FILE NO. 3-4107

# AIRCRAFT ACCIDENT REPORT

MONTANA POWER COMPANY,

ROCKWELL TURBO COMMANDER 690A, N40MP

and USAF F-111A, 77-055

NEAR KINGSTON, UTAH

NOVEMBER 12, 1974

ADOPTED: AUGUST 1, 1975

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20594
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16. Abstract

About 1804 m.s.t., on November 12, 1974, a United States Air Force (USAF) F-111A, 77-055, and a Montana Power Company, Rockwell Turbo Comnder, Model 690A, N40MP, collided in flight near Kingston, Utah. The F-111A was the lead aircraft in a formation of two F-111A's. The formation was attempting a rendezvous with a USAF KC-135 for night air refueling training when the planes collided. The pilot of N40MP, the sole occupant, was killed. The two crewmembers of the F-111A ejected successfully from their aircraft. Both aircraft were destroyed by the collision, the postcollision fire, and impact with the ground.

The National Transportation Safety Board determines that the probable cause of this accident was the F-111A pilot's misidentification of the Turbo Comnder as a refueling tanker with which he intended to rendezvous. Contributing to the misidentification was his failure to use prescribed procedures and techniques during rendezvous with a tanker aircraft for refueling.

As a result of the investigation of this accident, the Safety Board made recommendations to the Acting Administrator of the Federal Aviation Administration and to the Secretary of Defense.

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AIRCRAFT ACCIDENT REPORT

Adopted: August 1, 1975

MONTANA POWER COMPANY, ROCKWELL TURBO COMMANDER, MODEL 690A, N40MP
AND
U.S. AIR FORCE F-111A, 77-055
NEAR KINGSTON, UTAH
NOVEMBER 12, 1974

## SYNOPSIS

About 1804 m.s.t., on November 12, 1974, a U.S. Air Force F-111A, 77-055, and a Montana Power Company, Rockwell Turbo Comnander, Model 690A, N40MP, collided in flight near Kingston, Utah. The F-111A was the lead aircraft in a formation of two F-111A's. The formation was attempting a rendezvous with a U.S. Air Force KC-135 for night air refueling training when the collision occurred. The pilot of N40MP, the sole occupant, was killed. The two crewmembers of the F-111A ejected successfully from their aircraft. Both aircraft were destroyed by the collision, the post-collision fire, and impact with the ground.

The National Transportation Safety Board determines that the probable cause of this accident was the F-111A pilot's misidentification of the Turbo Comnander as a refueling tanker with which he intended to rendezvous. Contributing to the misidentification was his failure to use prescribed procedures and techniques during rendezvous with a tanker aircraft for refueling.

As a result of the investigation of this accident, the Safety Board made recommendations to the Acting Administrator of the Federal Aviation Administration and to the Secretary of Defense.

## 1. INVESTIGATION

### 1.1 History of Flight

On November 12, 1974, a Montana Power Company, Rockwell Turbo Commander, Model 690A, N40MP, departed Phoenix, Arizona, at 1650 m.s.t. 1/ The pilot was the sole occupant of the aircraft. Although N40MP was destined for Butte, Montana, its visual flight rules (VFR) flight plan as filed, indicated that it was destined for Prescott, Arizona. The pilot of N40MP reported over Prescott at 1705. At 1723 he cancelled his flight plan with Prescott Flight Service Station (FSS) through Grand Canyon radio and advised that he was over the Grand Canyon.

1/ All times herein are mountain standard based on the 24-hour clock.

About 1800, the pilot of N40MP called the Cedar City, Utah, FSS, reported his position as over the Bryce Canyon VOR and filed an instrument flight rules (IFR) flight plan to Butte, Montana. He requested the following intended route: Jet airway J-11 to Salt Lake City, Utah, jet airway J-9 to Dillon, Montana, and airway V257 to Butte. He requested flight level (FL) 180 and gave his true airspeed as 270 kn. The Cedar City FSS specialist gave him a Cedar City altimeter setting of 30.30 in. and gave him the weather for Salt Lake City, Dillon, and Butte. N40MP was advised to contact Los Angeles Center for further clearance.

The pilot contacted the Los Angeles Air Route Traffic Control Center (ARTCC) at 1804. Los Angeles ARTCC requested N40MP to "Ident, say altitude." N40MP replied, "Okay we're squawking fourteen hundred. We're here at seventeen five and I'd like to go to eighteen. Have you got a flight plan from the Flight Service?" Los Angeles ARTCC replied, "Four Zero Mike Papa I don't see your, what is your position from Bryce Canyon?" N40MP did not reply. N40MP's request was the last known radio contact.

