RAS 5855 72-22-ISFSI - Joint Exhibit 11 - Recd 4/11/02

AFI 51-503 ACCIDENT INVESTIGATION REPORT

AUTHORITY: Under the provisions of Air Force Instruction (AFI) 51-503, the Eighth Air Force Commander, Lieutenant General Phillip J. Ford appointed Lieutenant Colonel John R. Strifert on 12 December 1996 to conduct an aircraft accident investigation of the F-16A (82-1020) accident that occurred on 21 November 1996 near Skiatook, Oklahoma. The accident resulted in the successful ejection of the pilot, Captain Derrick S. Knight and the destruction of F-16A aircraft serial number 82-1020. Estimated private property damage was $96,433 (Tab P). The investigation was conducted from 12 to 24 January 1997. Technical advisers were Captain Michael A. Lewis (Legal) and Staff Sergeant Darrin E. Sutterfield (Maintenance) (Tab Y).

PURPOSE: An aircraft accident investigation was convened under AFI 51-503. This investigation is separate and apart from the safety investigation conducted under AFI 91-204. The purpose of this investigation is to find and preserve evidence to use in claims, litigation, disciplinary actions, adverse administrative proceedings, and for all other purposes. The report is available for public dissemination under the Freedom of Information Act (5 U.S.C. 552) and AFI 37-131.

SUMMARY OF FACTS

1. History of Flight: On 21 November 1996, Captain Derrick S. Knight was scheduled to fly as number 3 of a 4-ship Night Airborne Air Refueling (NAAR) training mission to the Eureka Military Operating Area (MOA), Kansas. The flight of 4 F-16As was filed as callsign Ozark 1, led by Major Kean U. Cunningham, (the subsequent member's callsigns were Ozark 2, 3, and 4) and departed Tulsa, Oklahoma Airport at 1754 Central Standard Time (CST). Ozark 1 Flight took off, flew directly to Eureka where they joined with Buddy 48, a KC-135 refueler from McConnell AFB, Kansas, and refueled at 21,000 feet. Refueling order was Ozark 1, followed by Ozark 3, Ozark 2 and then Ozark 4. After refueling, Ozark 1 and 2 remained in the MOA to perform intercept training, and Ozark 3 and 4 returned pursuant to their flight plan to Tulsa Airport for full stop landings. While leveling off at 10,000 feet on an enroute descent, Ozark 3 experienced a loud bang which knocked his feet off the rudder pedals. He noticed a loss of thrust, and decreased engine RPMs. Ozark 4, the wingman flying on Ozark 3's right side, noticed sparks, flames, and baseball-sized pieces of glowing debris exit Ozark 3's tailpipe. Ozark 3 attempted to restart the engine using emergency procedures. Two airstart attempts were unsuccessful, and Ozark 3 then prepared for an ejection. Ozark 4 assisted with radio communications to notify Kansas City Air Route Traffic Control Center and Tulsa Approach Control of the emergency. Upon receiving a directional heading from the Tulsa RADAR facility to an unpopulated area, Ozark 3 initiated a bail out sequence. The ejection equipment performed normally. Captain Knight ejected and touched down near the Skiatook Airport, and suffered just superficial bruises. The aircraft impacted in a field approximately 2 miles southwest of Skiatook, Oklahoma. News media interest was high. All three local TV stations (Channel 2-NBC, Channel 6-CBS, and Channel 8-ABC) came on the scene following the accident. Representatives from local newspapers and radio stations were also present. Captain Kimberly Maloy, acting public affairs officer from the Tulsa Air National Guard fielded questions and answered queries for Air Combat Command and the Air National Guard. In the days following the mishap, The Tulsa World and Skiatook Journal published articles about the mishap (Tabs A, V 1, V 8, S).

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2. Mission: The 188th Fighter Wing, Arkansas Air National Guard, had been deployed to the Tulsa Air National Guard facility since 13 September 1996. The deployment was to support continuation training requirements for all assigned pilots. The deployment was necessary because the runway at Fort Smith was being resurfaced. The mission on 21 November was scheduled and planned as a continuation training sortie for flight members to fulfill night refueling, intercept, and night landing requirements (Tabs K, V 1).

