 100 percent oxygen on [REDACTED] oxygen regulator. [REDACTED] choking symptoms cleared; however, the smoke and fumes continued to increase and [REDACTED] had difficulty seeing the aircraft instruments. [REDACTED] positioned the environmental control system air source knob to RAM, thus clearing the smoke and fumes from the cockpit. Then [REDACTED] transmitted to [REDACTED] flight lead that [REDACTED] had smoke and fumes in the cockpit. Polio 05 initially did not see Polio 06; however, [REDACTED] instructed [REDACTED] to select 100 percent oxygen and turn [REDACTED] aircraft to a heading of north toward Al Kharj Air Base. Polio 05 visually acquired Polio 06 and rejoined on [REDACTED]. As Polio 05 was performing the rejoin, Polio 06 transmitted that [REDACTED] engine oil pressure had decreased to zero. [REDACTED] had observed a flashing "warning" on the HUD and heard a voice audio "warning" through [REDACTED] headset. Additionally, the oil/hydraulic pressure warning light had illuminated. [REDACTED] checked the A system and B system hydraulics gauges and the engine oil pressure gauge. Both hydraulics systems were operating within normal pressure ranges; however, the engine oil pressure gauge was reading zero. [REDACTED] set the throttle at 80 percent RPM in accordance with the emergency action checklist procedures, and continued to climb. As [REDACTED] was preparing to selective jettison the two external fuel wing tanks, [REDACTED] heard and felt a "clunk". As the engine RPM rapidly decreased through 50 percent the main electrical generator failed, thus illuminating several additional warning and caution lights. [REDACTED] observed that the EPU run light had not illuminated. Realizing that the EPU should have automatically started and provided auxiliary electrical power and hydraulic pressure to A system hydraulics, [REDACTED] raised the red mechanical guard around the cockpit EPU switch and moved it from normal to on. Twenty eight seconds after the main electrical generator failed, the A and B system hydraulics completely failed, driving the flight control surfaces to their neutral position, and the aircraft rapidly pitched up and departed controlled flight in a flat inverted clockwise spin. Approximately ten seconds later and at an altitude of approximately 23,000 feet, [REDACTED] successfully ejected (U-4). The aircraft crashed in an unpopulated desert area. Polio 05 maintained visual contact with [REDACTED] during [REDACTED] ejection and parachute descent until [REDACTED] entered a 1000 foot thick cloud layer at 5000 feet AGL. Polio 05 marked that position with the aircraft inertial navigation system (INS) equipment and a few minutes later descended through an opening in the clouds. Polio 05 navigated to the marked INS point and located [REDACTED]. Utilizing [REDACTED] survival radio, [REDACTED] established radio contact with Polio 05. Polio 01 through 05 orbited in the area until [REDACTED] coordinates had been passed to the Al Kharj Command Post and search and rescue (SAR) operations were initiated. As each aircraft reached bingo fuel, they returned to base. [REDACTED] was later picked up by a French helicopter and transported back to the Al Kharj Air Base field hospital (V-2, V-5, V-14, V-17).

5. Impact: The aircraft impacted in an unpopulated desert area, approximately 31.5 nautical miles south southwest of Al Kharj Air Base, Saudi Arabia (A-1, R-3, R-4). The aircraft caught fire and was destroyed. The aircraft impacted the ground in a near wings level inverted position with

little to no forward airspeed (R-2). The engine had seized due to oil depletion and was rotating at low to zero RPM at ground impact (J-2, J-4, J-6).

6. Ejection Seat: The ejection seat functioned normally (V-18).

7. Personal and Survival Equipment: All inspections of the mishap pilot's survival equipment were current and functioned normally (U-3, V-18).