Toft 51, a United States Air Force (USAF) KC-135 tanker from Grand Forks Air Force Base (AFB), North Dakota, arrived at the Air Refueling Control Point (ARCP) 2/ about 1739. The Salt Lake City Center cleared the aircraft into an altitude block of FL 180 to 210 for the air refueling exercise. One minute later Toft 51 requested, and Salt Lake City ARTCC granted, a delay at the ARCP while awaiting the arrival of two USAF F-111's from Nellis AFB, Nevada, at the Air Refueling Initial Point (ARIP). 3/ The altitude proposed for the refueling operation was FL 200. Toft 51 made a 360° turn at the ARCP and then departed down track at FL 200. At 1759 Toft 51 contacted Sigma 71 and advised that it was on the 129° radial, 42 nmi from the Milford VORTAC.

At that time and throughout the rendezvous attempt, Toft 51's wingtip and tail position lights were on. The anticollision beacons 4/ located on the top and undersides of the fuselage were illuminated and flashed red and white. The engine nacelle floodlights, the underbelly lights, the refueling boom lights, and the boom nozzle lights also were illuminated.

At 1757:15 the crew of Toft 51 indicated that they were experiencing difficulty with their ultra high frequency (UHF) radio and requested that they be allowed to remain on a Salt Lake City ARTCC frequency for refueling. Salt Lake City ARTCC cleared them to conduct the refueling exercise on one of the center's radio frequencies (360.8 MHz).

The two F-111A's, Sigma 71 and 72, were to join in formation at the ARIP, and then rendezvous with Toft 51 for a refueling exercise on the

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2/ The Milford, Utah, VORTAC.

3/ A geographic position 100 nmi on the 125° radial of the Milford VORTAC.

4/ Anticollision beacon is a red rotating beacon which enhances the conspicuity of aircraft during the day or night. It is commonly referred to as rotating beacon or red beacon.

Coronet Milford Air Refueling Track **(AR-316).** Sigma **72** was designated the flight leader for the refueling portion of the mission and was to assume flight responsibility for rendezvous with the tanker. Sigma **71's** takeoff was delayed for maintenance, but it was able to proceed directly to the ARIP and join Sigma **72,** since **72** departed the ARIP about 10 minutes behind schedule.

Before Sigma **71** joined Sigma **72** at the ARIP, Sigma **72's** tactical air navigation (TACAN) equipment had become unreliable and the vertical steering bar on the heading indicator was not receiving navigational information from the inertial navigation system (INS). Consequently, the pilot of Sigma **72** was unable to position his aircraft accurately over the ARIP. He did not know whether he had overflown the ARIP on departure for the rendezvous with Toft 51 or if he was off to one side. Since his capability to navigate precisely was influenced by these malfunctions, he passed the formation lead to Sigma **71.** Thereafter, Sigma **72** flew in formation about **10** to **12** feet off the right wing of Sigma **71.** Because of these navigational equipment problems, Sigma flight passed the ARIP 15 to **17** nmi to the right of the published track.

Because of the change of formation lead, Sigma **71's** weapons system officer (WSO) had to accomplish a refueling precontact checklist, reconfigure the aircraft's external lighting to help Sigma **72** maintain formation, take over navigational duties, and carry out his portion of the rendezvous while proceeding outbound from the ARIP and toward the ARCP. Normally, all of these procedures are completed by the lead aircraft before leaving the ARIP.

The aircraft in Sigma flight had their position lights on and steady. Sigma **71's** anticollision beacon was off; Sigma **72's** anticollision beacon was on.

In a postaccident interview, the pilot of Sigma **71** stated that he saw a landing light and beacon and that, "As far as I was concerned /they/ were at the same position." He called a tallyho 5/ at **12** o'clock and "followed that beacon the rest of the way." He made a correction to the right to an approximate heading of 330° in order to align his aircraft with the beacon. He also stated that when the flightcrew of Toft **51** said they were rolling out on a "308° heading," he rolled back to 308° and followed the beacon. (The crew of Toft 51 actually reported that they were rolling out on a heading of 301°.)

