RAS 5420 72-22-ISFSI— Applicant Exhibit 199—Rec'd 7/1/02

AFI 51-503
AIRCRAFT ACCIDENT INVESTIGATION REPORT

1. AUTHORITY AND PURPOSE

a. Authority: On the evening of 25 March 1998, F-16D aircraft 90-0792 impacted the water and was destroyed during a routine training sortie. The pilot ejected, but was fatally injured. Paragraph 1.1 of Air Force Instruction (AFI) 51-503, *Aircraft, Missile, Nuclear, and Space Accident Investigations*, requires the major command (MAJCOM) commander or his designee to convene an accident investigation board (AIB) to investigate every such "Class A" mishap (reportable damage of $1 million or more, or a fatality or permanent total disability). The mishap aircraft was assigned to the 36th Fighter Squadron, 51st Fighter Wing, Osan AB, Republic of Korea (ROK) (Tab A).[1] In turn, the 51st Fighter Wing is a component unit of the Pacific Air Forces (PACAF) major command.

By memorandum dated 27 April 1998 General Richard B. Myers, PACAF Commander, convened an aircraft accident investigation board (AIB) to investigate the mishap (Tab Y). Col Thomas J. Fiscus, PACAF Staff Judge Advocate (SJA), acting as the MAJCOM commander's designee, amended the original appointment memorandum on 28 Apr 98, and again on 4 May 98 (Tab Y).

As finally constituted, the AIB consisted of the following members:

BOARD MEMBERS	POSITION
Colonel Thomas J. McKinley	President
Lt Col Douglas W. Gregory	Pilot Advisor
Capt Zebby Miles	Maintenance Advisor
Capt Curtis L. Heidtke	Legal Advisor
Capt (Dr.) Gerald A. Price	Medical Advisor
SSgt Merry A. Montgomery	Recorder
Amn Tammy L. Ries	Assistant Recorder

b. Type and Purpose. This investigation was conducted to find and preserve evidence relating to the loss of F-16D aircraft 90-0792 and its pilot about 60 miles west of Osan AB, ROK on 25 March 1998, for possible later use in claims, litigation, disciplinary actions, adverse administrative proceedings, and for all other purposes except mishap prevention. The purpose of the investigation was to ascertain the relevant facts and circumstances of the accident and, if possible, to determine its cause or causes.

[1] Many of the facts stated in this report are repeated more than once in the attached documentary evidence. Where multiple citations would not further the reader's understanding, this report cites only the primary source document.

PFS Exh. 199 58745

Template = SECY-028 SECY-02

NUCLEAR REGULATORY COMMISSION

Docket No. ________ Official Exh No 199

In the matter of PFS

Staff ________ IDENTIFIED ✓

Applicant ✓ RECEIVED ✓

Intervenor ________ REJECTED ________

Cont'g Off'r ________

Contractor ________ DATE 7/1/02

Other ________ Witness ________

Reporter ak

2. SUMMARY OF FACTS

a. **Historical Summary.** The mission was scheduled as a four-ship F-16 night vision goggle (NVG) upgrade sortie for the mishap pilot and the second element wingman (Tab A). The flight, call sign "CAJUN," took off from Osan AB at 1918 local time (Tab A). Following departure to the west, CAJUN flight air refueled and entered the ACMI and R-88 training areas, approximately 60 miles west of Osan (Tab A). As briefed, the flight split into two 2-ship elements, CAJUN 1/2 and CAJUN 3/4, to practice air intercepts (Tab V2). The first four intercepts proceeded without incident (Tab V2). On the fifth intercept, the mishap pilot (CAJUN 2) called "Notching 360 [degrees]," signifying that he was entering a right turning defensive maneuver (Tab A; Tab N; Tab V2). Thirteen seconds later the mishap pilot called "Terminate" three times (Tab A; Tab N). Almost immediately thereafter, he ejected (Tab O). Roughly seventeen seconds later, his aircraft impacted the Yellow Sea and was destroyed (Tab O). The mishap pilot's emergency locator transmitter (ELT) signal broadcast for approximately 39 seconds after he ejected (Tab A). Search and rescue operations began immediately (Tab V2; Tab V5). After extensive search efforts by numerous surface ships, aircraft and helicopters, a ROK Navy vessel found the pilot's body at 0755 on the morning of 26 March (Tab A; Tab O; Tab BB1).

News media interest was minimal. The 51st Fighter Wing Public Affairs office (51 FW/PA) issued an initial press release to the Armed Forces Korea Network (Yongsan) and the Pacific Stars and Stripes newspaper at approximately 2225 local on 25 Mar 1998, the night of the accident. PA issued a follow-up release at approximately 0330 on 26 March. PA sent out a third release at 1135 local on 26 March, reporting that the pilot's body had been found. PA issued a fourth, and final, press release at approximately 1500 local on 26 March, stating that the body recovered had been identified as the missing pilot. Two media queries were received – one, from Pacific Stars and Stripes, at about 0815 local on 26 March, and the other from UPI Radio (Washington, D.C.) at approximately 1330 local on 26 March. Outside USAF PA channels, Pacific Stars and Stripes published an article detailing the wreckage salvage operations in its 8 May 98 edition.

b. **Mission.**

(1) **Fighter Missions.** Fighter aircraft perform a variety of missions. These include: Counter-air operations, to attain or maintain air superiority by destroying or neutralizing enemy air forces; Counter-land operations, to support ground operations by destroying or neutralizing enemy surface forces; Counter-sea operations, the equivalent of Counter-land operations in the maritime environment; Strategic Attack, or strikes at the enemy's centers of gravity to achieve specific objectives; Offensive Counter-information, to disable enemy information systems; and Combat Search and Rescue. Counter-air operations are further divided into Offensive Counter-air, or strikes against enemy air forces and air defenses, and Defensive Counter-air, or defending friendly forces against enemy air strikes. Counter-land operations include Interdiction, or disruption of an enemy's ability to transport forces and supplies, and Close Air Support, or attacks upon enemy forces in close proximity to friendly forces.

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(2) **F-16 Aircraft.** The F-16 is a multi-role fighter aircraft, built by the Lockheed Martin company in several versions. The Air Force has more F-16s in its inventory than any other fighter aircraft. The F-16C entered production in the mid-1980's and incorporated improved avionics and engines compared to the original F-16A. The F-16CG is a specific version of the F-16C modified to carry and employ the Low Altitude Navigation and Targeting Infra-Red for Night (LANTIRN) system. Most F-16CG's were built with General Electric GE-100 engines and are known as "Block 40" aircraft. All F-16CG aircraft have a single seat for the sole crewmember, the pilot. The F-16DG is similar to the F-16CG in all respects except that it has two seats in tandem to permit a second pilot or a passenger to fly in the back seat. The mishap aircraft, tail number 90-000792, was an F-16DG Block 40 aircraft. It was assigned on 23 Aug 93 to the 36th Fighter Squadron, 51st Operations Group, 51st Fighter Wing, Osan AB, ROK (Tab D).

(3) **36th Fighter Squadron.** The 36th Fighter Squadron (36 FS), nicknamed the "Flying Fiends," flies F-16CG and F-16DG aircraft in defense of the Republic of Korea. Missions of the 36th FS include Offensive and Defensive Counter-air, Interdiction, and Close Air Support. In April 1997 the 36 FS began training a cadre of pilots in using NVG equipment, to expand its night combat capabilities. At the time of the accident, the squadron was continuing to increase the number of NVG-qualified pilots through syllabus-governed NVG training sorties (Tab V12).

c. **Crew Qualifications and Training.**

(1) **Air Force and PACAF Qualification and Training Requirements.**

(a) **General.** Multi-Command Instruction (MCI) 11-F16, Volume 1 sets forth basic policy for aircrew training and currency, as well as specific training and currency requirements for F-16 aircrew. The governing instruction specifies the ground (Table 4.1) and flying (Table 4.3) training currency items required of F-16 pilots on a recurrent basis. The mishap pilot was current in all ground training items required prior to performing flight duties (Tab CC1; Tab V27). He was also current and qualified in all applicable flying training requirements (Tab T5; Tab V27).

(b) **NVG Qualification and Training Requirements.** The NVG training program is contained in an ACC/PACAF Syllabus, Course No. F1600NVGPD, *Night Vision Goggles Training Course*. Per the training syllabus, the only prerequisites for entry into the NVG upgrade program are that the pilot be current and qualified in the F-16, and selected for upgrade by his squadron commander. The mishap pilot was selected for NVG upgrade by the squadron commander on 19 Mar 98, prior to his first NVG sortie (Tab CC2).

Per the 36 FS NVG upgrade syllabus, the NVG upgrade program calls for eleven hours of academic training, one hour of simulator/ground training device instruction, and five sorties. The sorties are designed to acclimate the pilot to the NVG equipment, and to teach the pilot to use the equipment effectively in a combat environment. The NVG academics include instruction on

NVG capabilities and limitations, NVG inspection and adjustment, proper cockpit setup, formation flying using NVG, threat reactions, and air-to-surface weapons employment. The single simulator/ground training device mission trains the upgrade pilot in preparing the cockpit for NVG use, properly operating internal and external lights in the NVG environment, donning and doffing the NVGs, changing NVG batteries, and handling emergencies, including ejection (Tab V10). Flight training begins with NVG-1, a two-ship sortie designed to introduce basic NVG operations. The second mission, NVG-2, is similar to NVG-1 but also requires the upgrade pilot to perform an air-to-surface attack in formation with the flight leader, employing laser-guided munitions. NVG-3, the syllabus sortie on which the accident occurred, introduces the upgrade pilot to air-to-air intercepts using NVG, including defensive threat reaction maneuvers. The NVG-4 sortie is a four-ship air-to-ground mission, in which the pilots practice surface-to-air threat reactions and formation flying. NVG-5, the final sortie, is a compilation of the previous missions. It includes training in air-to-air intercepts, air-to-ground weapons delivery, and surface-to-air threat reactions.

(2) **Unit Qualification and Training Requirements.**

(a) **General.** Every new pilot arriving in the 36 FS must complete initial mission qualification training (MQT). This entails a series of required briefings, ground training events, academics, simulators, and aircraft sorties. For an experienced pilot, such as the mishap pilot, the MQT program is typically shortened, with squadron operations officer concurrence. The mishap pilot successfully accomplished academic training, one simulator, and four sorties, and was certified as "combat mission ready" (CMR) on 29 Jan 98 (Tab CC3).

(b) **NVG Qualification and Training Requirements.** The 36th Fighter Squadron NVG Training Program is a locally-developed program that incorporates and expands upon the ACC/PACAF training course. Training hours and division of training (academic, simulator, and flight hours) are identical to the ACC/PACAF syllabus. Prerequisites for entry are more detailed. In addition to being selected by the squadron commander, the upgrading pilot must meet four additional requirements: (i) complete a flight within 14 days of beginning the upgrade; (ii) review and be familiar with the operation of interior and exterior lighting panels; (iii) read the 36 FS NVG Manual; and (iv) complete required academic training no more than 60 days prior to the first NVG aircraft sortie. Likewise, the 36 FS NVG training syllabus is more explicit and detailed than the ACC/PACAF syllabus. For example, the 36 FS NVG training syllabus contains more detailed tasks for the upgrade pilot to accomplish on each NVG mission; specific training parameters for the mission, such as the air-to-air training minimum altitude, aircraft lighting configurations, and simulated weapons configurations; and definite performance standards that the upgrade pilot must meet to satisfactorily complete each sortie.

(3) **Mishap Pilot (CAJUN 2).** The mishap pilot graduated from Undergraduate Pilot Training (UPT) and received his Air Force pilot's rating on 14 Dec 90 (Tab T6). According to the written evaluation of his T-38 squadron commander, the mishap pilot excelled in all phases of training. The commander specifically noted the mishap pilot's superb motivation and desire to excel (Tab T6). In October 1991 the mishap pilot completed F-111G/P upgrade training at Cannon AFB, NM, and was assigned to RAF Upper Heyford, United Kingdom as an F-111E/P

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aircraft commander (Tab T8). From September 1993 through October 1994 he served as an Air Liaison Officer stationed at Osan AB, ROK (Tab T7). From Korea, he transferred to Luke AFB, AZ in late 1994 for initial F-16 training (Tab T8). The mishap pilot began flying as a squadron F-16C/D pilot at Aviano AB, Italy in June 1995 (Tab T8). He remained at Aviano AB until December 1997, when he was assigned to the 36 FS at Osan AB (Tab T7). As of 25 March 1998, the mishap pilot had 1420.7 total credited flying hours in U.S. Air Force aircraft (Tab G).

(a) **F-16 Training.** The mishap pilot began flying the F-16 in November 1994, at Luke AFB, AZ (Tab T7; Tab T8). He amassed 61.4 F-16 flight hours, and 40.0 F-16 simulator hours, during his initial upgrade training (Tab T8). At Aviano AB, he accumulated an additional 555.4 F-16 flight hours, and 23.0 additional simulator hours (Tab T8). At the time of the accident, the mishap pilot had 655.7 total F-16 flight hours, and 66.0 total F-16 simulator hours (Tab G). While at Aviano, the mishap pilot was trained and qualified to perform a variety of different missions and deliver a host of weapons types, covering nearly all of the basic missions and weapons profiles flown by his new squadron, the 36 FS. Accordingly, the 36 FS accepted his qualifications from Aviano in lieu of upgrade training in virtually every category, with the exception of his flight lead and simulator instructor pilot qualifications, and certain weather minimums criteria (Tab CC8). According to the 36 FS Operations Officer, the mishap pilot was forecast to enter the flight lead upgrade program within the next few months (Tab V12).

(b) **Recent F-16C/D Flying History.** The mishap pilot's recent F-16 flying history is summarized below (Tab G):

MISHAP PILOT RECENT FLYING HISTORY		
Last 30 days	Last 60 days	Last 90 days
19.2 hours	31.6 hours	40.4 hours

(c) **Training Currency.** The mishap pilot was current in all command-directed training events required by MCI 11-F16, Volume 1. His most recent instrument/qualification flight occurred on 3 Oct 97 (Tab T4). He flew his most recent mission check flight on 26 Nov 97 (Tab T3). For both of these check flights, the mishap pilot received a "Q1" rating, indicating that he was fully qualified (Tab T3; Tab T4). Likewise, he was current and qualified for all training events planned for the mishap sortie (Tab T5).

