F-16A,81-0684,19970107FMKMS01A,7JAN97

AFI 51-503 ACCIDENT INVESTIGATION REPORT

AUTHORITY: Under the provisions of Air Force Instruction (AFI) 51-503, the Commander of Air Combat Command, General Richard E. Hawley, appointed Colonel Dwayne A. Alons on 24 February 97 to conduct an aircraft accident investigation of the F-16A (81-0684) accident that occurred on 7 January 97 near the town of Whyte, Minnesota. The accident resulted in the fatality of the pilot, Major Peter M. Woodbury, and the destruction of F-16A aircraft SN 81-0684 (Tab A-2). Damage to forested land was limited to broken evergreen trees and ground disturbance caused by the impact (Tab P-2). The investigation was conducted from 24 Feb 97 - 15 Mar 97 and 25 Apr 97 - 23 May 97. Technical advisors were Lieutenant Colonel Maurice E. Borud, Maintenance; Major Horacio P. Guerra, Flight Surgeon; and Captain Dawn D. Hankins, Legal (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 all other purposes. The report is available for public dissemination under the Freedom of Information Act (5 U.S.C. 522) and AFI 37-131.

SUMMARY OF FACTS

1. History of Flight: On 7 Jan 97, Maj Peter Woodbury was scheduled as number three in a four-ship night intercept mission in the Snoopy West Military Operating Area (MOA) (Tab K-3). The flight was filed with the callsign Wolf. Other flight members included Wolf 1 - Lt Col Mark Johnson, Wolf 2 - Maj John Spencer, and Wolf 4 - Capt Scott Anderson (Tab K-2). Wolf flight departed Duluth International Airport (IAP), Minnesota, at 1742 CST (Tab A-2). Minneapolis Center delayed the release of the airspace, causing the flight to takeoff twelve minutes later than planned. Wolf flight flew a single-ship radar trail departure to the MOA. Wolf 1 split the flight when inside the airspace to place Wolf 3 element (Wolf 3 and 4) in the east as targets. Wolf 1 element (Wolf 1 and 2) established a combat air patrol (CAP) in the west portion of the airspace using the altitude block of 10,000 - 14,000 feet. Wolf 1 element completed two uneventful intercepts on Wolf 3 element. Then the roles were reversed to make Wolf 3 element the fighters in the west in the 10,000 - 14,000 foot block. Wolf 1 element became the targets in the east in the 6,000 - 9,000 foot block. Wolf 3 element established a counter-rotating orbit centered on the 085° radial from the bull's-eye point at Eveleth. Wolf 3 element deployed from the CAP point to intercept Wolf 1 in the southeast portion of the MOA and Wolf 2 in the northeast. Wolf 4 was in position to engage the targets first, therefore he became the tactical lead with Wolf 3 in trail about ten miles. Wolf 4 followed by Wolf 3 successfully engaged both targets in spite of a wide azimuth separation. Kills were called by Wolf 4 and Wolf 3 indicating their success in simulating the missile launches. Wolf 3 element disengaged from the targets and headed west to return to the CAP point. After a fuel check with Wolf 1, who had reached the eastern edge of the area, the second intercept began. This

NUCLEAR REGULATORY COMMISSION

Docket No. _____ Official Exh. No. 187

In the matter of _____ RPS

_____ IDENTIFIED ✓

Staff _____ RECEIVED ✓

Applicant ✓ _____

Intervenor _____ REJECTED _____

Reporting Off'r _____ DATE 7/1/82

Contractor _____ Witness _____

Other _____

Reporter _____

time Wolf 3 deployed first from the CAP point with Wolf 4 ten to fifteen miles in trail. Wolf 3 obtained an initial radar lock on Wolf 2 who was flying easterly in the northern portion of the MOA (Tab J-52, V-2, V-11, V-18). Because of an earlier call from Wolf 1 indicating he was beginning his target run, Wolf 3 requested "bogey dope" for more information regarding Wolf 1's position. Wolf 3 began a turn to the southeast to acquire the other target (Tab N-2, O-40, O-72). Wolf 1 acknowledged with a bogey dope call of "094 at 53" (Tab N-2). Wolf 3 momentarily selected ACM override on the dogfight switch, possibly attempting an automatic radar lock-on to Wolf 1, the southeast target (Tab J-52). Wolf 1 voluntarily gave a bogey dope call of "095 at 52" fifteen seconds after the first (Tab N-2). Wolf 3 did not acknowledge these calls or obtain a radar lock-on (Tab J-52). Twenty-one seconds later Wolf 3 impacted the ground (Tab N-2). The impact point was 47 miles northeast of Duluth near Greenwood Lake (Tab A-2).