The **WSO** of Sigma **71** stated that he got a lockon 6/ on the aircraft about 5 miles and noticed that they had entered a turn to the right in the vicinity of 330° to chase the light that they saw in front of them.

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5/ Tallyho is a military term meaning, "I have visual contact."
6/ Lockon is a military term meaning that radar is continuously and automatically tracking a target.

The pilot of Sigma 72 also saw a beacon in his 12 o'clock position when 71 called a tallyho. He thought it was the tanker; however, from that point he concentrated on flying formation and did not "see any beacons after that."

As Sigma 71 continued to close on the beacon, the WSO told the pilot that the target's radar range was 2 nmi. The pilot requested that Toft 51 increase his speed to the refueling airspeed of 305 knots indicated airspeed (KIAS). The WSO called the target at a 4,000-foot radar range. The WSO said, "It looks like we have a fast overtake." The pilot rechecked his flight instruments and confirmed that he was at FL 180 and noted that his airspeed was about 320 knots calibrated airspeed (KCAS) and was decreasing. The WSO called the target's range at 2,000 feet and indicated that they were closing fast. The pilot said that he again checked his airspeed and altitude. The airspeed was down to about 310 KCAS, "no more than 315." He then looked up and he saw a white light and what he thought was the right outboard engine pod of a KC-135. He said he pulled back on the control stick and collided with what he thought was the tanker.

The crew of Toft 51 stated that they heard the receiver's tallyho when they were about midway through their turn to the refueling heading. The boom operator said that he had a "visual" on a beacon about 20 to 30 seconds before the completion of the turn. He saw only one beacon, and it was at his 3- or 4-o'clock position. The pilot said that after they completed the turn, he observed a beacon at his 3- or 4-o'clock position. Shortly thereafter, the tanker crew saw what they thought were flares. Unknown to the crew, the flares were the fires from the collision of N40MP and Sigma 71. The sighting was followed by a "Mayday" call from Sigma 72 on the international emergency UHF frequency (243.0 MHz).

A transcript of the recording of the communications between Toft 51 and Sigma 71 indicated that at 1800:45, Sigma 71 transmitted, "We show 59 miles on the INS from Milford." Toft 51 replied, "...and we're showing forty-seven and we're going ahead into a left turn this time and do you have us on radar yet." Sigma 71 answered, "Negative." At 1801:25, Sigma 71 transmitted, "..I believe I have tallyho at twelve o'clock. Can you turn?" At 1801:50, Sigma 71 transmitted, "We have a lockon at 8 miles. You can maintain your speed this time." Toft 51 replied, "rog, copy." At 1803:30 Toft 51 reported being at FL 200, airspeed 275 kn. Sigma 71 reported, "We're approximately (FL) 180." At 1804:45, Toft 51 stated, "I see the flares out there seven one ...."

After impact, the flightcrew of Sigma 71 ejected from their aircraft in an escape capsule. The pilot of the Turbo Commander died in the crash. The accident occurred during hours of darkness. The approximate coordinates of the crash were 38° -12'N, 112° - 12' W.

1.2 Injuries to Persons

| Injuries | Crew | Passengers | Other |
|---|---|---|---|
| Fatal | 1 | 0 | 0 |
| Nonfatal | 2 | 0 | 0 |
| None | 0 | 0 | |

1.3 Damage to Aircraft

Both aircraft were destroyed.

1.4 Other Damage

None

1.5 Crew Information

The crews of both aircraft were qualified for their respective flights. (See Appendix B.)

1.6 Aircraft Information

The Turbo Commander was certificated and maintained in accordance with existing Federal Aviation Regulations. The F-111A was maintained in accordance with applicable USAF regulations. The weight and center of gravity for both aircraft were within prescribed limits. (See Appendix C.)

1.7 Meteorological Information

The flightcrews of Sigma 71, Sigma 72, and Toft 51 reported that there was an overcast layer of cirrus clouds above the refueling track; there were no lower clouds and none at their flight levels. They reported good visibility, with ground lights visible in all directions. Although there was some light in the sky toward the west because of the sunset, it was completely black at their altitudes. The official sunset at Bryce Canyon on November 12, 1974, was at 1725. The winds aloft in the general area of the collision as measured by the National Weather Service at Grand Junction, Colo., were 315° at 49 kn. at 20,000 feet.