3. Briefing and Preflight: Crew rest was adequate with Captain Knight arriving at the deployed operating location two hours before the scheduled brief time of 1615 CST. Captain Adams (Ozark 4) arrived at the squadron at approximately 1200 CST (Tabs K, V 1, V 8). The flight briefing by Major Cunningham was adequate and covered all pertinent and required items, using the briefing guide in the 188th Fighter Wing Inflight Guide. All proceedings were normal that evening, with no problems or questions about the upcoming mission (Tabs V 1, V 8). Aircraft preflight inspection and start were normal (Tabs V 2, V 6, V 8).

4. Flight: Scheduled briefing time for Ozark 1 Flight was 1620 CST and was changed by the flight lead to 1615 CST with a proposed departure time of 1745 CST (Tab K). Ozark 1 Flight took off from Tulsa at 1754 CST one at a time, 20 seconds apart, using afterburner. The four planes then met up on departure, flying the TULEUREK Stereo Flight Plan. This flight plan is an instrument flight rules plan directing the flight to fly to a point 42 miles north of Tulsa, entering Eureka at a point 70 miles east of Wichita, Kansas, and delaying for 40 minutes at 20,000 feet and above. After refueling with the KC-135, the plan then exits 70 miles east of Wichita at 17,000 feet, and returns to a point 30 miles northeast of Tulsa. The plan then directs the flight to Tulsa, and directs members to fly an instrument approach to land based upon the primary runway pattern at Tulsa (Tabs K, V 2). Takeoff, departure, join-up, tanker rendezvous, and refueling were normal and flown as briefed (Tabs V 2, V 8). After refueling, Ozark 1 and 2 remained in the Eureka MOA, and Ozark 3 and 4 began their flight back to Tulsa. After positive contact with Kansas City Center, Ozark 3 and 4 departed Eureka, descended to a lower altitude and received RADAR vectors to Tulsa. At the level off sequence, at 10,000 feet and 350 knots, approximately 30 miles north of Tulsa, Ozark 3 (Captain Knight) experienced an engine anomaly. Ozark 3 described a noticeable loss of thrust, a significant "bang", and decreasing engine RPMs. He also reported that his feet were knocked off the rudder pedals. Ozark 3 began a sequence of steps to restart the engine. He climbed approximately 3-4,000 feet to give himself more time, released his external fuel tanks and weapon pylons to reduce weight, and brought the throttle to the cut-off position to reset the engine control. He then descended to maintain airspeed, and noticed the SEC (secondary engine control) light on the caution panel was illuminated. This light assured him that the engine control was acting properly. Ozark 3 then brought the throttle to idle to restart the engine, and turned on the JFS (jet fuel starter) to assist in the start attempt. After a call to Ozark 4 on the primary radio, Ozark 3 lost cockpit lighting and secondary radio capability. This occurred because the EPU (emergency power unit) had stopped running in its automatic mode. He selected ON on the EPU control to regain power to this backup source of electrical power. After approximately 15 seconds, the EPU stopped running for a second time. The first attempt to regain engine control failed, and Ozark 3 attempted another start attempt by shutting off the throttle and returning it to idle. Throughout this sequence, communication broke down between Ozark 3 and 4 due to the EPU interruptions. Ozark 3 remained on

Kansas City Center with his primary radio, Ozark 4 switched his primary radio to Tulsa Approach, and due to the EPU failure, the secondary radio capability was lost to Ozark 3. Ozark 3's primary radio was powered by the aircraft battery. It became apparent to Ozark 3, that the distance to Tulsa was too great to effect a glide, and that an ejection to a clear area was necessary (Tabs N, V 3, V 8). Weather during the entire flight remained constant. An overcast layer of clouds existed at 2100 feet, with the top of the layer approximately 3200 feet, and clear above. Moon illumination was between 60 and 70 percent (Tabs V 2, W).