8. Crash Response: The Al Kharj Air Base USAF Command Post activated the crash net and initiated the SAR operation (V-10, V-14). Due to delays in locating a helicopter to affect a pickup, a surface SAR was initiated. The pick up site coordinates were passed from Polio 05 to the Command Post and given to the surface SAR team (V-7, V-10). The composition of the multi-vehicle surface SAR team included the 174 TFW flight surgeon (Capt Holmes), two fully qualified medics, two sets of Security Police to secure the crash site, and a bioenvironmental engineer for environmental evaluation of the crash site (V-10). Polio 01 through 05 orbited at altitude over the site until they reached their bingo fuel and returned to base. The pick up site coordinates were passed to several C-130 aircraft and a French helicopter. A C-130 located [REDACTED] and vectored the French helicopter to [REDACTED] position. The helicopter picked up [REDACTED] just as the surface SAR team arrived on scene. The surface SAR team attempted to locate the aircraft crash site, but were unable due to darkness. They returned to Al Kharj Air Base at approximately 2300 local. The crash site was located and secured by USAF security police on 14 January 1991 (V-3, V-7, V-10, V-14, V-19).

9. Maintenance Documentation: A thorough review of maintenance records for aircraft 79-0400 revealed no discrepancies related to the mishap (H-2, H-3). There were no overdue Time Compliance Technical Orders (TCTO) or Time Change Items (TCI) on the aircraft or the engine (H-4, H-5). All scheduled inspections were satisfactorily completed with no discrepancies identified (U-2). Oil analysis records were reviewed and no abnormalities were noted (O-3). A records review showed no overdue time change requirements (U-2). The Equipment Review Record was reviewed and no overdue inspections were noted (U-2).

10. Maintenance Personnel and Supervision: Preflight servicing of the aircraft was reviewed with no discrepancies noted (H-5). Individual training records were reviewed with no discrepancies noted (H-7). Visual inspection by engineers at San Antonio Air Logistics Center revealed a clean EPU poppet valve. Additionally, the poppet valve guide was installed into the gas generator body only finger tight and the valve guide safety wire was present but broken. No residue from the shear pin or o-ring was visually present on the poppet valve (J-6, V-44). Additional microscopic, and spectrometric analysis by the 174th NDI (non-destructive inspection) Lab at Hancock Field, New York, revealed traces of burned o-ring on the poppet valve and in the valve guide (O-2, O-3).

11. Engine, Fuel, Hydraulic, and Oil Inspection Analysis: A review of the aircraft records revealed no abnormal findings with the engine inspection data (O-4, O-5), or the oil analysis paperwork (O-6 to O-12). Fuel and hydraulic fluid were not available for analysis.

12. Airframe and Aircraft Systems:

a. EPU:

(1) The EPU did not start automatically when the EPU switch was in the NORM (normal) position (V-18, V-48). When the EPU switch was manually selected to the ON position, the EPU did not start within two seconds as specified by system technical orders (V-18, O-11). EPU teardown and analysis indicated that the turbine was spinning at high speed upon ground impact (J-6, V-41, V-46). The seat data recorder analysis indicates the EPU was running and providing electrical power and A system hydraulics approximately six seconds prior to pilot ejection (U-4). Analysis of the nitrogen valve, fuel control valve and the electrical assemblies showed no abnormalities; however, extensive fire damage made a functional check impossible. The gas generator was intact; however, the poppet valve guide safety wire was broken and the guide was screwed into the gas generator body only finger tight (normal torque is 430 to 530 inch-pounds) (J-6). The poppet valve may have been removed and inspected at an undetermined time prior to arrival at Hill AFB for tear down and analysis by Air Logistics Center (ALC) inspectors (V-42, V-47). Visual inspection of the poppet valve and poppet valve guide revealed no residue from the o-ring or shear pin. Normally, after the monopropellant (hydrazine) mode has been used to start and run the EPU, the sooty remains of the o-ring and shear pin would be present in the poppet valve guide area. Since o-ring and shear pin residue were not present during the visual inspection by the ALC inspectors, they concluded that the o-ring and shear pin may not have been installed correctly. An incorrectly installed poppet valve may allow atmospheric humidity to enter the gas generator exhaust port via the EPU exhaust duct. Over a period of time, the catalyst performance will degrade to the point where it will not bring the EPU up to speed in the monopropellant mode even though it will still partially catalyze the hydrazine. Heat from the partial catalysis will eventually remove the moisture, enabling the turbine to come up to speed after an additional delay of one to two seconds (V-42, V-44, J-5). Further analysis by 174 TFW NDI laboratory was performed. Microscopic inspection of the poppet valve o-ring groove revealed a circular discolorization pattern within the groove. Additionally, spectrometric analysis revealed increased levels of silicon within the groove (O-19). The 174 TFW NDI laboratory concluded that an o-ring was present during the monopropellant mode of EPU operations (O-19). The automatic firing mode of the EPU was the primary failure within the EPU system. Several of the EPU system components that control and activate the EPU during the automatic start could not be functionally checked due to extensive fire damage; therefore, the specific failure is undetermined (V-41, V-48, J-5).

