

AIRCRAFT ACCIDENT INVESTIGATION

I. STATEMENT OF AUTHORITY AND PURPOSE:

A. AUTHORITY. Under the provisions of Air Force Instruction (AFI) 51-503, the Ninth Air Force Commander convened this Aircraft Accident Investigation. The investigation was conducted from 21 February 1996 to 7 March 1996. The following individuals were appointed by the commander to conduct the investigation:

1. Col Henry S. Parker, Investigating Officer, by letter dated 21 February 1996
(Tab Y.1.1).
2. Capt Stephen J. McManus, Legal Advisor, by letter dated 21 February 1996
(Tab Y.1.2).

B. PURPOSE. The purpose of this investigation was to obtain and preserve all available evidence for possible use in claims, litigation, disciplinary actions, adverse administrative proceedings, or any other purposes deemed appropriate by competent authority. The investigation focused on the facts surrounding the Class A aircraft accident involving an F-16CG, tail number 89-2079, the Mishap Aircraft (MA) assigned to the 112th Fighter Squadron, 180th Operations Group, 180th Fighter Wing, Toledo Air National Guard Base, Ohio (Tab A).

II. SUMMARY OF FACTS:

A. History of Flight: On 20 January 1996, Col Philip C. Lehman, Vice Commander, 180FW, Toledo Air National Guard, OH, the mishap pilot (MP) was scheduled as number one of a two ship aircraft delivery mission to Luke AFB AZ, call sign Loma 21, that included air refueling. The second aircraft was scheduled to be piloted by 1Lt Kevin H. Sonnenberg, 112FS, Toledo Air National Guard, OH. Loma 21 flight departed Toledo Express Airport on 20 January 1996, at 1338 hours Eastern Standard Time (EST) (Tab K.3) with Lt Sonnenberg in the lead position (Tab V.32). Both aircraft were configured with three external fuel tanks. Enroute to Luke AFB, the flight rejoined on a scheduled KC-135 tanker, Upset 51, in Air Refueling Track 110West and both aircraft refueled. After refueling and enroute to their destination at flight level (FL) 310, the mishap flight declared an emergency for trapped fuel and started an emergency divert to Cannon AFB NM. During the divert, the MA engine flamed out and the MP jettisoned his external fuel tanks. The MP initiated a successful low altitude ejection approximately eleven miles northwest of Cannon AFB. The MA impacted the ground in an open area and was destroyed (Tab V.17). Lt Sonnenberg landed at Cannon AFB (Tab V.32). The aircraft impacted the ground approximately 11 miles northwest of Cannon AFB at 34° 33.01' North latitude, 103° 22.67' West longitude. (Tab R.2). Public Affairs were handled by the 27th Fighter Wing Public Affairs Office.

B. Mission: The mission was scheduled and planned as a two ship aircraft delivery mission to Luke AFB, to include aerial refueling (Tab K.3). The planned profile included single ship takeoffs, climb to cruise altitude, and rejoin with the tanker aircraft (Tab V.32). The mission was planned to continue after onloading approximately 6,000 pounds of fuel to Luke

AFB. The mission planning was accomplished by Lt Sonnenberg on Thursday, 18 January 1996, including Form 70, route of flight, fuel data, military divert bases, and data transfer cartridge input. (Tab V.32).

C. Briefing and Preflight: Col Lehman reported for duty at approximately 0630, 20 January 1996, with adequate crew rest (Tab V.17). Col Lehman planned, briefed, led and debriefed an air combat maneuvers mission prior to the mishap mission (Tab K.3). Lt Sonnenberg reported for duty at approximately 0930, 20 January 1996, with adequate crew rest (Tab V.32). At approximately 1200, Col Lehman and Lt Sonnenberg had lunch and while sitting on the operations counter eating a sandwich, discussed the route of flight, fuel calculations, divert bases, and other planning factors for the mission. Col Lehman testified that this was not a demanding mission (Tab V.17). At that time Col Lehman asked Lt Sonnenberg if he would like to lead the flight, and Lt Sonnenberg agreed (Tab V.32). Lt Sonnenberg is not a qualified flight lead, nor is he in the flight lead upgrade program (Tab V.30). The flight crews stepped to their aircraft on time, and stowed their personal clothing and aircraft forms in the aft transparency and under a panel in the vertical tail of the aircraft (Tab V.22). Col Lehman had a paperback novel and a copy of an emergency procedures examination in the cockpit with him (Tab V.22). Col Lehman experienced a boost pump problem on start that was quickly resolved and a flight control computer system malfunction that was also quickly remedied (Tab V.29). Lt Sonnenberg's aircraft would not start which caused a 20 minute delay while the jet fuel starter air bottle was recharged (Tab V.32). Taxi and marshaling procedures proceeded normally, and the flight proceeded through the last chance inspection to the runway (Tab V.35).