(d) **NVG Specific Training.** The mishap pilot accomplished the required NVG academics and training device session (completed in the F-16 simulator) on 17 March 98 (Tab CC4). The mishap pilot flew NVG-1, his first NVG sortie, on 23 Mar 98, accomplishing all required items including NVG donning and doffing, single-ship maneuvering, 2-ship formation maneuvering in various formations, and tactical intercepts in which the mishap pilot completed intercepts by himself against a single target (Tab CC4). He flew two sorties to complete NVG-2 on 24 Mar 98 in accordance with the 36 FS schedule, which called that night for each first sortie to refuel on the ground after landing with engine running and then fly a second mission. The mishap pilot's NVG-2 instructor pilot (IP) described his performance as average for a pilot of his experience (Tab V7). Both NVG-1 and -2 were flown in low-illumination conditions over land (Tab V8; Tab V9).

(4) **Flight Lead (CAJUN 1).** CAJUN 1, the flight leader, was an experienced instructor pilot and evaluator in the F-16. He graduated from UPT on 9 Jun 87 (Tab DD6). He was initially assigned as a T-38 instructor pilot at Williams AFB, AZ (Tab DD6). In the summer of 1991 he entered F-16 initial training at Luke AFB, AZ (Tab DD6). Prior to reporting to Osan AB in February 1997, CAJUN 1 was a squadron F-16C/D pilot and instructor at Shaw AFB, SC (Tab DD6; Tab V2). As of 25 March 1998, the flight leader had 3188.7 total credited hours of flight time in military aircraft (Tab DD4).

(a) **F-16 Training.** The flight leader began flying the F-16 in July 1991. At the time of the accident, he had flown a total of 1610.2 hours in the F-16, and accumulated 141.4 total F-16 simulator hours (Tab DD4). He upgraded to F-16 instructor pilot in July 1995 (Tab DD6). At the time of the accident, he had flown 491.5 hours as an F-16 instructor, and another 22.3 hours as a Standardization and Evaluation Flight Examiner (SEFE) (Tab DD6). The flight leader was trained and qualified to perform all of the basic missions and weapons profiles flown by the 36 FS (Tab T5).

(b) **Recent F-16C/D Flying History.** The flight leader's recent F-16 flying history is summarized below (Tab DD5):

FLIGHT LEADER RECENT FLYING HISTORY		
Last 30 days	Last 60 days	Last 90 days
21.4 hours	33.1 hours	52.7 hours

(c) **Training Currency.** The flight leader was current in all command-directed training events required by MCI 11-F16, Volume 1 (Tab T5). His most recent instrument/qualification flight occurred on 29 Dec 97 (Tab DD1; Tab DD2). He flew his most recent mission check flight on 31 Jan 97 (Tab DD1; Tab DD3). He was rated fully qualified ("Q1") for both of these check flights (Tab DD2; Tab DD3). The evaluator on the flight leader's instrument/qualification check flight commented that he was "exceptionally qualified" (Tab DD2). CAJUN 1 was current and qualified for all training events planned for the mishap sortie (Tab T5).

(d) **NVG Specific Training.** The flight leader was one of the first cadre of 36 FS pilots to upgrade to NVGs. He entered the upgrade program in May 1997. By his own estimate, CAJUN 1 had approximately 30 flight hours on NVG missions. The flight leader did not fly either NVG-1 or NVG-2 with the mishap pilot (¶ Tab V2).[2]

[2] End-of-paragraph Tab references which include the "¶" symbol denote that all factual material in the paragraph was derived from the same, referenced Tab, unless otherwise indicated.

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(5) **Second Element Lead (CAJUN 3).** CAJUN 3, the second element leader, was a highly experienced F-16 instructor pilot. He graduated from UPT on 26 Jun 80 (Tab DD12). He was initially assigned as a T-38 instructor pilot at Sheppard AFB, TX (Tab DD12). He transitioned to the F-16 in January 1984 (Tab DD11; Tab DD12). He had been an F-16 pilot since then, first flying the F-16A/B and later, the F-16C/D (Tab DD12; Tab V3). As of 25 Mar 98, the second element leader had 3230.9 total military flight hours (Tab DD10). In fourteen years of flying the F-16, the second element leader had served in a host of positions, at a number of bases, including a recent tour as the squadron commander at the 422 TES (Fighter Weapons School) at Nellis AFB, NV (Tab V3). At the time of the accident, the second element leader was the Deputy Commander, 51st Operations Group at Osan AB (Tab V3).

(a) **F-16 Training.** The second element leader began flying the F-16 in January 1984 (Tab DD11; Tab DD12). At the time of the accident, he had flown a total of 1881.5 hours in the F-16, and 59.8 total hours in the F-16 simulator (Tab DD10). He was a current and qualified F-16 instructor pilot. At the time of the accident, he had 1197.5 hours as an F-16 instructor, and another 34.8 hours as a Standardization and Evaluation Flight Examiner (SEFE) (Tab DD10). The second element leader was trained and qualified to perform all of the basic missions and weapons profiles flown by the 36 FS (Tab T5).

(b) **Recent F-16C/D Flying History.** CAJUN 3's recent F-16 flying history is summarized below (Tab DD11):

SECOND ELEMENT LEADER RECENT FLYING HISTORY		
Last 30 days	Last 60 days	Last 90 days
7.4 hours	14.9 hours	18.7 hours

(c) **Training Currency.** CAJUN 3 was current in all command-directed training events required by MCI 11-F16, Volume 1 (Tab T5). His most recent instrument/qualification flight occurred on 19 Jun 97 (Tab DD7; Tab DD8). He flew his most recent mission check flight on 25 Jun 97 (Tab DD7; Tab DD9). He was rated fully qualified ("Q1") for both of these check flights (Tab DD8; Tab DD9). CAJUN 3 was current and qualified for all training events planned for the mishap sortie (Tab T5).

(d) **NVG Specific Training.** Like the flight leader, the second element leader was one of the first cadre of Osan pilots to upgrade to NVGs. He entered the upgrade program in April 1997. While at the Fighter Weapons School, CAJUN 3 participated in the initial Air Force F-16 flight testing for the NVG. By his estimate, CAJUN 3 had approximately 30 flight hours on NVG missions. The second element leader did not fly either NVG-1 or NVG-2 with the mishap pilot (¶ Tab V3).

(5) **Second Element Wingman (CAJUN 4).** CAJUN 4, the second element wingman, graduated from Undergraduate Pilot Training (UPT) on 27 Sep 96 (Tab DD18). He completed initial F-16 upgrade training at Luke AFB, AZ in August 1997 (Tab DD18). Osan AB is his first operational assignment (Tab V4; Tab DD18). He has been assigned to the 36 FS

since September 1997 (Tab V4). As of 25 March 1998, the second element wingman had 395.4 total military flight hours (Tab DD16).

(a) **F-16 Training.** CAJUN 4 began flying the F-16 in January 1997 (Tab V4; Tab DD18). At the time of the accident, he had flown a total of 149.3 hours in the F-16C/D, and 50.5 total hours in the F-16 simulator (Tab DD16). As a relatively new pilot, the second element wingman was not certified as a flight leader, instructor pilot, or evaluator (Tab V4). However, he was trained and qualified to perform all of the basic missions and weapons profiles flown by the 36 FS (Tab T5).

(b) **Recent F-16C/D Flying History.** CAJUN 4's recent F-16 flying history is summarized below (Tab DD17):

SECOND ELEMENT WINGMAN RECENT FLYING HISTORY		
Last 30 days	Last 60 days	Last 90 days
14.4 hours	22.7 hours	37.8 hours

(c) **Training Currency.** The second element wingman was current in all command-directed training events required by MCI 11-F16, Volume 1 (Tab T5). His most recent instrument/qualification flight occurred on 5 Mar 97 (Tab DD13; Tab DD15). He flew his most recent mission check flight on 9 Dec 97 (Tab DD13; Tab DD14). He was rated fully qualified ("Q1") for both of check flights (Tab DD14; Tab DD15). CAJUN 4 was current and qualified for all training events planned for the mishap sortie (Tab T5).

(d) **NVG Specific Training.** The second element wingman entered the NVG upgrade program at the same time as the mishap pilot (Tab V4). He completed the NVG academic curriculum on 23 Mar 98 (Tab DD19). He flew his NVG-1 and NVG-2 sorties on 24 Mar 98, the night before the mishap (Tab DD19; Tab V4). According to the second element wingman, he accomplished both NVG-1 and -2 sorties without any significant problems (Tab V4). CAJUN 4 was not in the same flight as the mishap pilot on either of his first two NVG sorties (Tab V4).

d. Briefing and Preflight.

(1) Mission Planning and Briefing.

(a) **Forecast Weather.** Surface weather conditions at Osan AB forecast for the flying period from scheduled takeoff to scheduled landing included the following: winds variable at 6 knots, visibility 3 miles with fog, ceiling broken at 20,000 feet, ambient temperature 46 degrees Fahrenheit, and altimeter setting 30.15 inches of mercury. Average winds from the surface to 5000 feet were forecast from 300 degrees at 18 knots. The sea temperature in the flying area was briefed as 52 degrees Fahrenheit, with 1-3 foot waves and a westerly current. Sunset was to be at 1848L and the moon would not rise until 26 Mar at 0508L, well after the planned landing time (¶ Tab W).

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(b) **Mission Planning.** The mishap pilot and the other members of CAJUN flight planned the mission at Osan AB on 25 Mar 98. Both the mishap pilot and the formation's other wingman (CAJUN 4) were to fly the NVG-3 upgrade profile (Tab K). The mishap pilot assisted the other wingman with obtaining weather and Notices to Airmen (NOTAM) information, making maps of the operating airspace and navigation steerpoints, obtaining takeoff and landing data, and other minor planning tasks normally assigned to the mission wingmen (Tab V4). The mishap pilot used a computer-based Tactical Decision Aid to predict illumination levels for the mission. The results showed that low-illumination conditions could be expected (Tab K). The flight leader performed the major mission planning tasks such as designating mission objectives, planning the sequence of events, coordinating the specific administration of five intercept scenarios, and preparing the mission briefing. The mishap pilot performed a preflight of his NVGs independently and reported problem-free completion of that task to the flight leader before the briefing (Tab V2; Tab V31).

(c) **Mission Briefing.** The briefing began at 1640L and followed the flight leader's personal briefing guide. Each of the four pilots in CAJUN flight attended the briefing in its entirety. As the 36 FS Assistant Operations Officer and the 51 OG Deputy Commander, respectively, the flight leader and second element leader represented squadron supervision present at the brief. The flight leader (CAJUN 1) conducted the brief, discussing mission events in accordance with the 51 FW NVG upgrade syllabus for NVG-3 with the exception of adding in-flight refueling prior to intercepts. The briefing covered the forecast weather described above and all required items, including expanded discussion of NVG cockpit setup, NVG operations and training rules, task prioritization, and coping with spatial disorientation and unusual aircraft attitudes (Tab V2). The briefing was normal for the type of mission planned. Flight members reported that there was adequate time for the briefing and no one had unanswered questions or unresolved mission-related conflicts at its completion (Tab V2; Tab V3; Tab V4). The IP in CAJUN flight's second element reported that the flight leader's briefing was thorough and well above average (Tab V3).

(2) **Ground Operations.** The mishap pilot donned his anti-exposure suit, anti-G suit and vest, survival vest, and parachute harness prior to stepping to his aircraft (Tab J7; Tab V31). Members of CAJUN flight were transported to their aircraft at 1810L and started engines at 1834L (Tab U7). The mishap pilot aborted his original aircraft, number 88-0519, when its Jet Fuel Starter failed to start, which precluded a main engine start (Tab V13). The maintenance Production Superintendent shortly thereafter transported the mishap pilot to the mishap aircraft, which he successfully started at 1852L (Tab V13). At 1850L the other members of CAJUN flight taxied to the end of the runway for final checks and waited there for the mishap pilot, who taxied at 1903L (Tab U7). After taxiing to the end of the runway, the mishap pilot performed his pre-takeoff checks and radioed his flight leader that he was ready for takeoff (Tab V2).

e. **Mishap Flight Activity.**

(1) **NVG-3 Syllabus Sortie.**

(a) **Mission Objectives.** Per the syllabus for both NVG-1 and -2, the mishap pilot had not been required to perform defensive maneuvers, such as a notch, using the NVGs prior to the mishap sortie. The NVG upgrade program defined the main objective of NVG-3 for upgrading pilots as showing proficiency in maintaining tactical formation positions while executing intercepts. It was somewhat more complex than NVG-2 since an upgrading pilot had to divide his attention between maintaining proper formation with his leader, using his radar to find two adversary aircraft, employing weapons, and executing defensive maneuvers if required. Another program objective for NVG-3 was for upgrading pilots to observe a variety of external lighting configurations in their formations. The flight leader's briefed objectives for the mishap pilot were for him to support his element's air-to-air game plan by developing a "big picture" of each intercept, labeling threat groups, calling out and locking his radar onto threat aircraft, and effectively communicating on the radio (Tab EE1). The mishap pilot was to maintain visual awareness of his leader while performing his assigned tasks (Tab EE1). Once the elements split up, each element leader would monitor his respective wingman's performance of the briefed practice intercepts.

(b) **Planned Maneuvers.** The flight leader briefed mission tasks that followed NVG upgrade program guidance. Before takeoff, flight members were to prepare their cockpits for NVG use by setting up chemical light sticks in accordance with standard squadron procedures. The flight would take off to the southwest in trail formation, each flight member using radar to maintain 2- to 3-mile spacing behind the preceding aircraft. Pilots were to take off with NVGs stowed, then each flight member would don his NVGs in sequence (i.e. CAJUN 1, then CAJUN 2, and so on) after climbing through 2000 feet altitude. CAJUN flight would then rejoin to a visual formation and head west over the Yellow Sea to rendezvous with a KC-135R tanker, TORA 51, in an area known as the Fiend tanker track. Each aircraft would receive 2000 pounds of extra fuel. Pilots would not use NVGs during air-to-air refueling. CAJUN flight would then proceed north to restricted practice airspace areas R-88 and ACMI (for Air Combat Maneuvering Instrumentation), to set up for intercepts (Tab EE3). The flight would execute a G-awareness maneuver consisting of two 90-degree turns of between 3 and 5 Gs to test their anti-G systems and prepare their bodies for turning accelerations in subsequent intercepts. CAJUN flight would then split up into elements of 2 aircraft each, with CAJUN 1 and 2 flying to a pre-briefed western reference point and CAJUN 3 and 4 flying to a similar eastern point to obtain separation for the intercepts. Following the intercepts, CAJUN 2 and 4 were to practice changing their NVG batteries. Then the flight would rejoin to a trail formation as on departure, doff NVGs, and return to Osan AB by flying instrument approaches to full stop landings (Tab EE1; Tab V2).