2. Mission: The mission was scheduled and planned as a four aircraft night intercept training sortie (Tab K-2). Wolf 1 and Wolf 2 as an element would begin by intercepting Wolf 3 and Wolf 4, who were simulating enemy bomber aircraft or non-maneuvering cruise missiles separated by at least ten miles. Each element planned to practice two intercepts employing AMRAAM, AIM-7, or AIM-9 missiles to accomplish optimum simulated kills on the target aircraft. Wolf 1 and Wolf 2 planned to operate as the fighters for the first two engagements. As fighters, the elements would establish counter-rotating orbit points to defend their side of the MOA. After a "fight's on" call by the lead aircraft, the fighters would engage the targets separately to employ the simulated weapons. After a target was killed, it would return to the east end of the airspace to regenerate for another target presentation. The engagement would terminate after two intercepts and the element roles then reversed. The target element was assigned the 6000 - 9000 foot block of airspace, and the fighters were assigned the 10,000 - 14,000 foot block of airspace. The flight planned to complete a total of four low intercepts, two for each element, followed by NVG training for Wolf 1, 2, and 4, utilizing Wolf 3 as the target. Wolf flight planned to recover as elements for single-ship instrument approaches and landing at Duluth IAP (Tab V-11).

3. Briefing and Preflight: Crew rest was adequate. Maj Woodbury flew the previous night, 6 Jan 97, and left after debriefing the night intercept flight at approximately 2045 hours (Tab V-38, BB-22). He arrived for work on 7 Jan 97 at approximately 1430 hours for the flight briefing at 1530 hours (Tab V-23). Maj Woodbury met with Lt Col Dan Lewis, 148 FW Operations Group Commander, and was informed of his selection for the position of Operations Support Flight commander. He actively sought this position and was delighted at the prospect of beginning this increased level of leadership with the 148 FW (Tab V-54). Beginning at 1530 hours, Wolf flight was briefed by the flight lead, Lt Col Johnson (Tab V-11). He used the 148 FW Briefing Guide (Tab O-8) to cover all pertinent and required items concerning the night intercept mission. Special emphasis was placed on night operations, spatial disorientation, lighting, and the use of autopilot to lighten the pilot workload for night intercepts (Tab V-11). Aircraft preflight inspection and start were normal with the exception of the inertial navigation system alignment for

the MA. The system had to be restarted, and realignment was accomplished prior to taxiing (Tab V-32). Neither Wolf 1, the other flight members, or the Supervisor of Flying (SOF) were made aware of this problem (Tab V-2, V-11, V-18, V-23).

4. Flight Activity: Wolf flight departed Duluth IAP via the Snoopy stereo flight plan with standard coordination with Minneapolis center for clearance into the Snoopy MOA (Tab V-23). Takeoff time was 1742 hours (Tab A-2), one hour and five minutes after sunset (Tab K-10). Each aircraft in Wolf flight maintained about two mile separation in radar trail formation to the MOA. Following clearance to operate tactically in the Snoopy MOA, Wolf 1 split the flight into two elements; Wolf 1 element to the west in the 10,000 - 14,000 foot block to operate as fighters and Wolf 3 element to the east in the 6,000 - 9,000 foot block to simulate bomber or air-launched cruise missile targets (Tab V-2, V-11, V-18). The two intercepts conducted by Wolf 1 element were accomplished with no problems noted. All aircraft adhered to altitude blocks and training rules. Then Wolf 1 directed the role reversal of the elements for Wolf 3 element to practice weapons employment against similar targets (Tab V-11, V-18). Wolf 3 element flew to the western part of the MOA, climbed into the 10,000 - 14,000 foot block, and radioed that Wolf 3 element was established in the CAP (Tab N-2, V-2). Wolf 1 confirmed audibly that Wolf 2 should fly at 8,000 feet in the northeast part of the MOA while Wolf 1 would be at 7,000 feet in the southeast part of the MOA. Wolf 3 called "ready" indicating that Wolf 3 element was in position for the fight to begin (Tab N-2). The flight paths of all members of Wolf flight for the ten minutes preceding the crash of Wolf 3 are depicted on Tab BB-2. Wolf 1 simulated a cruise missile for the first target, and Wolf 2 simulated a slower speed bomber (Tab V-11, V-18). At the "fight's on" call by Wolf 1, bogey dope was given as "095 for 60" from bull's-eye to make Wolf 3 aware of Wolf 1's position when he began turning west (Tab N-2). Wolf 1 element presented two separate targets at least ten miles spread apart from north to south (Tab V-11, V-18). Due to their respective positions in the CAP at the "fight's on" call, Wolf 4 deployed from the CAP point first as the tactical lead and subsequently called a kill on the southern bandit (Tab N-2, V-2). Wolf 3 deployed from the CAP about ten miles in trail of Wolf 4 (Tab O-19, V-2, BB-2). Approximately twenty seconds after Wolf 4's "kill" call, Wolf 3 called, "kill on the southern bandit" (Tab N-2). Both Wolf 4 and Wolf 3 turned to the north to engage the northern bandit which they both identified as a slower bomber target at 340 knots (Tab O-19, V-2, BB-2). Shortly thereafter, Wolf 4 called a kill on the northern bandit. Wolf 3 called "tally" on the target, "visual" on Wolf 4, and a radar missile shot on the bandit. This call was followed quickly with a "kill on the northern bandit" by Wolf 3 (Tab N-2).