After receiving a vector of 220 degrees from Kansas City Center, Ozark 3 turned to this clear area and prepared for ejection (Tabs N, V 3). Ozark 4 changed his position from the right hand side to the left hand side, and increased distance to approximately 1,000 feet to avoid interference with Ozark 3. Ozark 3 initiated the bailout sequence, and ejection systems performed correctly (Tabs V 3, V 8). Ozark 4 witnessed the ejection, circled overhead twice, saw the impact and resultant fire ball. Ozark 4 then called Major Knox, the SOF (supervisor of flying), at the Tulsa Air National Guard, and was directed to return to base. He landed uneventfully (Tab V 8). Ozark 3 estimated his time in the parachute to be about 8 minutes, and landed near the Skiatook, Oklahoma Airport. There were no terrain or navigational difficulties encountered throughout the flight or ejection sequence (Tab V 3).

5. Impact: The aircraft impacted the ground (N 36 22, W 96 01) at 1831 CST, 21 November 1996, 2 miles southwest of Skiatook, Oklahoma, and 11 miles northwest of Tulsa, Oklahoma. Approximate aircraft parameters were: Heading 280 degrees, nose down attitude, right wing low, with an unknown airspeed and angle of attack (Tab R). The aircraft was destroyed on ground impact, with the wreckage strewn along a 280 degree axis, approximately 400 feet wide and 200 feet long (Tab S).

6. Egress System: Ejection was initiated at approximately 4-5,000 feet above ground level (AGL) and at about 150 knots (Tabs O, V 8). Sequencing was normal and there were no difficulties with the equipment. After successfully getting a full canopy, Captain Knight performed post ejection analysis of the parachute, the survival kit, and his personal life support gear. He opted not to inflate his life preserver units (LPU), but did elect to perform a four-line release of his parachute to better control his steering ability. Captain Knight was in the chute for approximately 8 minutes, and performed a parachute landing fall (PLF) without experiencing any serious injury (Tab V 3).

7. Personal and Survival Equipment: All equipment performed as it was designed. All inspections were up to date (Tab U). Captain Knight had no difficulty with the ejection sequence and preparation and training for the ejection were adequate (Tab V 3).

8. Rescue: Local fire and police officials responded after aircraft impact at 1831 CST. The local fire chief from the Skiatook, Oklahoma Fire Department, who was first on the scene, took control. Notification to the Fire Department came from an unknown resident nearby. Captain Knight, after completing his PLF, noticed a local police official scanning the site, and walked toward him. Several vehicles passed by before Captain Knight got someone's attention. A truck stopped, picked up Captain Knight and brought him to the police cruiser (Tab V 3).

9. Crash Response: Local crash response was immediate. Captain Knight, after contacting the police official, asked that a one-half mile cordon be set up around the wreckage, and secured a cellular phone to contact the SOF to bring out necessary military authorities for support. The SOF, after receiving notification from Ozark 4, called the county sheriff's office. He then dispatched Tulsa ANG Crash/Rescue vehicles, the ANG Security Police, and the ANG Hazardous Materials Response Team. Explosive Ordnance Disposal (EOD) personnel arrived from Tinker AFB, Oklahoma, approximately 0400 CST on 22 November 1996 (Tab V 3). Local fire department equipment at the scene had few difficulties gaining access to the scene due to its close proximity to a paved highway. Weather and terrain did not pose any problems (Tab S).

10. Maintenance Documentation: A review of maintenance documents revealed no discrepancies. All current Air Force Technical Order (AFTO) Forms 781 remained at the deployed location. On the day of the mishap, the aircraft received an adequate preflight inspection and forms revealed it was adequately serviced with fuel and LOX (liquid oxygen) (Tabs U, V 6). Airframe and engine cycle times were properly documented showing no overdue inspections. All routine inspections were current to include engine, egress, life support, and all other required scheduled activity. Time Compliance Technical Orders (TCTOs) were adequately documented and there were no overdue inspections. Oil analysis records and time change requirements were current and no trends or discrepancies were noticed. A scheduled phase inspection had been completed within 36.1 hours, and there were no unscheduled maintenance discrepancies other than routine tasks normally associated with flying training activity (Tabs D, H, U). Maintenance procedures performed by personnel were adequately accomplished (Tabs V 5, V 6, V 7).