D. Flight: Loma 21 made a single ship takeoff and climbed to cruise altitude. A climb check was accomplished including fuel status (Tab V.32). Loma 21 conducted air refueling operations on air refueling track 110 West with Upset 51, a KC-135 tanker (Tab K.3). Upon the completion of air refueling, the MA had approximately 14,000 pounds of fuel, all internal tanks full, the two 370 gallon wing tanks full and the 300 gallon centerline full (Tab O.2). Loma 21 flight climbed to FL 310 to optimize fuel consumption and accomplished a number of fuel checks (Tab V.17). The flight maintained a 3,000 to 4,000 feet line abreast formation. Col Lehman testified that he divided his time between maintaining formation and reading from the emergency procedures exam and from the paperback book he had in the cockpit. One hour and 36 minutes following air refueling, the MA master caution light began to flash accompanied by the FWD FUEL LOW light and the AFT FUEL LOW light (Tab V.17). The MP advised Lt Sonnenberg that he had a problem with trapped fuel and needed to land. Lt Sonnenberg queried Albuquerque Air Route Traffic Control Center (ABQ CENTER) which was closer, Cannon AFB or Albuquerque International Airport. ABQ CENTER responded that Cannon AFB was slightly closer and the MP turned towards Cannon AFB, 140° for 93 nautical miles (Tab N.3), reduced the throttle position and descended to FL 230 (Tab V.17). At the time the emergency was declared, Loma 21 was within 50 nautical miles of Las Vegas, NM, Municipal Airport (Tab Z.2), which has 8,200 by 60 feet of asphalt runway with sufficient bearing capacity for an F-16 (Tab BB.1). Col Lehman testified he did not request information from ABQ CENTER concerning other divert bases. Col Lehman testified he believed he inadvertently changed the Ultra High Frequency (UHF) radio channel while attempting to enter coordinates for Cannon AFB (Tab V.17). As Col Lehman attempted to divert to Cannon AFB, he flew within 20

nautical miles of Tucumcari, NM, Municipal Airport (Tab Z.2), which has a 7,100 by 100 feet asphalt runway with sufficient bearing capacity for an F-16 (Tab BB.1). Col Lehman testified he became extremely depressed as he realized the gravity of the situation and the implication of his actions to the 180FW. Col Lehman testified he referred to the trapped fuel section of the checklist (Tab O.15) and accomplished some of the steps to correct the trapped fuel condition (Tab V.17). Based on the position of the TANK INERTING and the EXT FUEL TRANS switches in the wreckage it can be concluded that not all the steps were completed (Tab J.3). It should be noted that the flight manual checklist states that if either reservoir tank is less than full, or a fuel low light is on, sufficient fuel transfer from the external tanks may not occur even if the malfunction is corrected (Tab O.16). Approximately 10 minutes later, the engine flamed out and the external fuel tanks were jettisoned. Approximately seven minutes later, the MP directed the aircraft away from inhabited areas and ejected (Tab O.3). Col Lehman testified he delayed ejection to below recommended altitude to insure collateral damage was minimized (Tab V.17).

E. Impact: The aircraft crashed in an uninhabited field 11 miles northwest of Cannon AFB, N $34^{\circ}33.01'$, W $103^{\circ}22.67'$, at 14:39 Mountain Standard Time (MST) (Tab A.1). The aircraft landed upright in a newly planted field (Tab J.2). The aircraft parameters at impact were 124-128 knots calibrated airspeed, 49-50 feet per second descent rate, 5.6°-7.0° nose up pitch, 2.8°-4.2° right bank, heading 147° true (Tab O.3). The wreckage was spread approximately 275 feet from the engine cowling to the radome. The ejection seat, canopy and parachute were from 425 feet to 900 feet short of the aircraft (Tab R.2). There was no inflight or a ground fire (Tab J.2). The external fuel tanks were located 45 miles northwest of Cannon AFB (Tab J.1). The aircraft was made safe for hydrazine (Tab B.1.3).