Wolf 3 element disengaged from the bandits by turning toward the CAP point with Wolf 4 still ahead of Wolf 3 (Tab O-19, V-2, BB-2). Wolf flight was given an "ops check" by Wolf 1 and each pilot responded with the amount of fuel on board. Shortly thereafter, Wolf 1 called new bogey dope for his position as a target in the southeast part of the MOA (Tab N-2). Wolf 3 acknowledged this radio call from Wolf 1 and turned to the northeast, resuming tactical lead of the element, with Wolf 4 in ten to fifteen mile trail. Wolf 3 initially picked up Wolf 2 on radar to the northeast of his position and committed

on him. Wolf 3 followed Wolf 2 to the northeast for another 30 seconds (Tab O-19, V-2, BB-2). Then Wolf 3 requested bogey dope for target information from Wolf 1. Two bogey dope calls were given by Wolf 1, "094 at 53" and "095 at 52," fifteen seconds apart. These calls were not acknowledged by Wolf 3 (Tab N-2, V-2). Following the second bogey dope call from Wolf 1, approximately twenty seconds before impact, Wolf 3 began a descent into the target altitude block while continuing the right turn. Wolf 3's descent rapidly increased due to over banking past 90^0 of right bank with three to six g's on the aircraft An appropriate high speed dive recovery was not initiated resulting in an impact with the ground at a high rate of speed (Tab O-21, Tab O-40). Ground impact resulted in fatal injury to the pilot (Tab X-2) and a fireball explosion. The fireball was seen by the other members of Wolf flight (Tab V-2, V-11, V-18) who were all ten to twelve miles away from the crash site (Tab O-19, BB-2). Wolf 4 called "knock-it-off" to terminate the engagement (Tab N-2, V-2). After Wolf 3 failed to respond to radio calls, Wolf 1 began the coordination with the 148 FW SOF concerning a Search and Rescue (SAR) effort. Wolf 4, with the least fuel, was directed to climb to 31,000 feet for high radio relay (Tab V-11). Wolf 2 began a search of the area in the lower part of the MOA (Tab V-18) while Wolf 1 orbited at 16,000 - 18,000 feet to make better radio contact with the 148 FW Command Post (CP). Wolf flight orbited for 45 - 50 minutes until bingo fuel attempting to make contact with the mishap pilot (MP), Maj Woodbury (Tab V-11). SAR efforts the night of 7 Jan 97 were unsuccessful (Tab CC-11).

5. Impact: The mishap aircraft (MA) impacted the ground near Greenwood Lake north of the town of Whyte, MN, in a snow-covered wooded area inside the Finland State Forest, which is maintained by St. Louis county. Coordinates of the site are N47- 32.73 and W91-36.10. Time of impact was 1818 hours CST, 7 Jan 97 (Tab A-2). The MA struck the ground banked about 20 - 25^o to the right in a nose low attitude of approximately 30^o (Tab R-4). The MA, with airspeed in excess of 550 knots (Tab O-21, O-40), cratered the snow and underlying soil to a depth of approximately ten feet (Tab R-7). Flight control elements recovered at the scene indicate that the aircraft was under a load of 4 to 6 G's at impact (Tab U-103). Wreckage ricocheted out of the impact crater in a fan-shaped area of at least 525 feet for the majority of the pieces. The center section of the engine was recovered 250 feet from the impact crater on a bearing of 220^o, defining the aircraft flight path at impact (Tab R-3). Post impact fire caused by the ignition of JP-8 fuel further damaged or consumed the wreckage (Tab J-27) until it was extinguished by the snow covered environment (Tab S-2).

6. Egress System: The F-16A ACES II egress system was evaluated by an Air Force Materiel Command (AFMC) investigator. Thorough evaluation of the evidence was limited by severe fragmentation and limited amount of debris available for examination. Indications were that the canopy was down and egress equipment was in place at the time of impact. Recovered evidence indicates the ejection seat sequence was not activated. There is no evidence of system discrepancies (Tab J-24).

7. Personal and Survival Equipment: Inspection records for survival kits/raft, parachute, anti-G suit, mesh net survival vest, life preserver, helmet, and oxygen connectors were reviewed. Inspections were current. No survival equipment was used (Tab BB-7).