(c) **Intercept Scenarios.** The flight leader planned five separate intercept scenarios for CAJUN flight in accordance with the NVG training program. The scenarios would become progressively more complex during the mission. On the first intercept, each element would fly directly at the other with wingmen approximately one mile abeam their leaders. Flight members would obtain radar locks on the other element's aircraft and simulate missile firing with

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neither element maneuvering. The second intercept was similar, except that each element would maneuver away from the other following simulated missile firing beyond visual range (BVR). For the next three intercepts, CAJUN 1 and 2 would continue to act as F-16s using USAF tactics while CAJUN 3 and 4 would simulate adversary aircraft using different tactics and simulating different air-to-air missile capabilities. On the third intercept, the adversaries would simulate a short-range missile capability and would fly straight ahead while CAJUN 1 and 2 obtained radar locks and maneuvered to identify and shoot them from within visual range. On the fourth and fifth intercepts, the adversaries would simulate a medium-range missile capability. During the fourth scenario, one adversary would lock either CAJUN 1 or 2 with radar; the locked aircraft would, when necessary, execute a defensive maneuver called a notch. To perform a notch, the locked aircraft would turn to place the adversaries abeam it while simultaneously descending. Although the notch maneuver itself would be the same as if flown in daylight, the flight leader briefed the importance of using instruments to accomplish the maneuver at night. As a technique, the flight leader also briefed the use of NVGs to better keep sight of the adversaries during the notch, to enhance the pilot's situational awareness. The other aircraft would continue the intercept to identify and simulate shooting both of the adversaries. On the fifth intercept, both CAJUN 1 and 2 would be locked by the adversaries and they would perform a notch together, with CAJUN 2 following CAJUN 1 using visual references. After five intercepts, CAJUN 1 and 2 would assume the adversary role so that CAJUN 3 and 4 could obtain training as F-16s, repeating scenarios three through five (¶ Tab V2).

(d) **Night Operations.** Fighter operations at night involve special challenges. The chief limitation at night is the loss of visual references a pilot would otherwise use for tasks such as setting aircraft attitude, formation flying, identifying other aircraft, and sighting targets. The lack of visual references makes depth perception more difficult and increases the chance that pilots will misorient their aircraft with respect to the earth or experience one of several common visual illusions. For example, pilots can confuse lights on the ground with stars or misidentify unlighted portions of the earth with an overcast cloud layer. At night, pilots must actively crosscheck aircraft instruments to keep themselves oriented properly. They also must rely more upon sensors such as radar, Forward Looking Infrared (FLIR), the targeting pod, and so on to properly execute fighter tactics.

(e) **Equipment.** Night Vision Goggles are battery-powered devices that amplify portions of the visible light and near infrared spectrum to permit vision in very low light conditions. NVGs amplify both radiated and reflected light from sources such as the moon, stars, and cultural lights on the ground to improve the wearer's visual acuity at night. NVGs can improve the wearer's night visual acuity from an unaided 20/200 to approximately 20/25 if adjusted and fitted properly. The main benefits of NVGs for fighter aircrew are improving their situational awareness and permitting them to fly nearly identical tactics at night as in daylight. NVGs permit aircrew to visually perform tasks at night for which they would otherwise require other sensors or instruments. NVGs also have known limitations. Their field of view is limited to 40 degrees wide. The image they provide is degraded by environmental factors such as haze, smoke, fog, or extreme darkness. They reduce the depth perception cues available to the wearer, and distance estimation while wearing NVGs is more difficult compared to day vision (Tab FF1). The NVGs worn by the mishap pilot were designated AN/AVS-9 F-4949. They were binocular goggles containing two batteries, a main and a backup, attached to the flying helmet via a mounting bracket on the helmet itself (Tab FF2).

(f) **F-16 Cockpit Setup.** NVGs vary their gain, or light amplification, depending on the intensity of the light they detect. If exposed to relatively bright light, NVGs will change gain so that the wearer is not blinded, resulting in only the brighter images appearing through the goggles. For NVGs to work best, it is therefore necessary to reduce ambient light levels in the cockpit as much as possible so that they approximate the environmental light level (Tab FF3). Aircraft of the 36th FS were not manufactured with all cockpit lights compatible with NVGs and require pilots to take two types of setup actions prior to NVG missions. First, pilots must place nine chemical light-emitting sticks ("chemsticks") around the cockpit, inside holders that are pilot-adjustable to vary light emissions. The chemstick holders attach with Velcro. Second, pilots must mask non-NVG compatible cockpit indicator and warning lights with either black tape or a film called "Glendale green," which permits viewing the lights without altering the NVG gain. These setup actions require approximately five minutes for a proficient pilot to accomplish, and permit night NVG operations with all cockpit interior lights turned off (Tab FF3). The mishap pilot was trained not to begin setup actions until he had completed other pre-takeoff checks. After cockpit setup, however, all pilots turn their cockpit interior lights back on because the PACAF supplement to AFI 11-214 prohibits takeoff while wearing NVGs (¶ Tab V2).

(g) **External Aircraft Lighting.** For all non-NVG missions, F-16 aircraft operate with bright, flashing position lights on the intake, wingtips, and fuselage and an anti-collision strobe light atop the vertical tail. During NVG operations, that lighting configuration is so bright that it gains down the NVGs and is distracting to the pilot and other flight members nearby. When transitioning to NVGs, therefore, pilots reconfigure their external lights (Tab FF4). The CAJUN flight leader briefed CAJUN 2 that his element would use a light setting known as "cloak" while performing NVG intercepts. While in cloak, each aircraft would turn off the anti-collision strobe, switch other lights from flashing to steady, and dim those remaining lights using an adjustable rheostat (Tab FF4). After initial brightness adjustment, CAJUN 1 would readjust as necessary if CAJUN 2 told him that his lights were too bright or dim. CAJUN 3 and 4 were to keep their external lights and strobe on, bright, and flashing while acting as adversaries for 1 and 2; this configuration was known as "Christmas tree" (¶ Tab V2).

(h) **Aircraft Configuration.** All CAJUN flight members were configured identically. Each had an AN/ALQ-184 electronic countermeasures pod mounted on the fuselage centerline station, LANTIRN navigation and targeting pods on the intake stations, one 370-gallon external fuel tank on each wing, a triple-ejection rack (empty of bombs) and mounting pylon on the right wing, a SUU-20 training ordnance dispenser containing six BDU-33 practice bombs and mounting pylon on the left wing, missile launchers on each of the four outboard wing stations, an AIM-9M captive training missile on the left wingtip launcher, an Acceleration Monitoring Device (AMD) on the right wingtip launcher, 511 rounds of 20 mm ammunition internally, 30 bundles of chaff, and 30 flares (Tab L).

(2) **In-Flight Conditions.**

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(a) **Weather.** Observed weather closely resembled forecast conditions. At 1855L the Osan weather observer recorded the surface conditions as a broken ceiling at 20,000 feet, visibility 4 miles in haze, and winds from 240 degrees at 6 knots. Surface observations from the operating airspace at 1957L were no ceiling, scattered clouds at 20,000 feet, visibility 3 miles in fog, and winds from 250 degrees at 10 knots (Tab W). Members of CAJUN flight stated that they encountered thin clouds above approximately 22,000 feet in the intercept airspace (Tab V2; Tab V3; Tab V4). The clouds were thin enough to see through vertically but obscured horizontal visibility. Some flight members stated that stars were visible when looking up through the clouds with NVGs (Tab V2; Tab V3). Flight members also reported later that low illumination conditions existed, and it was darkest when flying westbound away from the cultural lights of Korea (Tab V2; Tab V3; Tab V4). The flight leader judged that visibility was good below the clouds and a discernible horizon was present (Tab V2).

(b) **Communications.** The F-16 has two on-board radios, one using Very High Frequencies (VHF) and the other Ultra High Frequencies (UHF). From engine start through entry into the intercept airspace, all members of CAJUN flight used local channel 11 as a common inter-flight VHF frequency (Tab N). Review of mission videotapes revealed that after the flight completed the G-awareness maneuvers, the flight leader cleared CAJUN 3 and 4 to switch to VHF channel 12 to permit each element to communicate separately from the other element. Each element also operated on separate UHF frequencies to communicate with Ground-Controlled Intercept (GCI) radar controllers, call sign Airedale, during the intercepts. CAJUN 1 and 2 talked to Airedale on UHF 250.3 MHz while CAJUN 3 and 4 used 230.425 MHz. It was Airedale's responsibility to pass messages such as simulated kills and directives to terminate maneuvering between CAJUN's two elements while they operated on separate VHF and UHF frequencies. All flight members and Airedale also monitored the UHF emergency frequency (Guard) of 243.0 MHz. However, on 25 Mar 98 at 1500L the GCI radios at Mangilsan, nearest to the intercept airspace, went out of operation, forcing Airedale to use alternate radios located farther away (Tab BB2).

(c) **NAVAIDS and Facilities.** All navigational aids relevant to the mission were operating normally on 25 Mar 98. The Notices to Airmen (NOTAMS) for 25 March revealed no pertinent facilities limitations or outages that affected the mission (Tab EE2).

(d) **Planned Route.**

i. **Topography.** The only portions of CAJUN flight's mission that were over land were departure and recovery. Its departure route took it southwesterly over moderately populated low hills between Osan AB and the city of Seosan approximately 30 miles away. The flight was over water once it was more than 20 miles west of Seosan en route to the Fiend tanker track. The refueling ground track was entirely over the Yellow Sea. Within the R-88 and ACMI airspace, there was a group of islands from 2 to 7 miles to the north of CAJUN's eastern reference point. The largest of the islands was approximately 5 miles long, and the highest elevation on the islands was 1155 feet. Other than the islands, the intercept airspace was also completely over water (¶ Tab EE3).

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ii. **Airspace.** CAJUN flight was scheduled for exclusive use of R-88 and ACMI from 1915L to 2030L on 25 Mar 98 (Tab EE4). The lateral limits of the areas are depicted on CAJUN flight's area map, attached as Tab EE3. Where CAJUN flight planned to operate, in the western portion of ACMI and the eastern half of R-88, the airspace includes all altitudes from the surface to 40,000 feet (R-88) or 60,000 feet (ACMI). (¶ Tab EE3).

iii. **Maneuvering Limitations.** The maneuvering limitations for CAJUN flight were based upon configuration limits for their aircraft, limits selected by the flight leader, and administrative limits imposed by governing instructions. The aircraft configuration limits from the flight manual included a maximum symmetric acceleration of 7 Gs, increasing to 7.33 Gs once the external fuel tanks were empty. Asymmetric (rolling) limits were 4.5 Gs, rising to 5.5 Gs once all fuel in the external tanks had been depleted. Maximum allowable airspeed was 550 knots or Mach .95, whichever was lower. The flight leader briefed a maneuvering "floor" of 5,000 feet. The flight was to terminate maneuvering anytime it became apparent any aircraft was going to descend below the floor (Tab V2; Tab V3). Also, once any flight member reached "bingo" fuel of 3,000 pounds remaining, the mission would cease and the flight would return to Osan AB (Tab EE4). Training rules from AFI 11-214, briefed by the flight leader, stated that defending aircraft would be limited in their maneuvering to a maximum of 180 degrees of turn once an attacking aircraft passed behind them (Tab V3).

(3) **Flight Activity Prior to Mishap.**

(a) **Departure.** CAJUN flight took off at 1918L (Tab A). The flight proceeded in accordance with the planned route to the Fiend tanker track. The trail departure, NVG donning and flight rejoin took place as briefed (Tab V2; Tab V3).

(b) **In-Flight Refueling.** All CAJUN aircraft refueled from TORA 51 in the Fiend tanker track, each taking approximately 2000 pounds of fuel. Refueling occurred above the 22,000-foot cloud layer. CAJUN's pilots stowed their NVGs in the raised position during refueling operations, and returned them to their operating position after separating from the tanker (¶ Tab V2).

(c) **Area Transition.** After refueling, CAJUN flight proceeded north to R-88/ACMI and descended below the clouds. Review of the mission videotapes showed that, at 2005L, the flight executed the briefed G-awareness maneuver and split into elements with CAJUN 1 and 2 flying to the western reference point (latitude N 36° 55', longitude E 125°20') while CAJUN 3 and 4 flew to the eastern reference point (latitude N 37° 00', longitude E 126° 00'). En route, the two elements switched radio frequencies to the planned separate UHF and VHF channels and contacted their respective Airedale controllers. CAJUN 1 and 2 also switched their external lights to cloak and adjusted their lighting as planned (¶ Tab V2).

(d) **Pre-Mishap Intercepts.** CAJUN flight completed four intercepts prior to the mishap intercept. Videotape review showed that all four intercepts closely followed the flight leader's briefed plan. Throughout the first four intercepts, CAJUN 1 and 2 flew between

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15,000 and 19,000 feet while 3 and 4 flew between 20,000 and 24,000 feet (but below the clouds). Each of those four intercepts began with approximately 30 miles between elements, except the first in which separation was greater. The first intercept began at 2007L with CAJUN 1 and 2 westbound. During this intercept, CAJUN 2 had minor difficulty finding his assigned target on the radar, obtaining the correct radar lock at 8 miles from the adversaries. He simulated a missile shot but reported losing sight of CAJUN 1 following the shot. He regained visual contact when CAJUN 1 dispensed chaff. After the first intercept, CAJUN 1 reminded CAJUN 2 to use his NVGs to look for the adversaries visually inside 15 miles, with or without a radar lock, to increase his situational awareness. The second intercept began at 2012L with CAJUN 1 and 2 in the east, heading west. CAJUN 2 obtained the correct radar lock 20 miles from the adversaries and simulated a missile shot. He maintained formation with his leader throughout completion of the intercept, including a briefed element turn away from the adversaries at 10 miles distance. The third intercept began at 2016L with CAJUN 1 and 2 again in the east heading west. During this intercept, CAJUN 2 locked the trailing adversary at 13 miles range and flew an NVG visual formation with CAJUN 1 to within 2 miles behind the adversaries. CAJUN 2 simulated a missile shot on the trailing adversary while CAJUN 1 simulated attacking the leader, and both then egressed to the west. The fourth intercept began at 2022L. CAJUN 1 and 2 flew east from the west point with CAJUN 2 on the north side of the formation. While directing CAJUN 2 to lock the northern adversary, CAJUN 1 received indications that one of the adversaries had locked him with radar. CAJUN 2 achieved the correct radar lock at 16 miles range, and both reported seeing two adversary aircraft by 11 miles. CAJUN 1 then executed a defensive notch maneuver, turning to the southeast and descending. Following briefed tactics, CAJUN 2 split away from 1 and continued the intercept, obtaining visual identification of the adversaries and simulating missile shots against both. CAJUN 1 and 2 egressed east but lost sight of each other. They regained visual contact three miles southeast of the east point after a minute of coordination.