The Cedar City altimeter settings for 1700 and 1800 were 30.31 and 30.30 inches Hg., respectively.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

A review of the ARTCC tape communications revealed no communications difficulties between ground-based facilities and either N40MP or Sigma flight. Some difficulty, however, was experienced with one of Toft 51's UHF radios. As a result, the refueling was to be conducted on a Salt Lake City ARTCC frequency.

1.10 Aerodrome and Ground Facilities

Not applicable.

1.11 Flight Recorders

Not applicable.

1.12 Wreckage

Following the midair collision, the F-111A struck an alfalfa field about 1 mile northwest of Kingston, Utah. After cutting two powerline cables, the aircraft (except for the escape module, the nose cone and its electronic components, the nose wheel doors, the pitot static probe, and small miscellaneous structural parts of the nose section) hit the terrain inverted at a shallow angle on a magnetic heading of 065°. The ground impact and fire left a fan-shaped wreckage pattern and burn pattern. The crew escape module landed in a mountainous area about 4 miles southeast of the main wreckage site.

The other components of the F-111A were scattered along a path 2 to 11.2 miles from the main wreckage site on a heading of 164°. The pitot static probe could not be located. Longitudinal and circumferential fibers of F-111A radome material were found about 2 miles south of the F-111A main wreckage site, together with the Turbo Commander's right engine nacelle, oil cooler, and right main landing gear. The radome fiber material was piled over the Turbo Commander components. A number of fibers were wrapped around the landing gear strut just above the strut fork. The components were not burned; however, there were random burned spots on the ground near the components.

The Turbo Commander broke into several large and many small pieces. The pieces fell to earth along a northwesterly magnetic heading. They scattered along a 9-mile path which ended about 2 miles from the wreckage of the F-111A. Several components showed black and green marks which matched the paint of the F-111A. Some components showed evidence of in-flight fire or ground fire, or both. The compressor section of the right engine of the Turbo Comnander was not found, nor were any components that could be associated with the compressor section found. The right engine gearbox and propeller were found 312 feet west of the right engine nacelle.

The wreckage area was located just east of a course line defined by J-11, as it extends between Bryce Canyon VORTAC and Fairfield VORTAC.

1.13 Medical and Pathological Information

Both Sigma 71 crewmembers received back injuries,

The pilot of N40MP was killed in the collision. No autopsy or toxicological examination could be performed.

1.14 Fire

The flightcrew of the F-111A (Sigma 71) stated that an in-flight explosion and fire occurred upon contact with the Turbo Commander. Large pieces of the Turbo Comnder, including the right outboard wing section, a large portion of the fuselage, and the left wing, showed evidence of in-flight fire and post-impact ground fire.

The F-111A was destroyed by a fuel-fed fire after ground impact.

1.15 Survival Aspects

This accident was nonsurvivable for the pilot of the Turbo Commander. However, because the F-111A was equipped with a crew escape module system, it was survivable for the occupants of the F-111A. Immediately following the collision, the crew activated the escape system, and the module separated from the aircraft. The entire module parachuted to earth, struck the ground on an incline, and rolled over about 2½ times before coming to rest on its left side.

1.16 Tests and Research

The pilot's and copilot's altimeters were recovered from the wreckage of the Turbo Comnder and examined, Both altimeters had been damaged extensively. The barometric settings for the pilot's and copilot's altimeters were 29.88 in. Hg. and 29.92 in. Hg., respectively. No other useful information was obtained from the examination of the altimeters.

The central air data computer (CADC), S/N 808170, was removed from the wreckage of the F-111A and forwarded to the overhaul facilities at McClellan Air Force Base, California. The unit was examined in an attempt to establish the altitude and airspeed of the F-111A at the time of the collision. No useful information was obtained from the examination because of extensive damage.

The F-111A's "tape" type altimeter, which receives inputs from the CADC, was set at 29.89 in. (The altimeter was located in the escape module.) The standby barometric altimeter was found set at 29.92 in.

Since the F-111A pilot indicated that he attempted to pull up just before impact, the collision angle could not be computed accurately. However, measurements of scratch marks on the two aircraft indicated that the F-111A overtook the Turbo Commander within about 0 to 10° from the rear. Accordingly, the closure speed was calculated by using the difference between the true airspeeds of the aircraft.

1. F-111A--428 kn., as found on the true airspeed indicator following the accident.

2. Turbo Commander--270 kn., as filed by the pilot in his flight plan.

The closure speed was calculated to have been 158 kn.