8. Rescue: The time of the mishap was 1818 CST on 7 Jan 97 (Tab A-2). A ground explosion was noted by the other members of the flight (Tab V-2, V-11, V-18). Wolf 1 called the SOF at the 148 FW CP minutes after confirming no response from Wolf 3, the MP (Tab V-11). Wolf 2 and 4 circled the area of the explosion using Wolf 4's mark point coordinates of N47-31.4, W91-37.9 (Tab V-2, V-18). Wolf 1 subsequently relayed these coordinates to the CP (Tab V-2, V-11). Wolf 2 and Wolf 4 attempted to locate the crash site using NVGs while orbiting in the MOA (Tab V-2, V-18). At approximately 1825 hours, Colonel Stromquist, 148 FW Commander, was notified at his home, and he returned to the CP about ten minutes later (Tab V-30, CC-11). The Casualty Assistance Support Team (CAST) team arrived at the 148 FW CP at 2100 hours (Tab CC-11). The Coast Guard Air Station at Traverse City, MI, was notified of a downed F-16 by the 148 FW CP (Tab CC-11). Two Coast Guard helicopters were dispatched at 2145 hours to the mishap area (Tab CC-2). Two 148 FW F-16s were launched after Wolf flight landed (Tab BB-22). Captain Scott Verville and Maj Charles Nelson conducted a SAR mission with Maj Nelson using NVGs to search for the crash site (Tab V-23, V-47). Maj Geary Padden and Lt Col Jerry Mayer flew in a Cessna 150 below the MOA searching the crash site area with NVGs (Tab V-50). As of 2335 hours on 7 Jan 97, SAR efforts were being conducted by two Coast Guard helicopters, one Army National Guard helicopter, Lake County Sheriff's department and Minnesota Highway Patrol helicopter originating from Cloquet. Multiple SAR sorties were conducted by these units using NVGs with no crash site identified the night of 7 Jan 97. SAR efforts continued throughout 8 Jan 97 and the morning of the 9 Jan 97 with further assistance from a Wisconsin Air National Guard counter-drug C-26 aircraft (Tab CC-11). The crash site was spotted by a Coast Guard helicopter crew member at 0940 hours on 9 Jan 97 and confirmed twelve minutes later by the crew in the C-26 (Tab CC-2, CC-11). The Disaster Control Group (DCG) was subsequently placed on standby and departed as a convoy to the crash site at 1140 hours (Tab CC-11).

9. Crash Response: Initial search and rescue time-frame is described above. Search efforts were conducted under deteriorating weather conditions. On 7 Jan 97 searchers had unlimited visibility with south winds at eleven knots. The crash site was found at 0940 hours on 9 Jan 97 below a 400 foot overcast, five miles visibility, and winds from 160^0 at five knots. The crash site was approximately one mile NE of Greenwood Lake at N47-32.73, W91-36.10 in waist-deep snow, in a thinly forested swamp area (Tab CC-2, CC-11). Once the crash site was confirmed, the DCG convoy was dispatched to the crash site. Security police personnel (148 FW) were deployed via helicopter to secure the crash site area, followed by Explosive Ordnance Disposal and life support personnel in a second helicopter for possible seat de-arming. LTC Bordson, head of the 148 FW Logistics Division, was declared the on-scene commander and was informed the site had been declared a National Defense Area by Colonel Stromquist (Tab CC-11). Coast Guard

aircraft dropped a low level beacon 50 yards south of the crash site to identify the location in case of inclement weather (Tab CC-2, CC-11). The first description of ground conditions at the crash site was reported to the 148 FW CP at 1250 hours on 9 Jan 97. No survivor was found at the crash site.(Tab CC-11). With the coordinated efforts of the 148 FW, Coast Guard, National Forest Service, Army National Guard and the Duluth Police Department, equipment including a motor home, snowmobiles, snow shoes, food, beverages, portable toilets, vehicles, etc. were delivered to the crash site (Tab CC-11, CC-35). A 148 FW medical team was dispatched from the Duluth ANG base (Tab CC-11). Recovery of mishap aircraft wreckage was conducted under the direction of the Safety Investigation Board assembled to begin the mishap investigation (Tab Q-2). News media interest was high (Tab CC-43), and community involvement during the search and recovery phase was exceptionally supportive (Tab V-30, V-35).

10. Maintenance Documentation: A review of all Air Force Technical Order (AFTO) Forms 781, retained in the aircraft's portable storage kit during the mishap sortie, revealed no evidence of maintenance discrepancies contributing to the accident (Tab U-4). A review of the open Time Compliance Technical Orders (TCTO) does not reveal any evidence relating to the accident. All scheduled inspections were current and in order (Tab H-2, U-4). A review of the Oil Analysis records showed that they had been accomplished and were within technical data limits. The last oil analysis was accomplished on 7 Jan 97 and test results are within normal ranges (Tab U-2). A review of all unscheduled maintenance performed during the 90 days prior to the accident revealed nothing pertinent to the accident (Tab U-4). Examination of the Equipment Review Report does not reveal any overdue maintenance actions (Tab U-84). No discrepancies relating to this accident were noted in maintenance procedures or practices performed on this aircraft.

11. Maintenance Personnel and Supervision: A review of the training records and currencies for the maintenance personnel involved in preflight, through-flight, launch, and end-of-runway inspection for the mishap aircraft indicate that all were properly trained and had the level of experience required to perform their duties. Minor discrepancies in currencies existed for all personnel involved such as overdue for Checkered Flag Training, for example, but none were considered pertinent to this investigation (Tab U-88). Maintenance personnel and supervision do not appear to be factors in this accident.