11. Maintenance Personnel and Supervision: A review of documentation did not reveal any evidence of maintenance discrepancies which may have contributed to the accident (Tab H). A review of the crew chief's AF Form 623 (On The Job Training Record) and AF Form 797 (Job Qualification Standard Continuation/Command JQS) indicates he was properly trained and had the level of experience required to perform his duties. The level of supervision was proper for the assigned mission (Tab V 7).

12. Engine, Fuel, Hydraulic, and Oil Inspection Analysis: A review of engine inspection data revealed that inspections were accomplished frequently and in accordance with current directives (Tabs D, J 18, U, V 7). Fuel, hydraulic and oil inspection analysis revealed no abnormalities (Tabs D, J).

13. Airframe and Aircraft Systems: Flight control system components, hydraulic systems, fuel systems, egress, and avionics systems do not appear to be a factor in this accident. The power plant, emergency power unit (EPU), and jettison systems revealed discrepancies that played either a minor or major role in the mishap (Tabs I, J).

a. Extensive analysis of the engine revealed significant damage to the Low Pressure Turbine (LPT) Module. This module consists of two stages of uncooled turbine rotor blades and stationary turbine vanes that drive the forward portion of the engine directly. These blades are powered by hot gas exiting from a high pressure turbine (HPT) section located immediately in front of the LPT. Inspection revealed that the third and fourth stage blades were moderately to heavily damaged (Tab J 7, S 9, S 10). Damage to the third stage area can result from three types of damage - foreign object damage (FOD),

domestic object damage (DOD), or creep-induced stress rupture (Tab J 11). An object not part of the engine is foreign; an object that is part of the engine is domestic. For foreign object damage (FOD) or domestic object damage (DOD) to occur, damage in front of the third stage would have to be evident. There was no damage in front of the third stage (Tab J 11). The most forward section exhibiting damage is the third stage. Creep-induced stress is when blades "stretch" in length over time in a hot environment. Creep-induced stress rupture in the third stage cannot be ruled out and would cause secondary DOD to the fourth stage (Tab J 12, J 14). In the fourth stage, there are seven failure modes that have been identified in prior mishaps (Tab J 11). Three of these seven result from fractures in the base (root) of the blade itself. All of the fourth stage blades were broken above this base (Tab J 11, S 10). The remaining four failure modes are creep-induced stress rupture (fourth stage); patchy fatigue (when blades are not properly heat-treated during initial manufacture); porosity stress rupture (when blades are manufactured improperly); and FOD/DOD (Tab J 11). Each one of these four possibilities were analyzed (Tab J 11). For creep-induced stress rupture to be a primary failure, damage would be confined to the fourth stage. In this instance, damage occurred in both the third and fourth stages. For patchy fatigue and porosity stress rupture, faulty blades would have to pass manufacture analysis and quality control processes. For FOD to occur, damage would have to be evident in front of the LPT. There is no evidence to support this. DOD cannot be ruled out since an item from the third stage can damage the fourth stage.

b. Examination of the analysis of the emergency power unit (EPU) revealed that the EPU turbine was not turning at the time of the aircraft impact with the ground (Tab J 5). Extensive damage of the EPU due to ground impact resulted, and specific analysis is difficult.

c. Examination of the analysis of the jettison systems revealed that the right 370-gallon fuel tank did not jettison when commanded (Tab J 23). Thorough inspection of the components could not conclusively pinpoint a failed item, and only conjecture as to the cause of this failure is offered (Tab J 24).