(4) **Final Intercept.**

(a) **Intercept Set-up.** CAJUN flight's videotapes showed that, after an element fuel check during the setup for the fifth intercept, CAJUN 1 became concerned that CAJUN 2 would have insufficient fuel to fly the three subsequent intercepts required for CAJUN 4's training. He instructed Airedale to tell the adversaries to begin the intercept with only 20 miles separation, to expedite the intercept. However, CAJUN 3 and 4 had momentarily lost sight of each other and were not in the proper formation when they regained visual contact. Airedale consequently advised CAJUN 1 that the adversaries needed 30 seconds to prepare. CAJUN 1 then turned his element in a left 360-degree turn to increase separation from the adversaries and directed CAJUN 3 to dim his element's fuselage lights and turn their strobe lights off. CAJUN 3 acknowledged the instruction but did not instruct his wingman to change as CAJUN 1 had directed. CAJUN 3 later testified that his element's lights remained in the Christmas tree configuration (Tab V3). At 2030L, when the two elements were 25 miles apart, CAJUN 1 turned westbound and told Airedale to inform the adversaries "fight's on" so that they would start to execute their briefed tactics.

(b) **Intercept Sequence.** The following description is based on review of CAJUN flight's videotapes. From slightly southwest of the east point, CAJUN 1 turned to a

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heading of 272 degrees at approximately 17,000 feet, accelerating to between 410 and 420 knots. He directed CAJUN 2 to take up a "line abreast" position on the left, or south, side as they headed west. The briefed NVG line abreast position was 10-45 degrees aft of abeam the leader, at a distance of between 3,000 and 9,000 feet. From within 3 miles of the west point, CAJUN 3 and 4 turned to an easterly heading at 14,000 to 15,000 feet altitude and 360 knots. CAJUN 3 and 4 also assumed a line abreast formation with CAJUN 4 on the right, or north, side. At approximately 29 miles from the adversaries, CAJUN 1's radar displayed the adversary group, and he called that he had both adversaries in sight directly ahead. CAJUN 2 radioed that he had both of them in sight by 25 miles distance. At 22 miles, CAJUN 1 turned northwest to a heading of 310 degrees. CAJUN 2 matched 1's heading, but the turn placed CAJUN 2 in a position about one mile aft of 1, displaced slightly left of his leader's tail. After turning northwest, CAJUN 1 did not see CAJUN 2 again. After completing the turn, CAJUN 1 received warning that an adversary (CAJUN 3) had locked him on radar. CAJUN 1 told CAJUN 2 that he had locked the northern adversary and instructed CAJUN 2 to lock the southern adversary. He also began a descent at an approximate angle of 4 degrees. CAJUN 2 initially locked the northern adversary but locked the southern adversary after his flight leader repeated his previous instruction. CAJUN 2 also called twice that he had been radar locked from the west. By then, CAJUN 3 had switched his lock from CAJUN 1 to 2, while CAJUN 4 established a radar lock on CAJUN 1.

(c) **Element Notch.** By 2031:32L, each element's northern aircraft had locked the other, and each southern aircraft had locked the other. Airedale then advised CAJUN 2 that the aircraft locking him was 12 miles away. CAJUN 2 responded at 2031:43L by calling "Notching 360," signifying that he was starting a notch maneuver with an intended heading of 360 degrees. CAJUN 2's decision to start the notch maneuver was not in accordance with the briefing, in which the flight leader had said that he would initiate the notch and the mishap pilot would follow in formation. Once CAJUN 2 began his turn, CAJUN 1 decided to start his own notch maneuver so that his element would be in the notch together, as he intended (Tab V2). He called that he was notching to 350 degrees heading and increased his descent angle to approximately 9 degrees; he actually turned his aircraft to a heading of 330 degrees. Both CAJUN 1 and 2 started their notch maneuvers from a heading of 310 degrees at just over 15,000 feet above the water. Based on information from CAJUN 3's radar videotape, the mishap pilot never reached his intended heading of 360 degrees. For an unknown reason, instead of turning, the mishap pilot entered a steep dive at an angle of over 60 degrees, dropping 12,000 feet in 14 seconds. During the dive, the mishap pilot's heading remained initially between 310 and 320 degrees, but as he passed 7,000 feet altitude his heading changed rapidly to 020 degrees. At 2031:57, the mishap pilot was approximately 3,000 feet over the water heading 020 degrees, still descending at an airspeed that had increased from 420 knots at the start of the notch to 610 knots. At that moment, shortly after CAJUN 1 had called that he saw both adversary aircraft, the mishap pilot called "Terminate, terminate, terminate."

(d) **Aircraft Impact.** Videotape of CAJUN 4's FLIR sensor indicates that the mishap pilot initiated ejection at 2032:02L. At that moment, CAJUN 3's radar showed the mishap aircraft to be heading 040 degrees at 560 knots with an altitude estimated to be between 500 and 1,500 feet. According to CAJUN 3's radar, the ejection occurred at approximately latitude N 37°00.7', longitude E 125°46.1'. The exact aircraft attitude at ejection could not be determined. One second after ejection, CAJUN 1 and 3 both heard an Emergency Locator Transmitter (ELT) signal on guard frequency (Tab V2; Tab V3). The signal continued for approximately 39 seconds after it began, then stopped and never resumed. CAJUN 3's radar tracked the mishap aircraft for 17 seconds after the ELT began transmitting. During that time the tape indicated that the mishap aircraft's airspeed was 560-570 knots, its heading drifted slowly right to 070 degrees, and its altitude varied between 1,000 feet and the surface. Analysis of the CAJUN 3 radar tape suggested that the mishap aircraft struck the water at 2032:20L at latitude N 37° 01.9', longitude E 125° 48.4', approximately 2.3 miles northeast of its position at ejection.

f. **Egress Systems.**

(1) **Ejection Seat.**

(a) **Description.** The F-16 is equipped with the Advanced Concept Escape System (ACES) II ejection seat. The ACES II seat will function at any altitude, attitude, and airspeed so long as the pilot arms it before takeoff in accordance with the checklist. The seat contains a parachute and survival kit which attach to the pilot's parachute harness and separate from the seat during ejection. When the pilot pulls the ejection handle, the canopy is first jettisoned and an inertia reel tightens the parachute straps. As the canopy departs, it pulls a lanyard that initiates a rocket catapult, propelling the seat out of the aircraft. The seat contains environmental sensors which are then exposed to the airstream to measure airspeed and altitude, information that the seat's electronics use to determine how and when to complete the ejection sequence.

(b) **Performance Envelope.** If at altitudes above approximately 16,000 feet, the ACES II seat deploys a drogue parachute to stabilize it and remains attached to the pilot until it descends below 16,000 feet, in order to reduce the time the pilot descends in his parachute. At airspeeds above 250 knots, the seat also deploys the drogue chute to slow the seat before man-seat separation, to minimize pilot injury and main parachute damage upon deployment. When the seat senses the correct combination of airspeed and altitude, it fires the main parachute and separates from the pilot. Under certain circumstances, however, the system will have insufficient time to complete its automatic functions before ground impact. In general, ejecting in a steep dive combined with high airspeed, or at a bank angle other than level, requires a pilot to initiate ejection at a sufficient altitude above the ground for the seat to have time to function completely, giving the pilot an inflated parachute before he lands. This altitude varies depending on the aircraft's exact airspeed and dive angle, and whether the ejection is from an F-16D. Moreover, T.O. 1F-16C/D, Blocks 40 and 42 (the F-16C/D flight manual), warns that ejections at airspeeds between 450 and 600 knots can cause injuries due to drogue parachute opening shock and flailing of extremities. Also, at those speeds a pilot's helmet can be forcibly removed from his head by the airstream, particularly if its chin and nape straps are not properly fitted (Tab V22). For these reasons, the flight manual recommends slowing as much as possible before ejection.

(c) **D-Model Differences.** The F-16DG ejection system must permit two crew members to escape, and is modified accordingly. It can be set to permit one crew member to initiate ejection for both seats, or for each seat to eject alone. Whenever both seats eject, the rear seat ejects first followed by the front seat, to shield the rear seat occupant from the catapult rocket and avoid seat collision. This sequence delays the front seat .4 seconds compared to a solo ejection, where the front seat ejects without the rear. Therefore, the solo ejection mode results in faster ejection if the rear seat is empty. In addition, since the canopy on the D-model is larger, it requires longer to clear the aircraft upon jettison, requiring an additional .4 seconds compared to a C-model. The result of the above differences is that a D-model requires a higher minimum altitude for safe ejection if it is in a dive compared to a C-model, and it requires an even higher altitude if the solo mode is not selected. Finally, each seat has a trajectory divergence rocket that fires upon ejection to move the seat laterally either left or right. This movement prevents collision with the aircraft's tail and, in a D-model, further prevents the two seats from interfering with each other if both eject since the D-model seats move in opposite directions (Tab GG).

(d) **Inspections and Modifications.** The ejection seat was inspected by Egress Section personnel on 25 March 1998, as part of a required recurrent "egress final" inspection. The egress final inspection is a visual check of aircraft egress systems, performed by Egress Section personnel on each aircraft every 30 days (Tab V28). There were no uncompleted modifications due for the ejection seat (Tab U4; Tab U6).

(e) **Actual System Performance.** Analysis of CAJUN 3's radar tape indicates that ejection occurred at approximately 560 knots, at an altitude between 500 and 1,500 feet, at unknown angles of bank and dive. For these parameters, the seat would select Mode 2, its high-airspeed/low altitude mode in which it deploys the drogue parachute momentarily before the main parachute. Based upon analysis of the aircraft's flight path after ejection, a reasonable estimate of ejection parameters would be a dive angle not more than 30 degrees and a right bank not more than 45 degrees. Analysis of the wreckage revealed parts of the rear ejection seat, evidence that the pilot ejected in the solo mode (Tab J8). For the above parameters, the flight manual indicates that the minimum altitude for complete seat function is approximately 900 feet, within the estimated actual ejection altitude. It is therefore probable that the mishap pilot initiated ejection within the performance envelope of the seat. In addition, the pilot was found with his survival kit deployed, raft inflated, and parachute detached (Tab BB12; Tab J7). Survival kit deployment is the final event in the ejection sequence and is complete approximately seven seconds after the rocket catapult fires. This evidence strongly suggests that the seat functioned completely and in accordance with its design.

(2) **Parachute.**

(a) **Performance Envelope.** Assuming the ejection scenario described above, the ejection occurred within parachute design parameters, according to data tables in T.O.13A5-56-11, Section 4. The C-9 parachute provides a descent rate of 1,000 feet per minute (approximately 16 feet per second). This descent rate assumes no canopy lines are broken.

(b) **Inspections and Modifications.** Per Section 5.20.4.5.1 of PACAF Instruction 11-301(cc), the egress final inspection includes inspection of the parachute container. The parachute container was visually inspected by Egress Section personnel on 25 March 1998, at the same time as the ejection seat (Tab U22). The parachute was modified with the UWARS releasing system (Tab HH1; Tab V16). The seat and parachute were inspected as required (Tab HH1). The parachute and UWARS were installed in August 1997 and were still within their functional life. The parachute canopy was last inspected 17 Aug 97. The inspection was current in accordance with T.O. 14D3-11-1 (Tab HH1).

(c) **System Performance.** The parachute was not recovered. However, the nature of the pilot's injuries strongly suggests that the parachute slowed the pilot substantially. Those injuries which he received are more consistent with the effects of wind blast from high speed ejection, and possibly opening shock of the parachute (Tab J7; Tab X). At the designed descent rate of 16 feet per second, assuming the seat beacon started at man-seat separation and ceased transmitting the instant it hit the water, 39 seconds later, the calculated altitude at which the parachute inflated was approximately 600 feet.

g. **Personal and Survival Equipment.**

(1) **Anti-Exposure Suit (CWU-74/P).**

(a) **Purpose and Description.** The anti-exposure suit is designed to increase the time to the onset of hypothermia when a person is immersed in cold water by insulating the wearer from moisture. The suit is a full-body garment to include integrated socks with tight fitting water-tight rubber seals on the wrists and neck. There is a main zipper along the chest to allow the garment to be donned. In water conditions similar to those of 25 Mar 98 with a sea temperature of 45° F, without an exposure suit, a person's time of useful consciousness could be expected to be approximately 40 minutes, with death from exposure likely after approximately 2.5 hours. Wearing the suit, a person would be expected to survive 5 hours of immersion in 45° F water, according to AFR 64-4.

(b) **Inspections and Modifications.** This suit is tailored to fit each wearer. Life Support personnel inspect the suit inspected prior to its entering service, and perform a formal, documented inspection every 180 days. It is also informally inspected prior to each donning. Each time, the suit is inspected for overall condition, tears, holes, proper function of the zipper, condition of seams and seam seals, and condition of the neck and wrist seals. During the periodic inspections, the rubber lips of the slide fasteners are lubricated. After each wear, the suit is hung inside-out over a wooden hanger to dry, and post-flight inspected by Life Support personnel the same as periodic inspections, in accordance with T.O. 14P3-5-91, Chapter 5. There was no record of maintenance or inspections for the mishap pilot's anti-exposure suit.

(c) **Crew Use.** If water temperatures are 61- 70° F, T.O. 14P3-5-91 and PACAF Instruction 11-301 recommend that the pilot wear one set of appropriate thermal underwear under the anti-exposure suit. If water temperature is less than 50° F, the instructions recommend one set of thermal underwear and one set of waffle weave underwear worn under the suit. The accident pilot was wearing the anti-exposure suit, zipped, when his body was recovered (Tab BB12). He was not wearing any thermal underwear under the anti-exposure suit.