F. Egress System: The egress system appears to have functioned normally. The MP was trained and current in the use of the egress system (Tab V.21). Indications are that the escape system functioned as designed within the parameters for Mode I operation. There is no evidence of equipment problems that would injure the crewmember during the ejection sequence (Tab J.15). A computer simulation was accomplished utilizing parameters that resembled the MP, and it was established that the minimum ejection altitude could have been as low as 30 feet above the ground (AGL) (Tab J.16).

G. Personal and Survival Equipment: All inspections of the MP personal and survival equipment were current. The MP was trained and current in the use of all personal and survival equipment (Tab V.21). The seat kit deployed normally and the dropline was severed during rescue and recovery of the MP (Tab J.15). The four line release was not accomplished and lanyard loops in place (visible) below stowage tunnel (Tab J.14). The emergency locator beacon functioned normally (Tab N.20). A pilot lowering device was installed on the parachute harness (Tab J.15).

H. Rescue: Lt Sonnenberg observed the ejection and the impact at 1439 MST. He notified Cannon Approach Control of the ejection, confirmed a good chute and stated that Col Lehman was on the ground and all right. Lt Sonnenberg confirmed the location of the impact as the Cannon 330° radial at 11 nautical miles. The local control position in the tower rang out the

crash phone at 1440. That notification was called to local law enforcement radio nets (Tab V.7). Lt Sonnenberg asked if Cannon AFB was sending someone to the scene, was assured that there was crash response on the way, and landed at 1444 (Tab N.20). Lt Sonnenberg stated that he had approximately 6,000 pounds of fuel remaining when he landed. He stated his decision to land rather than continue to assist the rescue efforts (Tab AA.3), was influenced by his lack of understanding as to why Col Lehman had flamed out, fear that his airplane might be experiencing a fuel contamination problem like the unit had experienced in the past, and a general disorientation from the preceding events (Tab V.32). The 180FW had experienced fuel contamination problems after refueling on two separate occasions and had disseminated this information throughout the unit (Tab V.25.13). At 1446 MST, the pilot of Tigre 11, a transient F-16 based at the 162FW, Tucson, AZ, International Airport volunteered to conduct a search and rescue combat air patrol (SARCAP) to help direct crash response units to Col Lehman (N.24). Crash response units were having difficulty finding the MP since there was no fire or smoke (Tab V.18). At 1452 MST, Tigre 11 departed Cannon AFB, discovered the MP at 1457, and noted his position to the Cannon Tower. The position of the crash was outside the crash grid map coverage in the tower, but the tower obtained a sectional, plotted the crash, and passed that data to the fire department (Tab N.30). Tigre 11 identified three civilian police vehicles and directed them to the crash sight with a series of wing rocks over the MP (Tab V.15). At 1506 MST, the civilian authorities reached Col Lehman (Tab V.38). Tigre 11 then returned to Cannon AFB and landed (Tab N.32).

I. Crash Response: The first personnel to reach the incident site were a senior patrolman from the New Mexico State Police, a deputy marshall from the Texico, NM, Marshall's Office, and a deputy sheriff from Curry County, NM, Sheriff's Department. Deputy Marshall Timothy Kelly (Tab V.15) and State Police Officer Steve Whittington (Tab V.38) found Col Lehman, but did not move him because he complained of back pains. Deputy Sheriff Lawrence Plotkin (Tab V.26) secured the area as curious observers had begun to gather. The Cannon AFB fire department, along with security police, and medical personnel arrived on scene next and took control from the local police officers shortly after 1515 MST. Lack of a fire with associated smoke had made the crash difficult to find. Fire department personnel controlled the hydrazine with the assistance of a specialist from Cannon AFB (Tab V.18). 27th Medical Group personnel, including a flight surgeon, placed Col Lehman on a back board and transported him to the Cannon AFB Hospital (Tab V.5). Monitoring and remediation actions are continuing for hazardous materials by the 27th Medical Group bioengineer and the 27th Civil Engineer bioenvironmental flight (Tab BB.2).

J. Maintenance Documentation:

1. A thorough review of the AFTO Form 781 series documents was accomplished, and there were no open discrepancies which would have prevented this aircraft from flying (Tab H.1.1).