12. Engine, Fuel, Hydraulic, and Oil Inspection Analysis: Although the engine diagnostic unit (EDU) was not recovered, portions of the F-100-PW-220E, S/N PW0E703704, were recovered from the mishap site and evaluated by SA-ALC. Their analysis indicated that the engine was running normally, near idle power (throttle increasing from 26^0 to 42^0 in the last thirteen seconds (Tab O-21)) with no indications of fuel or oil system malfunctions at the time of impact (Tab J-8, J-52). Recent maintenance actions included work related to a suspected engine stall during ground operations on 9 Dec 96. Subsequent engine shop analysis produced no findings, and resulted in a request for functional check flight (FCF) on 18 Dec 96 (Tab U-4). The FCF was successfully completed on 6 Jan 97 (Tab

U-4, V-18), and the aircraft flew again on 7 Jan 97, prior to the mishap sortie, without any problems noted (Tab U-4, V-35).

The fuel sample taken from truck 90L-665, used to service aircraft 81-0684 prior to the mishap flight, meets all Military Specification (Mil Spec) limits except for Smoke Point and Conductivity. However, the fuel is considered satisfactory for Air Force use (Tab U-98). A liquid oxygen sample taken from Cart 907, used to service the mishap aircraft on 3 Jan 97, meets all Mil Spec requirements (Tab U-100). Two lot samples from hydraulic fluid containers were also evaluated and found to meet Mil Spec requirements except as noted in the lab report. The variances are typical of opened source containers and considered acceptable for use (Tab U-101). As noted in paragraph ten, there were no observed discrepancies in the oil analysis program. No samples of fuel, hydraulic fluid, or engine oil were recovered from the crash site.

Engine operation, serviceability of fuel, lox, and hydraulic fluid, and the oil analysis program do not appear to be factors in this accident.

13. Airframe and Aircraft Systems: There are no indications that hydraulic, electrical, mechanical, avionics, or power plant systems were a factor in this accident.

a. The engine report from SA-ALC gives strong indications that the engine was functioning normally and operating at or near idle power with throttle increasing from 26^0 to 42^0 in the last thirteen seconds prior to impact (Tab J-8, O-21, O-40).

b. Recovery of flight control system components was extremely limited because of the deep snow cover at the mishap site. The list of recovered items (Tab R-8) indicates that all major components of the aircraft, including flight control surfaces and speedbrakes, were present at impact. The position of the leading edge flaps at impact corresponds to a probable G-loading of four to six Gs for the estimated airspeed range of the mishap aircraft (Tab U-103). This is consistent with the rapidly increasing AOA readings shown by the flight data recorder during the last seconds of flight in a hard right turn (Tab O-21, O-40). This is also indicative of an aircraft capable of responding to flight control commands. The G load at impact exceeds the design limit of plus one incremental G available from the autopilot in altitude hold mode (T.O. 1F-16A-1, F-16A/B Flight Manual).

c. The electrical, fuel, and hydraulic systems appeared to be functional at the time of impact (Tab J-52). There was no indication of hydrazine consumption during the mishap flight (Tab J-2). A low voltage reading in the inertial navigation unit (INU) battery during system built in test (BIT) checks was reported during the FCF on 6 Jan 97 (Tab V-18). Avionics specialists logged the maintenance fault list (MFL), with the intention of monitoring INU battery

performance on subsequent flights. Low readings on the INU battery are not considered abnormal for an aircraft that has not flown recently (Tab U-113). No problems were noted on the next flight of this aircraft on 7 Jan 97 (Tab V-35). During launch for the mishap sortie, the crew chief reported that Wolf 3 had to re-initiate INS alignment sometime during the start sequence before the emergency power unit (EPU) check (Tab V-32). However, system operation data (Tab J-52) confirms normal output from the electrical system and accurate INS performance until impact.

d. Portions of the ACES II ejection seat and associated components of the egress system were sent to the Life Sciences Equipment Laboratory at Kelly AFB, TX, for evaluation. Evidence indicates that the canopy was down, and all life support and egress components were present in the cockpit at impact (Tab J-2, J-24). There was no indication of an ejection attempt (Tab J-24).

14. Operations Personnel and Supervision: The mission was authorized by Lt Col Carl Dahlin, the 179 FS Commander, in accordance with AFI 11-206 and AFI 11-401 (Tab K-2). Lt Col Dahlin was the Operations Supervisor on duty with the SOF on 7 Jan 97. All flight member currencies were accurate and the mission was tailored to meet their needs (Tab V-26). Mission planning weather and Notice To Airmen (NOTAM) information was updated by the SOF, Maj Charles Nelson, and by operations duty desk personnel. Weather information is available to each flight on a Minot weather service sheet, a civilian Kavoris weather/NOTAM computer screen display, and a Data Transmission Network (DTN) video display at the operations duty desk. Wolf flight was briefed and led by Lt Col Mark Johnson, 148 FW Vice Commander (Tab V-23).