The pilot was observed by a Life Support technician wearing a flexible plastic tube around the neck of the anti-exposure suit (Tab V31). This unapproved modification (commonly called a Jetson modification) is often done by wearers for comfort. The neck seal of the anti-exposure suit was damaged during the ejection, and the plastic tube was torn away (Tab J7).

(2) **Life Preserver Unit (LPU-9/P).**

(a) **Purpose and Description.** As described by T.O. 14S-1-102, the LPU is a 2-chambered life preserver connected to the back of the torso harness and worn in a horse-collar fashion. It is connected around the front of the chest by a clip. The LPU can be activated manually by pulling on activation cords on either side, or automatically when immersed in water, by two CO_2 cartridges. There are valves on each cell to allow for oral inflation. The LPU is designed to provide flotation and keep the head of an incapacitated pilot above water; however, the LPU may not keep the pilot's head above water if the chest strap is not correctly fastened or the connections are damaged or improperly fitted. PACAF Instruction 11-310 requires personnel to wear LPUs when flying over water.

(b) **Inspections and Modifications.** As described in T.O. 14S-1-102, the LPU-9/P is attached to the torso harness and the length of the chest strap is fitted to each person. The excess length is "tacked" down with thread to prevent loosening. In the event the LPUs are to be used on a temporary basis, the excess strap may be held by an elastic band and taped. The LPU is inspected on entering service and periodically every year, plus or minus 10 days. During inspection, the LPU is checked for overall condition, the fabric is examined for cuts, tears, abrasions, and security of stitching or other damage. The LPU is examined for safety ties on release pins, lanyards, stains, dirt, and general condition and cleanliness. During the periodic (annual) inspections, the LPUs are inflated and the bladders are checked for leaks. On every fourth periodic inspection, the LPUs the CO_2 cartridges are also fired manually. Prior to each wear, the aircrew should accomplish a preflight inspection of the LPU for overall condition, evidence of dirt and stains, and evidence of damage to the fabric and mechanical portion of the LPU. The last inspection of the pilot's LPU was performed 16 Oct 97, prior to the pilot's arrival in the 36 FS and its subsequent issuance and fitting to the pilot. The next inspection would have been due 16 Oct 98 (Tab HH2). The inspection was current for the LPU, but there is no indication that the excess strapping was tacked as required by the T.O. (Tab J7).

(c) **Crew Use.** The LPU-9/P was sent to the Air Force Life Sciences Equipment Laboratory at Kelly AFB, Texas, for analysis. The LPU was found to have been automatically activated. The LPU right side was damaged. The bladder was torn free of the strap which attaches it to the right side and the upper rear nape area. No tacking was found on the LPU. No evidence was found that the LPU straps had loosened from the force of the wind blast. The straps lengths were not changed as a result of the ejection. The right strap was adjusted looser than the left, but this could have been done to accommodate other survival gear

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worn underneath the LPU. The condition of the LPU-9/P indicated damage to the unit from the wind blast from the ejection (Tab J7).

(3) **Universal Water-Activated Release System (UWARS).**

(a) **Purpose and Description.** The UWARS is an automatic water release system which will release the parachute risers from the torso harness after the UWARS have been immersed in sea water for 2.5 seconds. The UWARS is attached at the end of the parachute riser, one on each riser, where the riser would enter the torso harness. The UWARS does not preclude manual riser release.

(b) **Inspections and Modifications.** In accordance with T.O. 14D3-11-1, the UWARS are inspected every 30 days for general condition and evidence of tampering. The inspection was current. The pilot's UWARS was last inspected 17 Mar 98 (Tab HH1).

(c) **Crew Use.** The UWARS activated automatically to release the accident pilot from the parachute risers. This is evident because the lower portion of the parachute riser attachment was found in the harness connector as expected for UWARS release. The parachute risers were not released manually (J7).

(4) **Torso Harness (PCU-15/P).**

(a) **Purpose and Description.** As described in T.O. 14D3-11-1, the torso harness connects the pilot to the parachute, which is stored in the ejection seat of the F-16. The pilot wears the harness over all his other gear. The risers are attached to the harness when the pilot is in the seat. There are two leg straps and a chest strap. The harness also contains attachments for the seat kit and LPU. The harness straps are adjusted to provide a custom fit.

(b) **Inspections and Modifications.** In accordance with PACAF Instruction 11-301, the harness has a 7-year service life. Inspections are required prior to use and every 30 days. T.O. 14D3-11-1 dictates inspection procedures. The harness is inspected for overall condition, tears, fabric damage, and corrosion of the metal fasteners. The inspection was current, having been last accomplished on 19 Mar 98 (Tab HH3).

(c) **Crew Use.** The torso harness was worn correctly by the pilot. The parachute risers were attached correctly and the seat kit was attached to the pilot at both attachment points (Tab J7; Tab BB12).

(5) **Anti-G Suit.**

(a) **Purpose and Description.** T.O. 14D3-11-1 describes the anti-G suit as a tight-fitting leg garment which prevents the pooling of blood in the legs during high-G maneuvers. It consists of an overgarment with air bladders in the waist and the upper and lower legs. These are automatically inflated during high-G maneuvers to prevent blood pooling in the extremities, and increase G tolerance. Pilots usually have two G-suits in the 36th FS, one for regular use and another sized to fit over the anti-exposure suit. This latter suit is usually labeled the "B" G-suit (Tab V22).

(b) **Inspections and Modifications.** The garment is custom fitted to the wearer by adjustable cords. T.O. 14D3-11-1 Section 5 and PACAF 11-301(cc) section 5.20.4.8.1 provides that the G-suit should be inspected monthly for evidence of wear and damage to the fabric and serviceability of the fasteners. It should also be pressure tested for leaks at the same time. The periodic inspection was current, the last having been performed on 19 Mar 98 (Tab HH4). PACAF Instruction 11-301 requires that the G-suit fitting should be checked every 90 days. Fit checks were not documented in Life Support records. Further, no inspection record exists for the pilot's "A" G-suit, which was not used on the mishap sortie.

(c) **Crew Use.** The pilot was wearing the "B" anti-G suit at the time of ejection. The anti-G suit was fitted correctly at the waist and the right leg and the right comfort panel was zipped as it should have been for flight. This implies that the left G-suit leg (torn off at the midriff attachment point) was also worn correctly. The Life Sciences analysis discovered traces of paint on the right G-suit leg near the area of leg injury. Analysis of this paint shows it to be representative of paint on the right thigh guard of an ACES II ejection seat. This suggests that the right G-suit leg impacted the right thigh guard with a significant force, most likely from the high-speed wind blast (Tab J7).

(6) **Helmet and Mask (HGU-55/P).**

(a) **Purpose and Description.** The helmet with detachable mask provides communications capability and oxygen to the pilot, and is part of the "Combat Edge" system. This system is designed to integrate with the anti-G suit and the counterpressure vest to decrease fatigue with high-G missions. The helmet contains an air bladder in the back which helps keep the wearer's face within the mask during high G maneuvers. The pressure in the mask will be increased at this time as well easing the work of inspiration. The helmet is held in place by a nape strap and chin strap combination.

(b) **Inspections and Modifications.** The pilot's helmet was fitted with the approved insert. The helmet was recently modified with approved NVG brackets to allow the mounting of the NVGs. The helmet and mask should be preflight inspected by the wearer prior to each use. This is done to ensure the communication and oxygen flow work. Life Support personnel also visually inspect and clean the helmet and mask after each flight. Every 30 days,

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the helmet and mask are disassembled and fully inspected. The last inspection of this type was 19 Mar 98 (Tab HH5), and was current in accordance with PACAF Instruction 11-301.

(c) **Crew Use.** The pilot was wearing the helmet on the night of 25 Mar 98. The helmet and mask were not recovered. The oxygen hose connector was found in the regulator attachment. This indicates that the hose was forcefully torn from its connector when the mask and helmet were forcibly removed from the pilot during the high-speed ejection (Tab J7; Tab V16).

(7) **Survival Vest.**

(a) **Purpose and Description.** As described by PACAF Instruction 11-301, the survival vest is a mesh vest designed to carry various survival equipment which can be used by the wearer to evade enemy forces and allow location by friendly forces. Among the contents are a radio and flares, discussed below. The vest can be adjusted by fittings on the back.

(b) **Inspections and Modifications.** The vest is checked after every use. The vest is required to be inspected every 30 days. The vest was last inspected 25 Mar 98, in accordance with PACAF Instruction 11-301 (Tab HH6).

(c) **Crew Use.** The vest was worn by the mishap pilot. When he was found, the radio and flares were out of their respective pockets (Tab BB12). These devices were attached to the vest by lanyards. The radio is stored in a zippered pocket. This pocket was torn open by forces from the high speed wind blast rather than the zipper tab (Tab J7). The zipper tab was located at its termination (closed) point. There is no indication the pilot attempted to use his equipment or open the vest pockets (Tab J7).

(8) **Survival Kit.**

(a) **Purpose and Description.** The survival kit contains materials which can aid the aircrew member to survive an ejection, evade capture if necessary, and facilitate location by friendly forces when in a survival situation.

(b) **Inspections and Modifications.** PACAF Instruction 11-301 requires an annual inspection of the survival kit. The inspection was current, having been last accomplished on 21 May 97 (Tab HH7).

(c) **Crew Use.** There is no indication that the survival kit was used. The survival kit's contents were not employed, and the survival kit itself did not appear to be opened (Tab J7). The kit was attached to the pilot by both clips when he was found (Tab BB1).

(9) **Signaling Devices.**

(a) **Personal Radio.**

i. **Purpose and Description.** T.O. 31R2-2PRC90-1 describes the PRC 90-2 survival radio as a hand-held radio with built-in beacon function. It is carried in the pilot's survival vest. The PRC 90-2 broadcasts as a radio or as a beacon. The range for voice (radio) transmissions is up to 50 miles and the range for the beacon function is up to 80 miles. The radio is carried in the "OFF" position. The user can manually select either of two radio frequencies or the beacon function by rotating the selector switch. The pilot carried one radio in the survival vest and a second was stored in the seat kit (Tab HH6, HH7).

ii. **Inspections and Modifications.** The radio is inspected every 30 days, in conjunction with the survival vest. The last inspection of the radio was performed 25 Mar 98. The radio was manufactured 1 May 1997. Per T.O. 31R2-2PRC90-1, the radio and spare battery were not due for maintenance or battery change out until 31 May 2000 (Tab HH6).

iii. **Crew Use.** The radio was found in the "OFF" position. The radio and beacon frequencies which this radio would utilize were monitored and no signals were received to indicate use. The PRC 90-2 radio was in operating condition with power in both the installed and spare batteries for each radio. The radio is stored in the survival vest with the flexible antenna folded over the top and held in position by a small bracket on the opposite side of the radio case (Tab V16). The radio was found out of the pocket with the antenna extended (Tab-O). However, Life Support personnel testified that when the radio is removed or falls out for any reason, the antenna is commonly found free of its retainer clip (Tab V16; Tab V31). There is no indication that the mishap pilot attempted to use the radio (Tab J7).

(b) **Locator Beacon (AN/URT-33C/M).**

i. **Purpose and Description.** The locator beacon is designed to transmit a signal on the emergency GUARD frequency through a flexible antenna. In AUTO, it automatically activates after ejection when the seat separates from the aircrew member. For use on the ground, the flexible antenna must be removed and the rigid antenna extended. According to T.O. 31R4-2URT33-2, if the flexible antenna remains attached to the beacon, and the seat kit is laying on the ground, the signal strength is decreased due to grounding. Also, the beacon will not transmit through water.

ii. **Inspections and Modifications.** The beacon is inspected in conjunction with the seat kit.

iii. **Crew Use.** The beacon was analyzed by the Life Sciences Laboratory. The analysis indicated that the beacon was functioning prior to water entry, and ceased after contact with the water. Evidence on the beacon itself in the form of corrosion that occurs when a battery discharges through salt water was found inside the battery well of the beacon, indicating the beacon had battery power during time of immersion. The beacon was activated automatically. There is no indication that the beacon was switched off by the pilot. The beacon was found in its pocket, with the flexible antenna attached. There is no indication that the pilot attempted to change out the antenna as both attachments to the seat kit were connected and the straps securing the beacon to the seat kit were not unsnapped. The beacon appears to have broadcast only for the time of descent (Tab A; Tab J7).

(c) **Strobe Light.** The torso harness contains a manually activated strobe light in a side pocket, optimally visible for miles. In accordance with T.O. 14S10-2-2, the strobe light is inspected in conjunction with the torso harness (Tab HH3). The strobe light was not activated, nor was the pocket opened (Tab J7).

(d) **Flares.** The survival vest contains manually activated flares, designed to be held in the user's hand. These are inspected as part of the survival vest. The flares were located outside of their Velcro closed pocket and on the end of their lanyards. The caps were on the ends (Tab BB12). There is no indication that the pilot attempted to use the flares. The Life Sciences analysis concluded that the pocket most likely had been opened by wind blast (Tab J7).

(10) Personal Life Raft (LRU-22/P).

(a) **Purpose and Description.** As described in T.O. 14S-1-102, the life raft is a one-man raft designed to allow the pilot to remain out of the water. The life raft is stored as part of the seat kit. After separation of the pilot from the ejection seat and deployment of the parachute, the seat kit opens and the life raft falls free. The life raft automatically inflates when it falls free. Should it not automatically inflate, the pilot can manually fire a CO_2 cylinder, or should this fail, the air cells can be inflated orally. The life raft contains additional manual (oral) inflation valves for the floor of the raft and the spray shield, which cannot be inflated automatically. The raft is attached to the seat kit by a cord. The pilot enters the raft by uncoupling one of the seat kit attachments.

(b) **Inspections and Modifications.** The LRU-22/P is inspected prior to installation and yearly plus or minus 10 days. The LRU is not functionally tested because it is vacuum packed. Per T.O. 14S-1-102, the package is inspected for cuts, tears, punctures, tears of the seal, and deterioration or damage to the vacuum package or expansion of the vacuum packing. During periodic inspections, the raft is weighed. Inspections were current for the LRU (Tab HH7).