14. Operations Personnel and Supervision: The mission was authorized by Lt Col Phillip C. Koch, Operations Group Commander, in accordance with AFI 11-206 and AFI 11-401. The flight briefing was conducted by Major Kean U. Cunningham using the 188 FW briefing guides, and the Supervisor of Flying was Major John W. Knox (Tab K). The SOF gave an initial brief of weather, and airfield conditions to Major Cunningham, then the four flight members briefed the mission in one of the flight briefing rooms. The briefings were thorough and in accordance with requirements for the mission (Tab V 1, V 8).

15. Pilot Qualifications: Captain Knight was current and qualified to perform the mission. He is an F-16 flight lead, with 947.9 total flying hours, 692.5 hours in the F-16 A/C (Tab G). He is current in all flying training events. Captain Knight had recent practice with emergency procedures training at the F-16 simulator at Hill AFB (Tab V 2). Captain Knight had 2.3 hours of flying the day prior to the mishap and his 30, 60, and 90 day history revealed the following (Tab G):

30 Day 2.3 hours/1 sortie

60 Day 14.5 hours/6 sorties

90 Day 24.1 hours/11 sorties

16. Medical: Captain Knight was medically qualified for flight duty. His last physical examination was performed 26 October 1996. No medical defects or diseases were noted. No chronic illnesses, medications or medical waivers are present. No recent or chronic dental problems were noted in his dental records. A review of toxicology reports reveal no indication of use of unauthorized drugs (Tab BB).

17. Navaids and Facilities: There were no notices to airmen (NOTAMS) pertaining to navigation aids or facilities on 21 November 1996 that affected the mission. All relevant navigational aids and facilities were functional (Tab W).

18. Weather: An overcast layer of clouds existed during the flight, but was not considered a factor in the mishap. The observation at takeoff time was winds out of the northeast at 10 knots gusting to 16 knots, 10 miles visibility, an overcast layer at 2100 feet with the temperature at 7 degrees Centigrade. An hour after takeoff, the weather was essentially the same with winds dropping to 8 knots. The forecast was for overcast clouds at 1700 feet, visibility 6 miles and winds from the north at 12 knots (Tab W).

19. Governing Directives and Publications: There is no evidence of violations of regulations, directives, or publications relevant to this accident. Primary regulations applicable to this mission are:

AFI 11-206, General Flight Rules

AFI 11-401, Flight Management

AFI 11-214, Aircrew and Weapons Director Procedures for Air Operations

MCR 11-F16, F-16 Pilot Operational Procedures

T.O. 1F-16A-1, Flight Manual

TCTO 2J-F100(III)-556, Inspection for Proper Blades

TCTO 2J-F100(III)-565, Borescope Inspection of LPT

With respect to TCTO 2J-F100(III)-556, the blade inspection, and TCTO 2J-F100(III)-565, the borescope inspection, evidence shows that these inspections were performed as required, and at the proper times (Tab J 14, V 5, V 7).

20. Original documents: All of the documents in Tabs A through CC are originals except the following:

a. Tab B-2 is not an original because it is a computer generated message.

b. Tab C-2 is not an original because it is a computer generated form.

c. Tab D-2 is not an original because it is a computer generated form.

d. Tab G-2 through G-4 are not originals because they are computer generated extracts. The original data is maintained on a database at Sheppard AFB, Texas.

e. Tab H-2 through H-5 are not originals because they are word processed computer documents prepared by the Safety Investigation Board.

f. Tab I-2 through I-5 are not originals because they are computer generated messages entered by the Fort Smith ANG, 188 FW/QA office through the TRICARS and INFOSEN database systems at the request of the Safety Investigation Board. The original data is maintained on those databases.

g. Tab K-4 is not an original. The original plan is kept by the Tulsa Air National Guard, 138 FW, 125 FS, Airfield Manager. Tab K-6 through K-8 are not originals because they are computer generated messages of the various weather conditions on 21 November 1996.

h. Tab N-2 through N-5 are not originals. They are word processed documents created by the Safety Investigation Board. Certified copies of the transcripts are available at Tab CC.