(2) The manufacturer of the Emergency Power Unit is Airesearch.

(3) Teardown and analysis of the Emergency Power Unit was performed at Odgen Air Logistics Center, Hill Air Force Base, Utah (J-5, V-41, V-44).

b. Engine:

(1) The number one bearing oil supply line tab broke due to high cycle fatigue, thus allowing the oil supply line to dislodge itself from the bearing housing. The leaking oil was drawn into the anti-ice air slots and ingested through the engine inlet cone down into the engine core. As the oil was consumed by the engine it entered the environmental control system (ECS) via the seventh and thirteenth stages of the engine compressor. This accounts for smoke and fumes in the cockpit (J-4, J-5). The oil from within the engine was depleted and the number three bearing quickly deteriorated and seized (J-5).

2. The manufacturer of the F100-PW-200 engine is Pratt/Whitney.

3. Teardown and analysis of the engine was performed at the San Antonio Air Logistics Center, Kelly Air Force Base, Texas (J-1).

13. Operations Personnel and Supervision: The mission was conducted under the authority of the 174 TFW and 138 TFS (K-1). The briefings were conducted by the flight lead of Migraine 01 (169 TFG), and [REDACTED] in accordance with 174 TFW briefing guide and Al Kharj Air Base operating procedures. The briefings were thorough and complete (V-2, V-5).

14. Pilot Qualifications:

a. [REDACTED] was current and fully qualified to conduct the mission. flying experience follows (T-3):

<u>AIRCRAFT</u>	<u>HOURS</u>
F-16	207.0
AT-38	32.5

30/69/90 Day Summary

30 Day	9 sorties/13.3 hours
60 Day	13 sorties/18.0 hours
90 Day	30 sorties/43.4 hours

15. Medical: [REDACTED] was medically qualified to fly (T-2). [REDACTED] sustained minor injuries from the ejection, primarily bruises on the right buttock, both outer thighs and muscle pain in both bilateral calves. The toxicology report showed no alcohol, carbon monoxide, medications, or illegal substances (X-2, X-3).

16. Navigation Aids and Facilities: All applicable navigation aids were operational.

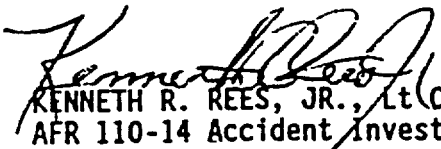
17. Weather: The Al Kharj Air Base weather at the time of takeoff was 1/8 Stratus at 1500 feet, 2/8 Stratocumulus at 4000 feet, 2/8 Altocumulus at 8000 feet, 2/8 Altocumulus at 14,000 feet, 1/8 Cirrus at 30,000, 8000 meters (5 miles) visibility, and winds 110 degrees at 7 knots. Airfield weather at the time of the mishap was 5/8 Stratocumulus at 1000 feet, 1/8 Stratocumulus at 4000 feet, 2/8 Altocumulus at 14,000 feet, visibility 8000 meters, and winds 110 degrees at 7 knots (W-2).

18. Directives and Publications:

a. Directives and publications applicable to the mishap were:

- (1) AFR 60-16, General Flight Rules
- (2) TACM 51-50, Tactical Aircrew Training
- (3) TACR 55-116, F-16 Pilot Operational Procedures
- (4) Al Kharj (New) Local Area Operational Procedures
- (5) TO 1F-16A-1, Flight Manual
- (6) TO 1F-16A-1CL-1, Flight Manual Checklist
- (7) 174 TFW Briefing Guide

b. No deviations to regulations occurred.


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