(c) **Crew Use.** The life raft was found automatically deployed. The floor and spray shield were not inflated. The accident pilot remained attached to both seat kit connections. The LRU was sent to the Life Sciences Equipment Laboratory for analysis. The laboratory found no evidence to suggest use or attempted entry by the pilot (Tab J7).

g. **Search and Rescue (SAR).**

(1) **SAR Command and Control.**

(a) **Seventh Air Force Organizations.** Seventh Air Force is responsible for all Air Force flying operations in Korea, with headquarters at Osan AB. The 607th Air Operations Group (AOG) is the specific unit within 7 AF responsible for air operations, which it monitors from an Air Operations Center (AOC) located within the Hardened Tactical Air Control Center (HTACC). At all times, a Senior Operations Duty Officer (SODO) is assigned to the AOC to monitor operations and notify the appropriate persons of significant events as well as taking initial actions in response. If the SODO determines that SAR operations are likely to occur, he notifies the Chief of SAR Operations assigned to the Korean Combined Rescue Control Center (KCRCC), also located within the HTACC. The SODO can also notify the alert helicopter from Detachment 1, 33rd Rescue Squadron (RQS) at Osan AB that it should prepare to launch. The Chief of SAR Operations is responsible for coordinating the SAR effort once he reaches the HTACC (Tab V5; Tab V6; Tab V7). He gathers information from the AOC and also from the Master Control and Reporting Center (MCRC), which is adjacent to the AOC within the HTACC. The MCRC is where the Airedale GCI controllers work. Airedale can provide radar tracks of all aircraft within its area of coverage as well as multiple radios for surface-to-air communications. The 621st Air Control Squadron runs US military operations in the MCRC and provides a Director of Control and Reporting (also known as the Battle Director, or BD) to supervise whenever GCI operations are ongoing.

(b) **51st Fighter Wing Organizations.** The 51st Fighter Wing (FW) is one step down the chain of command from 7 AF and, through its 51st Operations Group (OG), is responsible for all flying operations by the 36 FS and other Osan AB units. Whenever one of its subordinate units is flying, the 51 FW provides a Supervisor of Flying (SOF) in the Osan AB control tower. The SOF, one of a number of pilots trained for the task, represents the 51 OG Commander and assists aircraft experiencing emergencies or other unusual events. Should a serious incident require, the 51 FW Commander can also convene the senior officers, or Battle Staff, in the wing's Command Post to coordinate actions as required. Finally, each flying squadron keeps a SOF-qualified supervisor on duty in the squadron building during daily flying to supervise operations and assist airborne aircraft, particularly if the SOF is a pilot of a different kind of aircraft.

(c) **On-Scene Commander.** During a SAR operation, someone at the scene must assume command to control the actions of all rescue vehicles and personnel in the area. This On-Scene Commander (OSC) can come from a number of sources, but is usually the pilot of an aircraft over or near the area of interest. The OSC directs search patterns, coordinates separation of search aircraft to avoid conflicts, and is the central communication link to all ground agencies. He also actively searches for survivors as his other duties permit.

(2) **Initial Actions.**

(a) **CAJUN Flight.** CAJUN 1's videotapes show that, upon hearing the "terminate" call from the mishap pilot and the ELT, CAJUN 1 attempted to contact the mishap pilot on both UHF and VHF. He ordered tactical maneuvering to cease through Airedale and, 45 seconds after the ejection, used his avionics to mark his location, which was latitude N 37° 05', longitude E 125° 37', approximately 9 miles northwest of the ejection coordinates. At 2034L he told Airedale that there was a possible aircraft down, and at 2036L he told Airedale to activate a SAR operation. He passed his mark point to Airedale as a reference to begin the search, indicating that the mishap pilot's last known heading was northwest and ejection had probably occurred 3-5 miles southeast of the mark point. He also brought CAJUN 3 and 4 onto his VHF radio frequency and sent them to a higher altitude patrol to communicate with the SOF and attempt radio contact with the mishap pilot on the rescue frequency of 282.8 MHz.

(b) **Notifications.** At Osan AB, notifications of the situation went from CAJUN 1's GCI controller to the BD, who called the SODO. The SODO ran his SAR checklist, including notifying the Chief of SAR Operations and the 607 AOG commander, both of whom were in the HTACC by 2100L. At 2040L the SODO notified the alert HH-60 helicopter to prepare for launch, and he contacted the Korean SODO to begin coordinating for Korean help (Tab V6). CAJUN 3 notified Mustang 10, the Osan SOF, who then ensured that the 51 OG commander and the 36 FS were notified as well (Tab V10).

(3) **SAR Assets.** A large number of aircraft, helicopters and ships participated in search and rescue efforts during 25 and 26 Mar 98. They are summarized below (Tab BB):

Call Sign	Number/Type	Category	Time on Station (approximate)	Night Search Aids
CAJUN 01	3/F-16CG	Fighter Aircraft	2032-2220	LANTIRN, NVG
FOOL 11	2/F-16CG	Fighter Aircraft	2045-2230	LANTIRN
DICE 01	4/F-15E	Fighter Aircraft	2045-2240	LANTIRN
TORA 51	1/KC-135R	Tanker Aircraft	2035-2130, 0230-0330	None
AF Rescue 207	1/HH-60	Rescue Helicopter	2135-0040	NVG
SPECTRE 11	1/AC-130	Attack Aircraft	2130-2245, 2340-0630	Numerous
JAKAL 91	1/MC-130P	Special Ops Aircraft	2240-0245	Numerous
NOMAD 05	1 MH-53H	Special Ops Helicopter	2145-0210	Numerous
NOMAD 45	1 MH-53H	Special Ops Helicopter	2215-0210	Numerous
CHONG JU	ROK Navy PCC	Frigate ship	2130*-0900	Searchlights

* There were numerous Korean naval vessels participating in the search, some of which were on station by 2130L. The precise time the Chong Ju joined the search is unknown.

(4) **Search Coordination.**

(a) **Search Commanders.** CAJUN 01 was the initial On-Scene Commander. He passed this responsibility to FOOL 11 when he left the area to refuel with TORA 51 at 2115L. SPECTRE 11 assumed OSC responsibilities at 2204L and kept them until departing at

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2245L, passing OSC to JAKAL 91. SPECTRE 11 reassumed OSC when it returned at 2340L, and remained OSC until departing at 0630L. After this time, no USAF aircraft were involved in the search for the pilot (Tab BB).

(b) **Tasking and Arrival.** When the SAR effort began, CAJUN, FOOL, TORA, SPECTRE, DICE, and NOMAD 45 were already airborne. The KCRCC, with approval from the 607 AOG Commander, worked with Airedale controllers to divert the other airborne aircraft to the SAR location (Tab V5, Tab V7). The 33 RQS, which had been alerted by the SODO, launched AF Rescue 207 at 2110L, 30 minutes after the alert, within its tasked response time (Tab V5, Tab V7). The KCRCC placed several Korean aircraft on alert but decided not to launch them for three reasons: there were numerous aircraft already searching, the Korean aircraft lacked night vision equipment, and the Korean aircraft would be more valuable the next day when all US military aircraft would be on the ground (Tab V5, Tab V7). The American SODO did, however, ask the Korean SODO to send any available naval vessels to the area. As a result of that request, numerous vessels arrived within an hour of the ejection and remained in the area through the pilot's recovery (Tab V6). JAKAL 91 joined the search after its crew, who had finished their scheduled training mission, heard of the ongoing SAR and volunteered to assist. They coordinated through their unit, the 17th Special Operations Squadron (17 SOS), and the KCRCC and were asked to participate, taking off at 2215L (Tab BB3). The 31 SOS also launched NOMAD 05 under similar circumstances (Tab BB8).

(c) **Attempted Communications.** The first SAR-related attempt to communicate with the mishap pilot were when, as shown on mission videotapes, CAJUN 1 directed CAJUN 4 to switch to 282.8 MHz and attempt contact. There was no response. CAJUN 1 and the other search aircraft monitored guard frequency but heard no transmissions of any kind from the mishap pilot. While it was on scene, SPECTRE 11 transmitted every half hour on both guard and 282.8 MHz with no responses (Tab BB6).

(5) **Limiting Factors.**

(a) **Weather.** Visibility at low altitudes and lack of illumination were significant limitations to the search. Osan AB observed a surface visibility of 4 miles from the time of the ejection through 2255L. By midnight, visibility was 3 miles and fell to 2 miles by 0055L on the 26th. At 0620L visibility fell further to 1 mile (Tab W). Conditions were similar in the search area. AF Rescue 207 reported visibility at no more than 3 miles during their search and, even at 200 feet above the water, often relied upon instruments for aircraft control. By 0155L, the NOMAD helicopters reported low altitude visibility as 100 yards. The Chong Ju, which finally found the pilot, did not spot the pilot until it was within 1000 feet of him in daylight (Tab BB1). The low illumination conditions noted by CAJUN flight continued throughout the search until moonrise after 0500L. The BD recalled a search aircraft describing the conditions as an "inkwell", and AF Rescue 207 also reported poor illumination (Tab BB4). As noted previously, the conditions limited the effectiveness of the NVGs used by many of the search aircraft. JAKAL 91 reported being unable to see the water through its NVGs (Tab BB3). Some weather conditions were favorable, however. The sea state was as forecast, with waves no larger than 3 feet, and currents were light. The surface wind direction and speed were such that they tended to negate the currents, resulting in little expected drift of a survivor floating in the water (Tab V7).

(b) **Survival Conditions.** Other than the initial ELT, no one heard or observed any kind of signal from the mishap pilot. The Chief of SAR Operations found that the ELT failed to trigger satellite systems designed to pinpoint the location of ELT signals (Tab V7). The searchers therefore had to rely upon estimated positions of the mishap pilot to orient their searches. Plus, the mishap pilot's survival equipment was very dark in color to provide camouflage in wartime, and his raft (the largest piece of equipment floating) was only five feet long. The small size and dark color of the mishap pilot's equipment, combined with the lack of signals to pinpoint his location, made finding him extremely difficult (Tab BB4; Tab BB5).

(c) **Fuel.** Most aircraft involved in the initial search had completed their primary missions beforehand and were therefore somewhat low on fuel. Extensive in-flight refueling operations permitted many search aircraft to remain on scene considerably longer. TORA 51 extended FOOL 11 and CAJUN 1 at least one hour after they would otherwise have had to land. TORA 51 then landed and refueled, launching again around 0200 to refuel SPECTRE 11. JAKAL 91 also refueled both NOMAD helicopters but was unable to refuel AF Rescue 207. Moreover, when SPECTRE 11 had to return to Osan AB for fuel at 2245, it was able to refuel very quickly and return to the scene within an hour (Tab BB6). Fuel was more of a limitation for the fighters than the other aircraft.

(d) **Crew Duty Day.** Aircrew members are limited in the amount of time they can spend on duty when they are performing flying duties. PACAF fighter aircrew flying at night, for example, must land and shut down engines no more than 10 hours after they report for duty. The duty day for other aircrew varies, and limits can be waived up to a point by higher levels of command in special circumstances. In this mishap, duty day limits mainly affected the non-fighter aircrew. JAKAL 91 obtained a crew duty waiver to 18 hours before takeoff and landed at 0305 when further waivers were denied (Tab BB3). SPECTRE 11 also obtained a waiver to 18 hours duty time and, after their second takeoff, remained airborne as long as that waiver permitted. The duty day waivers permitted at least one search aircraft to remain in the area continuously from the time of ejection until 0630L on 26 March, 10 hours later (Tab BB6).

(e) **Search Location.** Uncertainty about the precise crash location affected the SAR to a degree. CAJUN 1's initial mark point anchored the search for the first two hours. CAJUN 1 communicated the uncertainty of the mark to other search aircraft (Tab V2), but even his estimate was at least four miles away from the probable ejection location. CAJUN 1's plan to search southeast of the mark point was not clearly communicated to the KCRCC, which planned initial search operations northwest of the mark point along the mishap pilot's last known heading (Tab BB7). Nonetheless, the pattern CAJUN 1 established and directed the other fighters to fly took them over the ejection area numerous times. Videotape review showed that CAJUN 1's pattern was an orbit starting at the mark point westbound and turning left to east, flying 15 miles, then turning left again westbound to return to the mark point. CAJUN 1 also relayed his southeast search priority to both SPECTRE 11 and AF Rescue 207 as they arrived on-scene. By approximately 2205L, the SOF relayed to CAJUN 1 a new search location based on 51 FW analysis of CAJUN 3's radar videotape. The new search point was latitude N 37° 00', longitude E 125° 46', 2 miles southwest of where the mishap pilot's body was eventually found. Further analysis of CAJUN 4's FLIR videotape allowed the SOF at 2240L to relay a second location 1 mile north of the updated point (Tab BB8; Tab V3). Both SPECTRE 11 and AF Rescue 207 reported searching the updated locations without success (Tab BB4; Tab BB6). At some time after midnight, the KCRCC received indications that the initial ELT signal had been heard by a receiver on land in Korea. The Chief of SAR Operations shifted the search focus to the south of the updated points, analyzing that the ejection could have occurred at a higher altitude if the ELT had been heard on land, and the resulting drift downwind during parachute descent would have been in a southeasterly direction for as much as 3 miles (Tab BB5). Starting at 0135L, JAKAL 91 and the NOMADs systematically searched an extensive area south of the updated locations without success (Tab BB3). No one directed any other changes in the search location during the SAR.

(5) **False Sightings.** Periodically during the SAR, aircraft reported sighting objects and oil spills in the water. For example, SPECTRE 11 examined an object at N 37° 00' latitude, E125° 46' longitude at about 2200L, but identified it as a buoy. At 2237L, DICE 03 reported an oil slick at N 37° 03.8' latitude, E125° 50.7' longitude that JAKAL 91 investigated extensively with no sightings of wreckage or the mishap pilot (Tab BB3). The search area's waters are used extensively by both commercial and naval vessels, which may have accounted for the presence of objects and spills on the water not resulting from the crash.

(6) **Recovery of Mishap Pilot.** By the time SPECTRE 11 departed at 0630L, the ROKAF had launched a C-130 (Honam-A) to continue the SAR. The Korean navy continued its search efforts, and an HH-60 (Sung Ri 31) was on alert. At an undetermined time, Honam-A found an oil slick and reported its location to the naval vessels. At 0745L, the watch officer aboard the Chong Ju, a Korean destroyer searching the oil slick area, spotted floating debris 300 yards distant through the fog. By 0755 the crew identified the debris as a raft, life vest, and pilot located approximately at N 37° 01' latitude, E125° 48' longitude. At 0805 the destroyer crew lifted the pilot and raft out of the water on a stretcher, determined that the pilot had died, and identified him as the mishap pilot (Tab BB1). The pilot's body and equipment were transferred at 0850L to a second vessel, the Sok Cho, to permit the Chong Ju to resume training operations. At 0855 Sung Ri 31 launched and retrieved the body and equipment from the Sok Cho at 0940L. Sung Ri 31 landed at Osan AB at 1030L, where USAF personnel received the mishap pilot's body (¶ Tab BB5).