2. There were two time compliance technical orders (TCTO) due on the aircraft. The first required the replacement of the Heads-Up Display by 2 June 1996, and the second the

replacement of the HAVE QUICK radio by 15 November 1996. Neither of these TCTOs was relevant to the mishap (Tab H.4.2).

3. There were no calendar, hourly or higher authority inspections due on this aircraft (Tab H.4.1).

4. On 11 January 1996, after configuring the aircraft with three external fuel tanks, a functional check revealed the right hand drop tank was transferring fuel before the centerline tank. The right tank was removed and replaced and a functional check revealed no further discrepancies. The work was inspected by a SSgt Tracy Troxel and signed off on 16 January 96 (Tab H.1.4). A preflight inspection was conducted on 20 January 1996 (Tab H.2).

K. Maintenance Personnel and Supervision: Interviews with supervisory personnel showed all personnel associated with the preflight, maintenance, and launch of this aircraft to be fully qualified or were supervised by a fully qualified technician (Tab V.24). Aircraft 89-2079 was properly serviced, inspected, and prepared for flight (Tab V.6). There is no evidence of maintenance malpractice associated with this mishap.

L. Engine, Fuel, Hydraulic, and Oil Inspection Analysis:

1. The engine, F100-PW-220 serial number PWOE719247, had 2045.5 total hours operating time. The engine exhibited no signs of fatigue failure. All fractures were caused by an over stress condition when the aircraft and engine impacted the ground. The engine was not running when it impacted the ground. The jet fuel starter was not turning the engine in a restart attempt at ground impact. The engine exhibited signs consistent with flame out due to fuel starvation (Tab J.28).

2. Fuel samples were taken from aircraft 89-2079 and sent to USAF Aerospace Fuels Laboratory for analysis, which stated that the sample met specification requirements. Fuel samples were also sent to Wright Patterson Air Force Base, OH, for analysis which appeared to be conventional JP-8 with no indication of obvious contamination other than dirt (Tabs U.1 and U.2).

3. Hydraulic and oil analysis was accomplished and determined to be normal.

M. Airframe and Aircraft:

1. There was no evidence to indicate that flight controls were a contributing factor to this accident. The pilot did not mention any problem with the flight controls or related systems in his testimony (Tab V.17).

2. Hydraulic, avionics, instrument, and electrical systems were not mentioned by the pilot as malfunctioning (Tab V.17).

3. Fuel Systems: The aircraft was configured with three external fuel tanks, a 300 gallon centerline tank and two 370 gallon wing tanks. On 19 January 1996, Col Lehman flew this aircraft in this configuration and the tanks fed. The pilot testified that the external tanks fed prior to refueling on 20 January 1996 (Tab V.17). The fuel system contained approximately 14,200 pounds at the completion of refueling. Col Lehman testified that when the MASTER CAUTION illuminated, accompanied by the AFT FUEL LOW and FWD FUEL LOW lights, that the fuel quantity selector knob was in the EXT WING position (Tab V.17). At that time the crash survivable flight data recorder (CSFDR) indicated there was approximately 7,400 pounds total fuel on board, but only approximately 280 pounds in the front right system and approximately 80 pounds in the aft left system. This equates to 360 pounds of usable fuel (Tab O.2). Having the fuel quantity selector knob not in NORM disables the TRAPPED FUEL warning system and causes the BINGO fuel warning to be based on total fuel onboard rather than internal useable fuel (Tab AA.1). There were no evidence to conclude that the trapped fuel warning system and BINGO fuel warning system would not have functioned properly had the fuel quantity selector knob been in NORM. Damage to the external tanks indicates they all contained a significant amount of fuel at ground impact (Tab J.3). The external vent and pressurization valve was sent to OC-ALC for testing and tear down. The valve as received would have prevented outflow through the tank inlet port, which would have prevented the external tanks from pressurizing and consequently trapping that fuel (Tab J.4). The environmental control system automatic water drain valve failed to close at the proper pressure. This failure would have slowed external tank fuel transfer, but would not have prevented transfer (Tab J.8). Only minimal damage occurred to the internal fuel tanks. The internal fuel system was in remarkably good condition and only 1.5 gallons of fuel was recovered from the reservoir tanks (Tab J.2). All other fuel system components tested normal (Tab J.1-J.10).