i. Tab O-2 through O-12 are not originals. They are word processed documents and extracts of readings from the Seat Data Recorder.

j. Tab Q-2 is not an original because the original order was misplaced and could not be located before this report was filed.

k. Tab R-4 through R-6 are not originals. They are computer generated documents from the Safety Investigation Board.

l. Tab T-2 through T-5 are not originals. They are certified copies of Captain Knight's flight records. Originals are not required under AFI 51-503, paragraph 1.13.2. The originals are maintained at the Fort Smith ANG, 188 FW, Flight Records Office.

m. Tab U-12 is not an original because it is a computer generated report.

n. Tab W-2 through W-4 are not originals because they are computer generated messages of the various weather conditions on 21 November 1996. Tab W-5 through W-8 are not originals because they are listings of weather terms and abbreviations maintained by the National Weather Service and the Air Force.

o. Tab CC-2 through CC-10 are not the originals tapes of the air-to-ground communications. They are certified transcripts of the conversations recorded on the original tapes.

STATEMENT OF OPINION

Under 10 U.S.C. 2254(d), any opinion of the accident investigators as to the cause or causes of, or factors contributing to, the accident set forth in the accident investigation report may not be considered as evidence in any civil or criminal proceeding arising from an aircraft accident, nor may such information be considered an admission of liability by the United States or by any person referred to in those conclusions or statements.

Captain Knight, the pilot flying F-16A SN 82-1020, is a capable and qualified flight leader. He is healthy and in good physical condition. His training and experience show he was capable of performing the tasking and mission required on the night of 21 November 1996. Faced with a serious aircraft emergency, he performed the critical actions necessary to try and regain engine control when he experienced an engine failure on the return leg of the flight into Tulsa, Oklahoma. In addition, he demonstrated sound reasoning when faced with deteriorating conditions. He was aware of his altitude, his relative position to Tulsa, and he properly used all available information to assist him in his predicament. When faced with no restart capability, Captain Knight wisely chose the next course of action - steer clear of a populated area and bail out. This decision resulted in a successful ejection with no serious consequences.

Analysis of the engine and why it failed led to research of its history, inspection criteria, and maintenance performed. Detailed analysis of the engine revealed significant damage to the turbine section, specifically the low pressure turbine module. More specifically, the third stage turbine in this module, contains sixty-eight small airfoil-shaped blades that when combined with other engine components provide thrust. Should major failure occur in this section, engine thrust would be non-existent.

This area of the engine requires inspection at specific intervals based upon flying time or computerized engine equipment that records cycle time. This cycle time measures when this section of the engine is at a certain temperature or higher over a given time span. Adequate inspection of this particular engine was performed by qualified and trained personnel at the required times directed in the specific engine technical orders.

Analysis of the third and fourth stages of the LPT looked at a number of failure possibilities. These include FOD, DOD, creep-induced stress rupture, patchy fatigue, and porosity stress rupture. FOD can be ruled out since all damage occurred in the LPT module, and not from a source outside of the engine cavity. Patchy fatigue is unlikely since blades exhibiting this phenomenon are removed from supply channels during the manufacturing process. Porosity stress rupture is also unlikely because of X-ray inspections used throughout the manufacturing process. This leaves DOD and creep-induced stress rupture. It is my opinion that creep-induced stress rupture of a third stage turbine blade occurred causing collateral DOD to the remainder of the third stage and all of the fourth stage turbine sections.

The accident investigation revealed neither improper maintenance practices, nor inspections left unaccomplished. The engine failure and subsequent loss of F-16 1020 was

due to a premature failure of one or more turbine blades in the third stage of the -220E engine.

JOHN R. STRIFERT, Lt Col, VTANG
AFI 51-503 Board President

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NUCLEAR REGULATORY COMMISSION

Docket No. _____ Official Exh. No. 11

In the matter of PFS

Staff	IDENTIFIED ✓
Applicant	RECEIVED
Intervenor	REJECTED
Other Joint	WITHDRAWN
DATE 4-11-02	Witness
Clerk L. Shindurling	

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