(7) **Wreckage Search and Recovery.** The Korean AF continued to search for wreckage of the mishap pilot's aircraft until approximately 1400L on 26 Mar, utilizing C-130 and CN-235 aircraft. They ceased searching due to poor weather conditions, reported by a search aircraft as a ceiling of 1,000 feet, visibility 2 miles in drizzle (Tab BB10). An Air Force HH-60 also searched on 26 Mar from 1545L to 1830L, spotting several oil slicks but failing to locate the wreckage (Tab BB8). Searches for wreckage during the following weeks involved Korean Navy vessels, including the Kochang and Kimpo. Using sonar, those ships detected and mapped the aircraft's debris on the ocean floor on 28 April. The mishap aircraft's wreckage was found in a 100-yard long path bearing 055 degrees centered on latitude N 37° 03.40', longitude E 125°

48.87', approximately 2 miles northeast of where the mishap pilot's body was recovered (Tab BB11). Analysis of wreckage recovered from the ocean floor indicated a high-speed water impact (exceeding 400 knots) resulting in severe aircraft breakup. Exact bank and dive angles are unknown, but the aircraft was in a right bank with speedbrakes partially open at impact (Tab J8).

e. **Medical.**

(1) **Flight Crew Qualifications.** A review of medical and dental records show that the accident pilot was medically qualified to perform flying duties. He was not prescribed any medications around the time of the mishap. His last flight physical examination was current, and the pilot was not on any medical waivers for flying duties. The medical records of the other members of the flight were also reviewed. In all cases, these pilots were taking no medications and were medically qualified for flying duties.

(2) **Autopsy Report.** The autopsy results from the Armed Forces Institute of Pathology (AFIP) were reviewed. This indicates that the pilot's death was due to drowning. An injury to the pilot's head due to high-speed ejection contributed to the drowning (Tab X, Tab II-2). The head injury likely caused immediate incapacitation in the form of a deep stupor or, more probably, loss of consciousness (Tab II-1; Tab II-2). This incapacitation is directly related to the drowning event. The pilot also had other injuries, none of which were life threatening (J-7). These are all consistent with injuries anticipated from high-speed ejection. Except for the head injury, these injuries would not have prevented the pilot from entering his life raft or using his signaling devices (Tab J7).

(3) **Toxicology Reports.** Toxicology testing was performed as part of the postmortem. The results were negative for alcohol, medications, and illicit drugs. Toxicology testing was also performed on the other members of the flight. The results were negative for ethanol (alcohol), amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, opiates, and phencyclidine (Tab II3).

(4) **Behavioral and Environmental Factors.** Associates and friends of the pilot reported no indication that the pilot was under any increased stress or exhibited any unusual behavior. There is no indication of heavy or increased intake of alcohol, unusual change in sleep/wake cycles, or other indicators of fatigue. The mishap pilot had adequate time in the week prior to the accident to adjust to a night flying schedule (Tab V30). He flew both nights prior to the night of the accident. On this last mission, he did not appear to change his schedule. A review of the days prior to the mishap flight do not reveal any particularly stressful events, and there appears to have been both adequate opportunity for rest and adequate rest (Tab V8; Tab V9; Tab V30).

(5) **Crew Rest.** AFI 11-401 requires a minimum of 12 hours crew rest, including an opportunity for 8 hours of uninterrupted rest, prior to the start of the duty day of flight operations. Crew rest starts at the time a pilot ends his duties and leaves the duty area. A review of the mishap pilot's schedule shows that he had 12 hours from the end of his flight debrief on 24 Mar 98 until he reported to duty 25 Mar 98 (Tab V8; Tab V30). During this time the pilot had adequate time for rest.

(6) **Crew Duty Time.** The maximum crew duty day is set forth in AFI 11-401, ¶ 7.8.1. The duty day is defined as the time when a pilot comes in to work. The limits apply until the time the aircraft engines must be shut down. During day operations, this maximum time from start of the duty day until engine shut down is 12 hours; at night this maximum time is 10 hours. The mishap pilot began work on 25 Mar 98 at approximately 1300. He had not exceeded the crew duty day at the time of the accident, nor would he have if he had completed the mission as briefed (Tab V30).

f. **Maintenance.**

(1) **Forms Documentation.** The AFTO Forms 781 were reviewed from Dec 97 to Mar 98. There were no open discrepancies which would have compromised safety of flight. The mishap pilot failed to sign the exceptional release prior to takeoff. All time compliance technical orders (TCTOs) were completed with zero discrepancies noted. An Aircraft Significant History Data Equipment History (U6) revealed that all TCTOs were complied with. The aircraft forms (U1), egress inspection checklist (U4), maintenance history report from 97060 to 98091 (U10), planning requirements (U11), engine time change forecast (U19), engine automated history (U20), and engine management TCTO status sheet (U21)review show that all scheduled aircraft inspections were completed on time. The aircraft oil analysis record (U3) for 30 days prior to the accident show zero abnormal trends for JOAP atomic emissions. Samples are taken after each flight. Time change requirements were reviewed via aircraft forms (U1), egress inspection checklist (U4), planning requirements (U11) and engine automated history (U20) with zero discrepancies noted and all actions completed within specified timelines. All thruflight inspections and servicing were accomplished and documented (U1). The egress system final inspection was last accomplished on 25 Mar 98, with no discrepancies noted (U1). The aircraft had been serviced and prepped as a spare for the second sortie. A review of the mishap aircraft history from Jan 97 - Mar 98 revealed normal procedures with zero trends in reference to mission capable (MC) rates (U12,U23), abort rates, in-flight emergencies (IFEs), chargeable deviations (U15), code 3 breaks (U13), repeat and/or recurring discrepancies (U14). There were no maintenance procedures, practices, or performance indicators that appear related to the accident.

(2) **Aircraft Inspections.** The mishap aircraft went through a #2 phase inspection in Sep 97. During phase, all applicable requirements and special inspection items were accomplished or verified as previously complied with (U2). The aircraft #1 phase inspection was due at 1800 flying hours--scheduled for 13 Apr 98 (U8). The engine #2 phase inspection and 100-hour boroscope of the combustion case and aft blade retainer were due within the next 25 flying hours (U11). The engine augmentor fuel control time change was overdue by 26.4 hours;

however, this item has a 10% overfly authorization which would allow it to fly 400 hours past the scheduled time (U19). The aircraft and engine phase inspections were scheduled to be accomplished simultaneously.

(3) **Engine, Fuel, Hydraulic and Oil Inspection Analysis.** The mishap aircraft oil analysis samples for 30 days prior to the mishap sortie were normal (U3). The oil analysis record for the first flight of the day showed no areas of concern (U3). Since the mishap aircraft crashed in the Yellow Sea, no fuel, oil, or hydraulic samples were obtained. Samples were taken from the vehicles that last serviced the mishap aircraft (U5). The samples of oil, liquid oxygen and fuel from the oil servicing cart, liquid oxygen servicing cart and fuel servicing tank respectively were within normal limits. The hydraulic fluid sample taken from the servicing cart did not meet specifications for water content and particle contamination; however, there was insufficient evidence to suggest contamination.

(4) **Unscheduled Maintenance.** A review of unscheduled maintenance since completion of the last scheduled phase inspection (Sep 97) revealed no significant trends or negative indicators (U10). The mishap aircraft flew more than 120 sorties and 160 flying hours with a 90 percent mission capable rate since its last inspection (U23). For the last month prior to the mishap, the aircraft had flown 28 sorties. Of those, 23 landed without discrepancies, and 5 landed with only minor discrepancies. None of the sorties landed with a "groundable" discrepancy. Unscheduled maintenance actions do not show any correlation to the mishap.

g. **Aircraft Airframe and Systems.**

(1) **Structures.**

(a) **Impact Debris Field.** The crash debris is on the ocean floor in approximately 60 feet of water with strong currents in the area. Debris was located within a 100-yard area. With the exception of a large portion of the left wing, The largest pieces were approximately 2 feet by 1 foot in size. Aircraft breakup was severe, indicating a high-speed impact. There is no pre-impact evidence of failure of aircraft systems and/or components. Structural integrity of the aircraft at impact could not be determined (Tab J8).

(b) **Aircraft Flight Control Surfaces.** The flight control system is a digital 4-channel, fly-by-wire system that hydraulically positions the flight control surfaces. Electrical signals are generated by the stick, rudder pedals, and a manual trim panel. Command signals are sent to the FLCC by applying force to the stick and rudder pedals. The signals are transmitted to the integrated servo actuators of the horizontal tails, flaperons, and rudder to give the commanded response. Pitch motion is controlled by symmetrical horizontal tail movement; roll motion is controlled by differential movement of the flaperons and horizontal tails; yaw motion is controlled by use of the rudder. Digital backup software is also available with reduced capabilities. The FLCS data recorder is attached to the ejection seat. It records FLCS failure data, airspeed, altitude, true heading and elapsed time from takeoff. Some of the Flight Control system controls include the stick, rudder pedals and the flight control panel. The salvage operation recovered portions of the left and right wings. A large portion of the left wing was

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recovered, to include #2, #3, and #4 LEF rotary actuators. The only portion of the right wing that was recovered included a LEF rotary actuator. The right horizontal tail ISA and a right speedbrake actuator were also found. The FLCS data recorder was not recovered. There was not enough evidence to determine the flight conditions at impact (Tab J8).

(2) **Power Plant.** The aircraft engine, serial number 509296, was installed on 16 Jun 97 (U20). Since the initial installation, this engine has been removed only one time for maintenance problems. This occurred on 16 Dec 97 for fan blade damage. The engine was reinstalled on 21 Dec 97. There were no other removals and installations prior to 25 Mar 98. All TCTOs and TCIs were current and completed within specified timelines (U17-21). All inspections were current. None of the engine instruments or components of the jet fuel starter were recovered. Salvage operations recovered less than 5% of the engine. This was not enough to make a factual determination of engine operating conditions at impact (U24).

(3) **Aircraft Systems.**

(a) **Indication Systems.** The cockpit systems listed below are of critical importance to a pilot in maintaining aircraft control at night or in poor weather. At no time from engine start to initiation of ejection did the mishap pilot report any difficulties with these systems. Due to the severe nature of the crash and inability to locate most of the wreckage under water, the operational status of these systems during the mishap intercept cannot be verified.

i. **Attitude References.** The pilot has three sources of information about his aircraft's attitude, two of which rely upon inputs from the Inertial Navigation System (INS). These two are the Attitude Director Indicator (ADI), a "round dial" instrument on the instrument panel, and the Heads-Up Display (HUD) directly in front of the pilot. Of these two indicators, the ADI is the pilot's primary attitude reference since the HUD lacks adequate failure warning systems and can be difficult to interpret. Most ADI failures cause an "off" flag to appear in the instrument, but the ADI can fail without failure indications. An INS failure would cause an "aux" and possibly an "off" flag to appear in the ADI, combined with audible and visible malfunction warning. If the INS, ADI, and/or HUD fail, the pilot has a smaller Standby ADI on the instrument panel.

ii. **Altitude Indicators.** The pilot has two sources of altitude information. His primary reference is the altimeter, a barometric instrument on the instrument panel that measures altitude above sea level. The altimeter's altitude indication is repeated on the HUD. Another source of altitude information is from the Combined Altitude Radar Altimeter (CARA), which uses a radar signal to measure the aircraft's altitude above the terrain below it. Barometric and radar altitude are virtually identical when flying over water. The altimeter has no operational limits, but the CARA will not work if the aircraft exceeds 60 degrees of bank or dive. Failure of the CARA illuminates a caution light.

iii. **Altitude Warning Systems.** There are two altitude warning systems in the F-16 Block 40. One, called the "line in the sky," gives the pilot an audible warning if he descends below a preset barometric altitude. The other, called CARA ALOW, gives a similar

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but continuous warning if the pilot descents below a preset altitude above the terrain (as measured by the CARA). Both warnings require the aircraft's Fire Control Computer (FCC) to be operational in order to function. The ALOW warning will not occur if the CARA's operational limits have been exceeded. The specific altitudes at which both warnings occur can be set by the pilot at any time. It is therefore impossible to verify which altitudes the mishap pilot selected for his warning systems. During the mission briefing, the flight leader briefed that he would set his line-in-the-sky at 7,500 feet and his ALOW at 6,000 feet (Tab V2).

iv. **Vertical Velocity Indicator.** There is a tape instrument indicating vertical velocity located next to the ADI. It is a barometric instrument, but the cockpit indicator requires electric power. Its maximum indication is a climb or dive rate of 6,000 feet per minute.

v. **Cockpit Lighting.** During the intercepts on 25 March, CAJUN 2 should have had his cockpit interior lights turned off, relying on chemsticks to illuminate his instruments. The chemsticks decline in lighting intensity over time, but they were in holders that allow brightness adjustment, and should have still been functioning adequately during the mishap intercept (Tab J2). Pilots also routinely carried spare chemsticks with them. The only interior lights the mishap pilot would not have turned off were caution and warning indicator lights covered with Glendale green before takeoff.

(b) **Hydraulic Systems.** Hydraulic pressure is provided by two systems, commonly referred to as systems A & B. These systems operate simultaneously to provide hydraulic power to the primary flight controls and leading edge flaps. If one system fails, the remaining system will continue to supply sufficient, but limited, hydraulic pressure. System A also provides power to the fuel flow proportioner and speedbrakes. In addition, System B provides power to all other utility functions—landing gear, brakes, nose wheel steering, etc. The emergency power unit (EPU) can also provide hydraulic pressure if both systems A and B should fail. Flight control system accumulators provide hydraulic pressure to flight controls while the EPU comes up to speed. The only parts recovered from the hydraulic system were the reservoir from System A and one of the flight control system accumulators. The condition of the right speedbrake actuator showed that the speedbrake was partially open, at approximately 35 degrees (J8). Thus, some System A hydraulic pressure was available late in the mishap sequence.