15. Pilot Qualifications: Maj Woodbury was current and qualified to perform the mission (Tab O-4, O-5) He had accomplished a two-ship night intercept flight on 6 Jan 97 (Tab G-2, V-38) and a day intercept flight prior to that on 20 Dec 96 (Tab G-2). He was a fully qualified two-ship DACT flight lead since 9 Mar 91 (Tab T-2, O-4) with 2636.3 total hours and 1198.7 hours in the F-16A/B (Tab G-2). Maj Woodbury's pilot skills were judged as average to above average. He was regarded as a flight lead who prepared thoroughly, paid attention to detail, and adhered to strict flight discipline (Tab V-26, V-54). Maj Woodbury had flown a consistent number of sorties per month to maintain Mission Ready status for the previous six months of the training cycle. His lowest monthly sortie rate was October 96 with five sorties (Tab T-8). Maj Woodbury's most recent checkride was an Instrument/Qualification Evaluation accomplished on 13 Nov 96 in an F-16A with the SEFE in a chase aircraft. He had one minor discrepancy, i.e., the use of an incorrect steerpoint which did not downgrade him for the overall checkride evaluation. Unusual attitude recoveries were evaluated during the emergency procedures evaluation (EPE) in the cockpit procedures trainer (CPT) with no problems noted. His last Mission Evaluation was accomplished on 14 Mar 96 where he employed two F-16s against two F-15 adversaries at Tyndall AFB, Florida. This mission was completed with

no discrepancies noted (Tab T-4). Maj Woodbury completed a G-awareness check on his last daytime air-to-air sortie, 20 Dec 96, with no problems noted. (Tab AA-5).

30/60/90 Day Flying Summary (Tab G-2):

30 Day	4.4 hours/ 3 sorties
60 Day	18.2 hours/14 sorties
90 Day	21.8 hours/17 sorties

16. Medical: MP medical and dental records were reviewed. MP was medically qualified for flight duty at the time of the accident. There were no disqualifying medical, psychological, or physiological discrepancies noted in the medical or dental records. A valid AF Form 1042 was filed in the MP's medical and flight records (Tab T-9). Postmortem toxicology analysis for ethanol and drugs was negative. DNA analysis from AFIP strongly supported the identification of the MP as Maj Woodbury. X-ray analysis of dental fillings are consistent with the dental records of the MP (Tab X-2). Human factors pertaining to this mishap include the following:

a. Personal relationships: He was described as an individual with a professional attitude. He was characterized as having excellent flight discipline and average to above average pilot skills. He was well liked and respected by those interviewed, and was described as a family-oriented individual. He worked well with his peers with no adverse behavior mentioned (Tab V-11, V-54).

b. Lifestyle: Medical records review showed no indications of smoking or adverse alcohol consumption (Tab X-2). He worked for NorthWest Airlines and had a well balanced schedule between his airline and ANG flight schedules. He was thought to consistently adhere to crew rest requirements (Tab V-2, V-54, AA-6).

c. Physical characteristics: The MP was 70" tall and weighed 204 lb. at the time of his last physical exam. A body fat assessment of 17% was done in the orderly room in either May or June of 1996 (Tab AA-3). He was described by orderly room personnel as healthy and physically fit.

d. Physiological factors: G-induced adverse effects and spatial disorientation (SD) were further investigated.

e. Pathological factors: There was no evidence of predisposing injury or disease according to medical and dental records review (Tab X-2).

f. Psychological factors: Evidence indicates no history of behavioral or psychological problems (Tab X-2). He was described as a happy individual

who was mission focused and maintained a positive attitude at all times (Tab V-38, V-50).

g. Environmental factors: The mishap sortie was conducted in full darkness, with takeoff occurring 65 minutes after sunset. There was no moon illumination, and there were no cloud layers in the operating area. (Tab K-4, K-10). The horizon was hazy but visible (Tab V-47, V-58). Snoopy MOA was described as favorable to night operations with few ground lights and roads (Tab V-11, V-47, BB-37). The night of the mishap, Snoopy MOA was described as "nothing seemed out of the ordinary" (Tab V-47). No judgment can be made regarding cockpit lighting, temperature, or noise.

17. Navaids and Facilities: There were no NOTAMs pertaining to navigational aids or facilities on 7 Jan 97 that affected the night intercept mission. All relevant navigational aids and facilities were functional. The NOTAM system, updated daily at 1400 hours via a printed hard copy, was received in the 148 FW CP. Pertinent NOTAMS for Duluth and local area alternate fields are displayed on television screens in the flight briefing rooms (Tab K-4, V-23).