N. Operations Personnel and Supervision:

1. The flight was authorized by the 180th Operations Group commander (Tab K.1). The operations group commander did not know that Col Lehman intended to have Lt Sonnenberg lead the flight the entire flight (Tab V.17.10).

2. There was sufficient time between the flights for an adequate briefing (Tab V.25). The mission planning was accomplished 18 January 1996 and only required a weather and NOTAM update, which was available at squadron operations (Tab V.17). The supervisor of flying made arrangements for lunch to brought to the squadron for the flight (Tab V.30). There was no formal briefing. Col Lehman did not brief the mission, only discussed the planning which Lt Sonnenberg had accomplished. The briefing guide (Tab U.11.1) was not used. Supervisor personnel were not in attendance at the briefing (Tab V.17), nor did they know that a formal briefing did not occur (Tab V.30). The briefing was insufficient.

O. Crew Qualifications: Col Lehman was current and qualified to perform the scheduled mission. Col Lehman is a flight lead (Tab T.3). All ground and flying training had been accomplished to include life support training (Tab V.2). On 31 December 1995, the flight management section had assigned Col Lehman a professional qualification index (PQI) of B1Y, indicating he had not flown a sufficient number of sorties to be a mission ready pilot, thus

regressing him to mission capable status (Tab G.1.5). On 3 January 1996, the training section notified the operations group commander of the change in Col Lehman's status due to only two sorties flown in December, 1995, the requirement being five (Tab T.3). Col Lehman lost two sorties in December, 1995, and one in January, 1996, due to weather cancellations (Tab T.4) and to personal vacation time (Tab V.17). His flying experience is as follows (Tab G.1.1.& G.1.3):

F-16 C/D	349.0
A-7 D	1485.5
F-4	1161.4
Student	250.0
Total	3245.9

Hours/Sorties	
Last 30 days	2.7/2
Last 60 days	5.8/4
Last 90 days	13.6/9

P. Medical: Col Lehman was medically qualified to fly (Tab G.1.5). Toxicological test administered when Col Lehman was brought to the Cannon AFB Hospital were negative (X.2). Col Lehman sustained back injuries either during the ejection or parachute landing fall. He was immobilized on a back board and transported to Cannon. It was determined that Col Lehman's injuries were beyond the scope of the Cannon hospital so he was transported to the Texas Tech Hospital for treatment. At Texas Tech it was determined that surgery was required and Col Lehman was transported to Wilford Hall Medical Center for the surgery. Col Lehman's prognosis is good (Tab V.5 and X.1)

Q. Navaids and Facilities: All applicable NAVAIDS were in operation. There were no Notices to Airmen (NOTAMS) applicable to this accident.

R. Weather: The weather was 12,000 feet scattered, visibility 7, temperature 54°F, dew point 17°F, winds estimated 300° @ 12, altimeter setting 29.99 inches of mercury at the time of the mishap. There was a Weather Watch Advisory for winds 270° maximum expected gusts to 25 knots. Winds aloft (from Amarillo, TX) were 280° @ 74 knots at FL 320, 285° @ 68 at FL 250, 305° @ 45 at FL 200, 330° @ 26 at 16,000 feet, and 265° @ t 11 at 10,000 feet. (Tab K.4)

S. Governing Directives and Publications:

1. MCI (ANG) 11-F-16 Vol 1, 1 Aug 95, Pilot Training - F-16 (Tab AA.2)
6.5. Flight Lead Upgrade. Col Lehman did not comply with the following guidance:

- *(Added) (ANG) The provisions of this section do not prohibit pilots who have not yet entered the flight lead upgrade program and are not flight lead qualified from leading limited portions of a mission under the supervision of an instructor pilot or a flight lead qualified squadron supervisor.*

2. MCI (ANG) 11-F-16 Vol 3, 21 Apr 95, Pilot Operational Procedures - F-16 (Tab AA.3). Col Lehman did not comply with the following guidance:

2.4. Briefing/Debriefing

2.4.1. Flight leaders are responsible for presenting a logical briefing which will promote safe, effective mission accomplishment.