(c) **Electrical Systems.** This system consists of a main AC power system, a standby AC power system, an emergency AC power system, a DC power system, a flight control system power supply, and provisions for external AC power. In all cases, battery buses provide a source of power to the flight control system power supply and start power to the EPU. This system generates sufficient power to operate the flight control systems at 40 percent rpm or greater. The system has redundancy with output limitations. For example, if the pilot is forced to switch from main AC power to standby AC power he loses the nonessential DC bus and the nacelle DC bus. Similar degradation of system capabilities occur when using the emergency AC power system or the DC power system. External power provides the same capabilities as the main generator. The pilot's late radio call, and the speedbrake's operation, lead to the conclusion that the aircraft had at least partial electrical power, sufficient to supply the minimum systems

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required for flight. Because none of the gauges, indicators, or other components of these systems were recovered, the operating status of those individual systems could not be determined.

h. Maintenance Personnel and Supervision.

(1) **Training and Qualifications.** Maintenance personnel had adequate training and experience to complete assigned tasks. According to documentation available, the mishap aircraft was properly serviced and inspected by qualified maintainers (U8). Squadron maintenance supervision ensured that training and certification guidelines were met and well documented for all maintainers.

(2) **Supervision.** Maintenance supervision adhered to established maintenance principles and practices in day-to-day operations. Quality Assurance inspections showed minor problems with documentation and attention to detail (U9). Objective measures of the squadron's aircraft maintenance quality have improved steadily since Aug 97. For example, aircraft mission capable rates improved from 71.9 to 87.9 percent (U23), despite high turnover rates in personnel/supervision.

i. Operations Personnel and Supervision.

(1) **Pilot Training Documentation.** As of 25 Mar 98, the mishap pilot was current in all training he needed to fly the NVG-3 sortie (Tab T5). However, not all of the mishap pilot's required training was properly documented, and he flew for a time prior to the mishap without required egress training.

(a) **Flying Training.** The mishap pilot's gradesheets from two different sorties during 36 FS Mission Qualification Training (MQT) described tasks required by the syllabus that were not accomplished as required on each mission (Tab CC4). These tasks, a precision approach controlled by Korean controllers on MQT-1 and a laser-guided bomb attack on MQT-8, were not entered as unaccomplished tasks on the gradebook's Upgrade Sortie Log (Tab CC5). Therefore, no evidence exists that they were ever accomplished on later sorties. The mishap pilot did perform graded laser-guided bomb attacks on NVG-2, nearly two months after MQT-8 (Tab CC4), but did so because the syllabus required them on that sortie, not to make up the unaccomplished training. Failure to accomplish the above tasks was not a factor in the mishap.

(b) **Ground Training.** The mishap pilot was not current in egress training, which covers ejection procedures, when he started MQT at Osan AB (Tab CC1). He obtained two other required life support training courses (life support equipment and annual life support refresher) before flying his first MQT mission on 7 Jan 98, and signed off the life support training block in his gradebook's Upgrade Program Checklist (Tab CC3; Tab CC6). He did not receive egress training until 20 Feb 98, after flying 8 sorties (Tab CC7). He should not have flown at all without current egress training, in accordance with AFI 11-F16 Volume 1. Moreover, computerized records still showed the mishap pilot non-current in egress training as of 14 April 98, even though an AF Form 1522 (Additional Training Accomplishment Input sheet) existed showing egress training completion on 20 Feb 98 (Tab CC1; Tab CC7). The squadron Life Support Officer (LSO) stated that he personally gave the mishap pilot egress training on 20 Feb and was having ongoing problems updating the computerized training accomplishment database, called AFORMS (Air Force Operational Records Management System). He further stated that the mishap pilot's training accomplishments were not correctly reflected in AFORMS (Tab V27). The 36 FS Superintendent of Operations Systems Management, whose office enters training accomplishments in AFORMS, reported few problems with AFORMS accepting new entries and accurately reporting entered data (Tab V26). A possible explanation for the differing views of AFORMS may be that the 36 FS prints training event and currency updates only each month, and sometimes less often. The board president visited the 36 FS on 15 May 98 and observed that the most recent life support training data posted in the squadron was current as of 31 Mar 98. It is therefore possible for a pilot to accomplish required training and still be shown as non-current on posted training products. Since the mishap pilot was current in all required life support training as of 25 Mar 98, these discrepancies were not a factor in the mishap.

(2) Life Support. The investigation revealed several deficiencies within Life Support operations, none of which had an impact on the mishap.

(a) **Training Documentation.** The airman that performed the most recent anti-G suit, anti-G vest, harness, helmet and mask (Combat Edge modification) inspections on the mishap pilot's gear was not certified as qualified in his training documentation (Tab HH3; Tab HH4; Tab HH5; Tab JJ). All of the equipment operated normally during the mishap flight as determined by a lack of reported problems by the mishap pilot on prior flights, and the condition of those items recovered (Tab J7).

(b) **Inspection Records.** There were no inspection records in the system for the mishap pilot's anti-exposure suit or primary anti-G suit. Post-recovery inspection of the anti-exposure suit revealed it was serviceable, except for a tear in the neck seal that was consistent with damage associated with the Jetson modification that would have occurred during the ejection (Tab J7). The pilot was wearing his back-up anti-G suit on the mishap flight (Tab V16).

(c) **Quality Assurance.** A formal quality assurance program, in accordance with PACAF Instruction 11-301, to cross-check individual work by Life Support technicians was not in place at the time of the mishap (Tab V16; Tab V19; Tab V22; Tab V24). Although this would reduce the number of minor discrepancies in equipment, none of the discrepancies affected the mishap.

(d) **Anti-G Garment Fitting Checks.** No formal program with documentation was in place to perform the 90-day anti-G garment fit checks in accordance with PACAF Instruction 11-301 (Tab V-16, 19, 22). There was no record that the mishap pilot's fit checks had been performed (Tab HH4). The anti-G garments were not a factor in the mishap.

(e) **Post-Flight Inspections.** Local policy to document post-flight inspections was not strictly adhered to. The mishap pilot had flown six other flights during March, but only one post-flight inspection was recorded (Tab HH9). Equipment operated normally during the mishap based on post-mishap analysis (Tab J7).

(3) **36 FS Supervision.** Capt Gregory M. Root, a duly appointed designee of Lt Col James J. Jones, the 36 FS Operations Officer, authorized the flight (Tab K). Supervision was not a factor in this mishap.

j. **Governing Directives and Publications.** The following directives and publications were relevant to the accident. Any suspected or known deviations are described in the appropriate sections above.

(1) ACC/PACAF Night Vision Goggles Training Course, F-16 Block 40, Sep 1996
(2) AFI 11-206, *General Flight Rules*, 1 Dec 96, and PACAF supplement
(3) AFI 11-214, *Aircrew, Weapons Director, and Terminal Attack Controller Procedures for Air Operations*, 25 Sep 97, and PACAF supplement
(4) AFI 11-401, *Flight Management*, 15 Oct 97, and PACAF supplement
(5) AFI 21-101, *Maintenance Management of Aircraft*, 7 Jul 97, and PACAF supplement
(6) AFI 21-103, *Equipment Inventory, Status, and Utilization Reporting*, 1 Sep 97, and PACAF supplement
(7) AFI 21-104, *Selective Management of Selected Gas Turbine Engines*, 17 Jun 94
(8) AFI 21-112, *Aircraft Egress and Escape Systems*, 1 Nov 97, and PACAF supplement
(9) AFI 21-124, *Air Force Oil Analysis Program*, 1 Feb 96
(10) AFM 11-217 Volumes 1 and 2, *Instrument Flight Procedures*, 1 Apr 96
(11) AFR 64-4, *Search and Rescue Survival Training*, 15 Jul 85
(12) MCI 11-F16 Volume 1, *F-16 Training*, 1 Jul 97
(13) MCI 11-F16 Volume 3, *F-16 Pilot Operational Procedures*, 21 Apr 95, and 51 FW supplement
(14) PACAF Instruction 10-201, *Pacific Air Force Search and Rescue Operations*, 10 Apr 95
(15) PACAF Instruction 11-301, *Air Crew Life Support (ALS) Program*, 10 Oct 95
(16) PACAF Instruction 21-101, *Aircraft Maintenance Organization and Procedures*, 25 Dec 96
(17) PACAF Instruction 21-108, *Aircraft Flying and Maintenance Scheduling Procedures*, 2 Feb 98
(18) T.O. 1-1B-40, *Weight and Balance Data*, 1 Jan 83 (Change 14, 1 Dec 97)
(19) T.O. 1-1B-50, *Basic T.O. For USAF Aircraft Weight and Balance*, 1 Mar 83 (Change 13, 18 Jun 97)
(20) T.O. 1F-16C/D Blocks 40 and 42, *Flight Manual*, 27 May 96 (Change 2, 8 Sep 97

(21) T.O. 1F-16CG-5-1, *Basic Weight Checklist*, 16 Sep 96
(22) T.O. 1F-16CG-5-2, *Loading Data*, 16 Sep 96 (Change 1, 1 Jul 97)
(23) T.O. 1F-16CG-6WC-1-11, *Combined Preflight/Postflight, End of Runway, Through Flight, Launch and Recovery, Quick Turnaround, Basic Postflight, and Walk-Around after First Flight of the Day Inspection Work Cards*, 25 Jul 88 (Change 29, 17 Oct 97)
(24) T.O. 1F-16CG-2-12JG-00-1, *Job Guide Servicing*, 15 Sep 88 (Change 32, 24 Oct 97)
(25) T.O. 1F-16CG-2-95JG-00-1, *Crew Escape and Safety System*, 14 Nov 88 (Change 16, 6 Feb 98)
(26) T.O. 13A5-56-11, *Operation and Maintenance Instructions with Parts Breakdown Escape Systems*, 1 Apr 82 (Change 22, 15 Sep 97)
(27) T.O. 14D3-11-1, *Operation. Inspection, Maintenance, and Packing Instructions for Emergency Personnel Recovery Parachute (Chest, Back, Seat Style, and Torso Harness)*, 16 Jan 89 (Change 16, 1 Sep 97)
(28) T.O. 14P3-5-91, *CWU-74/P Flyers Anti-Exposure Coverall*, 12 Aug 87 (Change 10, 15 Aug 97)
(29) T.O. 14P3-6-121, *Use. Operation and Maintenance Anti-G Cutaway Garment Types CSU-13A/P and CSU-13B/P*, 15 Oct 76 (Change 35, 15 June 97)
(30) T.O. 14S-1-102, *USAF Flotation Equipment*, 1 Apr 86 (Change 21, 1 Dec 96)
(31) T.O. 14S10-2-2, *Operation and Service Distress Marker Light Part No. SDU-5/E*, 15 June 87 (Change 5, 31 Mar 97)
(32) T.O. 31R2-2PRC90-1, *Radio Set AN/PRC90-1 and Radio Set AN/PRC90-2*, 31 Jan 86 (Change 8, 31 May 97)
(33) T.O. 31R4-2URT33-2, *Radio Beacon Set*, 15 Oct 91 (Change 4, 15 May 96)
(34) 36th Fighter Squadron Night Vision Goggle Training Program
(35) 36th Fighter Squadron Read File
(36) 51st Fighter Wing Viper Pilot Aid 15 Oct 97
(37) 51st Operations Group Flight Crew Information File

Thomas J. McKinley

27 MAY 1998 THOMAS J. McKINLEY, Colonel, USAF
President, Accident Investigation Board

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 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.

1. **Summary of accident.** F-16D aircraft 90-0792, controlled by the mishap pilot, entered a right banked, descending turn while performing a defensive maneuver to defeat a simulated air-to-air missile attack. During the turn, the aircraft transitioned to a very nose low, steep diving attitude. The pilot initially attempted to pull out of the dive, then abandoned his efforts and ejected. The mishap pilot survived the ejection, but sustained injuries which rendered him incapacitated. As a result, he survived for only a short time after water entry.

2. **Areas which were not substantially contributing factors.** The board investigated the following areas, and concluded that none contributed substantially to this mishap: aircraft maintenance, aircraft structures and systems, medical factors, crew qualifications, navigational aids and facilities, weather, briefing and preflight, egress systems, search and rescue, and maintenance personnel and supervision. Although some deficiencies were uncovered in operations supervision and life support, these also did not contribute substantially to the mishap.

3. **Causes.** This mishap was caused by a combination of the pilot unintentionally maneuvering his aircraft in excess of briefed parameters, and personal injuries and equipment damage sustained during the subsequent ejection.

a. **The pilot unintentionally maneuvered his aircraft in excess of briefed parameters, resulting in the loss of the aircraft.** This was the root cause of the mishap and began the sequence of events leading to both the pilot fatality and the aircraft loss. The pilot had performed the defensive maneuver previously at night. The mishap sortie was the first time he executed it with NVGs. The maneuver was briefed as a normal, night defensive notch, which meant establishing parameters on instruments due to limited visual cues at night. The new "event" for which he was being trained was to use the NVGs to maintain visual contact with the flight lead, and to assess the notch relative to the adversary aircraft, after establishing the notch. Shortly after beginning the maneuver, the aircraft gradually entered into an extremely steep dive, significantly exceeding the briefed parameters. The pilot recognized the unusual attitude late, and at approximately 3000 feet above the water broadcasted a "terminate" call. He then made the decision to eject, and did so, at an altitude between 500 and 1500 feet above water level and an airspeed of approximately 560 knots.

b. The high-speed ejection caused pilot injuries and survival equipment damage. The combination resulted in the pilot fatality.

(1) **Pilot Injuries.** During the ejection, the pilot sustained incapacitating head injuries. Therefore, when he landed in the water he was unable to effectively use his life raft or life preservers to keep afloat, nor was he able to use any signaling devices to hasten his recovery. Assuming his expeditious rescue, the pilot's other injuries would not have necessarily prevented his survival.

(2) **Equipment Damage.** The helmet and oxygen mask were forcibly removed during the high-speed ejection. Although there is no evidence that this event alone caused the head injury, it did expose the pilot's head to potential injury during the remainder of the ejection sequence. The right bladder of the LPU-9/P was also torn loose from its fittings during the ejection sequence. As a result, the life vest could not keep the incapacitated pilot's head above water, as designed, and the pilot drowned shortly after entry in the water. Other equipment damage had no effect, due to the pilot's incapacitation.

4. **Contributing Factor.** Night was a contributing factor in this mishap. Visual cues for positioning are reduced, requiring integration of other sensors. However, sufficient sensors were available to perform the maneuver safely in a night environment, and the pilot had safely executed the maneuver previously at night. Therefore, night was not a "cause" of the mishap.

27 MAY 1998

Thomas J. McKinley

THOMAS J. McKINLEY, Colonel, USAF
President, Accident Investigation Board

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