18. Weather: (Tab K-4, W-2)

SYNOPTIC WEATHER ON 7 JANUARY 1997 FOR NORTHERN MINNESOTA

The northern section of Minnesota was under the influence of a high pressure system over Wisconsin. The only hazard noted in the area was light to moderate turbulence extending from 25,000 to 42,000 feet. Skies were basically clear with scattered clouds at a minimum of 10,000 feet. Visibility in flight was seven miles or greater. Surface winds were light and variable and forecast to stay below seven knots. Sunset was at 1637 CST on 7 Jan 97. The moon phase was one day before the new moon. There was no illumination since the setting time was 1533 hours.

DULUTH (DLH) OBSERVATIONS AND FORECAST

At 1624 hours, Minot weather service forecast winds to be from the southeast at seven knots, with visibility greater than six miles. The sky could have some scattered clouds at 3000 feet by 2100 hours. A civilian pilot flying at 5500 feet MSL twelve miles west of the crash site reported the sky was very clear with bright stars, but the horizon was hard to define. Concentration of four to five seconds was necessary to discern the horizon (Tab V-58).

F-16A,81-0684,19970107FMKM501A,7JAN97

SNOOPY WEST OPERATING AREA PLANNING FORECAST

Weather forecast at 1546 hours by Minot Weather Cell, valid until 2300 hours, called for weather conditions of scattered clouds at 10,000 feet with inflight visibility of seven miles. Winds were forecast as variable at five knots and the minimum altimeter setting 30.06.

19. Governing Directives and Publications: Primary directives and publications relevant to this investigation are:

AFI 11-206, General Flight Rules
AFI 11-206, Acc Sup 1, General Flight Rules
AFI 11-401/ANG Sup 1, Flight Management
AFI 11-214, Aircrew and Weapons Director Procedures for Air Operations
AFM 11-217 Vol 1, Instrument Flying
MCI 11-463, Operations Supervision
MCI 11-F16 Vol 1, Pilot Training F-16
MCI 11-F16 Vol 3, F-16 Pilot Operational Procedures
MCI 11-F16 Vol 3, 148 FW Sup, Chapter 8, Local Operating Procedures
MCH 11-F16 Vol 5, Flying Operations - Combat Aircraft Fundamentals - F-16
MCM 3-1 Vol 5, Tactical Employment F-16 (U)(S)
ACCI 11-301, Aircrew Life Support Program
AFP 11-404, G-Awareness For Aircrews
T.O. 1F-16A-1, F-16A/B Flight Manual
T.O. 1F-16A-1-1, Supplemental Flight Manual
T.O. 1F-16A-1-4, Supplemental Flight Manual
T.O. 1F-161-34-1, Avionics and Non-nuclear Weapons Delivery Flight Manual (U)(S)
T.O. 1F-16A-34-1-3, Avionics and Non-nuclear Weapons Delivery Flight Manual
T.O. 00-20-5, Aircraft, Drone, Aircrew Training Devices, Engines, and Air-Launched Missile Inspections, Flight Reports, and Supporting Maintenance Documents
AFM 66-279, Core Automated Maintenance System Users Manual
148 FW Inflight Guide

Dated this 23rd day of May, 1997.

Dwayne A. Alons

DWAYNE A. ALONS, Col, IAANG
Accident Investigation Board President

F-16A,81-0684,19970107FMKM501A,7JAN97

Statement of Opinion

Under 10 U.S.C. 2254(d), any opinion of the accident investigators as to the cause or causes of, or the factors contributing to the accident set forth in the accident investigation report may not be considered as evidence in a 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.

Major Woodbury, the mishap pilot, was a highly qualified F-16 pilot respected by his superiors and peers for his excellent leadership and flying skills (Tab G-2, T-2, V-11, V-54). He was healthy and in good physical condition (Tab T-9, AA-3). He approached his duties with the 148 FW very professionally (Tab V-2, V-11, V-35). His currency for night flying was updated on 6 Jan 97 (Tab G-2, V-38). He regularly used sound practices and procedures while accomplishing all required training, including night intercept training (Tab V-50, V-54). However, during his second intercept of the mission, Major Woodbury failed to monitor his aircraft's position and flight path relative to the ground.

A thorough review of aircraft maintenance records (Tab U-2, U-4), flight data recorder information (Tab J-52), MP training records (Tab T-2, T-4, T-8), squadron standards, and common practices revealed no discrepancies or causal factors (Tab O, Tab V). Therefore, this mishap was caused by human factors.

Human factors embodies anomalies in human perception, thought processing and action, and the physical and mental status of an aircrew member before and during a mishap sequence. Specific human factors considered central to this investigation include loss of situational awareness and false perception leading to misprioritizing the need for a good instrument crosscheck. Both of these factors may have contributed to spatial disorientation (SD), which is a loss of accurate position sense with respect to the horizon and direction of flight. The semicircular canals and otolith organs in the middle ear are responsible for a set of illusions known as somatogravic illusions and somatogyral illusions. These illusions can result in an exaggerated sensation of body tilt when the body is subjected to other than 1 G conditions in flight (inversion illusion or G-excess illusion), or the loss of a turning sensation when actually spiraling downward (graveyard spiral). The pilot must suppress all sensory data except the visual necessary for a good instrument crosscheck to avoid the adverse effects of these vestibular illusions. These illusions may cause inappropriate control inputs which could result in disaster (AFMAN 11-217, Tab BB-42, Tab-BB-45).