- Begin briefings at least 1 and $\frac{1}{2}$ hours before scheduled takeoff. Alert briefings ...
- Structure flight briefings to accommodate the capabilities of each pilot in the flight.
- Briefing guide will be used to provide the flight leader/briefer with a reference list of items which may apply to particular missions. Items listed may be briefed in any sequence. Those items understood by all participants may be briefed as "standard." Specific items not pertinent to the mission need not be briefed

Terms:

Flight Lead (FL) -- As designate on flight order, the individual responsible for overall conduct of mission from preflight preparation/briefing to postflight debriefing regardless of actual position within the formation. A certified 4-ship FL may lead formations and missions in excess of four aircraft, unless restricted by the unit CC. A 2-ship FL is authorized to lead an element in a larger formation.

3.14. Ops Checks

3.14.1. Accomplish sufficient ops checks to insure safe mission accomplishment. Additionally, each pilot should monitor the fuel system carefully throughout the flight to identify low fuel, trapped fuel or an out of balance situation as soon as possible. Frequency should ... Ops checks are required:

- During climb or at level off after takeoff
- When external fuel tanks (if carried) are empty

3.14.3. For formation flights, the flight leader will initiate ops checks by radio or visual signal. Response will be made by radio or visual signal.

- The query and response for ops checks will be based on the location and amount of fuel (low tank needle, high tank needle totalizer) with the fuel quantity selector knob in the NORM position. (Exception: Total fuel only may periodically be used during high demand phases of flight).
- For mandatory ops checks when external tanks are carried, each flight member will check the external tank(s) and add "Tank(s) feeding/dry" to the ops check. Once the tank(s) have been confirmed and called dry, this may be omitted from subsequent ops checks.

3. Air Force Instruction 11-401, 11 Jun 94, Flight Management (Tab AA.3). Col Lehman did not comply with the following guidance:

1.5. Responsibilities of Personnel. Fliers and parachutists must:

1.5.2. Effectively and safely use flying resources available to them.

4. T.O. 1F-16CG, 24 Jan 94, Change 2, 11 Sep 95, Flight Manual (Tab AA.1).

5. T.O. 1F-16CG-1CL-1, 24 Jan 94, Change 2, 11 Sep 95, Flight Crew Checklist (Tab O.15). Col Lehman did not complete all the steps required by the flight manual checklist to correct a trapped fuel problem.

III. STATEMENT OF OPINION:

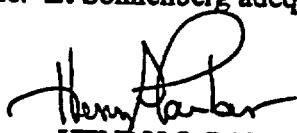
Under 10 USC 2254(d), any opinion of the accident investigators as to the cause or causes of, or the factors contributing to, the accident set forth in the accident investigation report may not be considered as evidence in any civil or criminal proceedings arising from an aircraft accident, nor may such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

The initial cause of the accident was the external tank pressurization and vent valve failing to close after refueling. This prevented external fuel transfer. However, the MP failed to recognize this mechanical malfunction in a timely manner. The MP had positioned the fuel quantity selector knob to a position that prevented warning of a trapped fuel situation or warning that there was only 1,000 pounds of useable fuel remaining. He failed to recognize this because he was distracted from his primary duty by reading a novel and training materials he carried in the aircraft cockpit.

Once the MP realized the emergency, he responded inappropriately, as outlined below:

1. The MP did not take command of the flight. In fact, the MP had requested and permitted an unqualified pilot to lead the flight and had insufficiently briefed the flight.
2. The MP descended rather than maintain his altitude or climb to maximize his glide capability.
3. The MP did not request assistance from ABQ Center directing him to the nearest suitable airport.
4. The MP did not complete all the steps recommended by the flight manual checklist to correct the trapped fuel condition.

The mishap aircraft was appropriately prepared for flight and mechanically sound at departure. The 180FW had adequate training programs in place. Supervision within the unit was adequate. The two hour, fifteen minutes between the two flights on 20 Jan 96 was adequate to debrief the previous flight and brief the second sortie. Lt Sonnenberg adequately performed all tasks he was qualified to perform.



HENRY S. PARKER, Col, NMANG
AFI 51-503 Accident Investigation Board
Investigating Officer

NUCLEAR REGULATORY COMMISSION

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Bucket No. _____ Official Exh. No. 8
In the matter of PFS

Staff _____ IDENTIFIED ✓
Applicant _____ RECEIVED ✓
Intervenor _____ REJECTED _____
Other Joint WITHDRAWN _____
DATE 4-11-02 Witness _____
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