Flight path depictions shown in Tab BB-2 and corroborated with the flight data recorder information (Tab O-40) indicate that the MP began the second intercept pursuing a cold target. Realizing this was not the target he should be engaging, the MP requested "bogey dope" as he turned to the southeast (Tab N-2, O-40). He appeared to enter the visual arena for this engagement by momentarily selecting ACM override on the dogfight

switch at that time (Tab J-52). Wolf 1 responded with a position call "094 at 53" indicating his position in the southeast part of the MOA (Tab N-2). Flight data shows the MP banking to the right (106^0 right bank) and allowing the aircraft to descend with a ten degree dive angle. The MP rolled rapidly to the left and appeared to initiate a dive recovery passing through 10,000 feet MSL (the bottom of his altitude block) by pulling 3.19 Gs. Approaching 9600 feet MSL while in a 30^0 right bank, the MP momentarily unloaded the aircraft to 0.19 G and remained below 1 G for seven seconds while continuing the roll to 90^0 of right bank. At this point he increased the G on the aircraft to nearly 3 Gs for five to six seconds while allowing the dive angle to increase significantly. In this descent, the MP allowed the aircraft to drop below the bottom of the MOA in 31^0 of dive (Tab O-21, O-40, O-72). Somewhere in the descent below 10,000 feet MSL, the MP neglected to continue a proper instrument crosscheck. His apparent entrance into the visual arena caused him to concentrate his central vision on his attack while neglecting the cues necessary for referencing the horizon and his position relative to the ground. A rapid correction by rolling to the left followed by unloading the aircraft to 0.19 G could have led to the MP's spatial disorientation (Tab BB-42, BB-45). Without SD present, an appropriate pilot response when discovering the aircraft in a nose-low unusual attitude would be an immediate roll back to wings level, placing the throttle at idle, and extending the speed brakes while pulling out of the dive with maximum available G (AFMAN 11-217). Unfortunately due to the MP's apparent SD his initial reaction at 5280 feet MSL was a loaded roll to an inverted position. At 2500 feet AGL, approaching 50^0 of dive, the MP appeared to recognize his unusual attitude. The MP may have tried to use the HUD without cross-checking the ADI to confirm his unusual attitude. In this fast moving environment, he possibly saw only a blur of lines and numbers. Any confusion or delay in initiating proper recovery inputs may make recovery impossible (AFMAN 11-217). He attempted a high-G roll back to an upright position but impacted the ground before the pull-out could be completed (Tab O-21, O-40).

The actual illusion causing the MP's spatial disorientation cannot be exactly determined; however, the trajectory taken by the MA suggests that the pilot was experiencing severe loss of orientation (Tab BB-42, BB-45). His rapid descent through the target altitude block and the floor of the MOA without any radio transmissions is very indicative of Type 1 unrecognized disorientation (AFMAN 11-217). His concentration on a perceived target low and to the right of his flight path would be consistent with the maneuvering he initially did below 10,000 feet MSL. The MP may have experienced SD due to an extended period of focusing away from cockpit instruments for head-down radar work, loss of peripheral vision due to darkness and lack of moon illumination, or distraction due to lights on the ground or canopy glare from interior lights. His reaction at 10,000 feet MSL leads one to believe he was in control of the aircraft at that point. His roll to an inverted position approximately 3.5 seconds after passing 6,000 feet MSL (Tab O-40) would lead one also to believe the MP had the altitude set for the MSL line-in-the-sky warning even though that maneuver was inappropriate for his actual aircraft attitude (Tab BB-42, BB-45). The MP also had the radar altimeter on because a "break X" signal was given approximately two seconds prior to impact (Tab J-52). The MP was a highly

experienced pilot with extensive civilian time in the instrument-oriented airliner cockpit (Tab AA-6). His training and flight preparation dictated high reliance on "flying the gauges" in this environment. The MP was regarded as disciplined and consistent in applying squadron standards. However, all of this preparation, experience, and reliable performance can be overridden by a momentary lapse into "seat-of-the-pants" flying due to some form of distraction.

Extensive interviews of 148 FW personnel, along with direct observation of unit pilots during a night training sortie flown with them, reveal a flying organization with a thoroughly professional unit culture. The 148 FW's approach to all training flights is methodical and well disciplined, and the briefing and execution of night training sorties reflects this high professional standard. Unfortunately, in the midst of the best preparation and capability, the human factor continues to be the ongoing limitation to perfect results.

Dated this 23rd day of May, 1997.

Dwayne A. Alons

DWAYNE A. ALONS, Col, IAANG
Accident Investigation Board President