1.17 Other

1.17.1 Air Refueling Route-316

The Airman's Information Manual (AIM), Part *4*, dated October 1974, describes the Military Aerial Refueling Track as follows:

> Military aircraft conduct refueling operations throughout the continental United States normally between 12,000 feet MSL and FL 330 on an IFR flight plan at assigned altitude(s). Refueling aircraft have right-of-way over aircraft in accordance with FAR 91.67(c). USN/USMC aircraft may operate green anticollision light(s) identifying aircraft involved in aerial refueling operations. When displayed, these light(s) will be used in conjunction with standard position lights.

There followed a listing of the air refueling tracks located below positive control airspace, one of which was Air Refueling Route-316:

| | |
|---|---|
| Name and Number | AR-316 Coronet Milford |
| Location | Utah, Nevada |
| Track Beginning | MF 197/100 |
| Track End | MF 235/32 |
| Altitudes | 16,000 to Positive Control Area |

There was no diagram of AR-316 in the AIM.

The Department of Defense (DOD) Flight Information Publication, Section IIa, Military Training Routes, dated 10 October 1974, described **AR-316**

as beginning at MLF VORTAC 125/100 with an exit point at MLF VORTAC 163/32. This publication provides a diagram of AR-316 on a separate page. The beginning and ending points for the AR-316 track had been changed by DOD effective September 1971. However, the AIM continued to carry the track's description incorrectly, as shown in the description above.

AR-316 overlaps portions of airspace controlled by both the Los Angeles Center and the Salt Lake City Center. The ARIP and the exit point are located in Los Angeles Center's airspace, while the ARCP and the refueling track are in Salt Lake City Center's airspace. Air traffic control of AR-316 is based on the location described in the DOD publication.

The Air Force sets forth the width of the refueling track in Tactical Air Command Manual 55-22 and Strategic Air Command Manual 55-14. (Both manuals cite FAA Manual 7610.4B as a reference.) The width of the track is as follows: From the ARIP to the ARCP, a magnetic heading of 305°, 15 nmi on the holding side (left side), and 10 nmi on the nonholding side (right side).

1.17.2 Air Traffic Control Radar

Los Angeles and Salt Lake City ARTCC's have an operational Phase II National Airspace (NAS) en route Stage A traffic control radar. Phase II NAS is an automated system for en route air traffic control and provides flight data processing and radar data processing. By means of this automated system, controllers can identify and track either discrete or nondiscrete coded beacon targets through automatic or manual acquisition.

Toft 51 was assigned discrete transponder code 1123, and a full alphanumeric data block associated with the target position symbol for Toft 51 was received by Salt Lake City Center. Sigma flight was assigned discrete transponder code 1120. Although only one target position symbol had been assigned to Sigma flight, the plan view display (PVD) showed two alphnumeric data blocks, which indicates that both Sigma 71 and 72 had their transponders operating.

The system also provides a data analysis and reproduction tool (DART) log. The last recorded DART altitude for Sigma 71 was 17,900 feet at 1804, the last altitude (within ± 100 ft.) scanned by the system before the loss of the radar signal at the time of collision.

Although the DART log indicated that Sigma flight was at 17,900 feet, the data block information received by the Salt Lake City Center radar indicated that the F-111A aircraft were within the blocked airspace at all times while under Salt Lake City Center surveillance. The NAS system is designed so that the altitudes shown in the data blocks are within ± 300 ft. of the aircraft's actual altitude in level flight.

The Salt Lake City Center DART logged an unidentified transponder code 1400 (VFR code) track which intersected the track of the discrete transponder code for Sigma 71 at about the time of the collision. (See Appendix D.) The DART will record a code 1400 although the target will not appear on the radar scope unless the controller has code 1400 selected.

1.17.3 ATC Procedures and Routes

VFR cruising altitudes are specified in 14 CFR 91.109, as follows:

(a) When operating below 18,000 m.s.l. and;

(1) on a magnetic course of 0 degrees through 179 degrees, any odd thousand m.s.l. altitude plus 500 feet, or

(2) on a magnetic course of 180 degrees through 359 degrees, any even thousand feet plus 500 feet.

J-11 crosses the AR-316 refueling track at Bryce Canyon. From Bryce Canyon, J-11 proceeds northward on a magnetic course of 351° direct to the Fairfield, Utah, VORTAC. Jet Airways begin at 18,000 feet.

The Positive Control Area (EA) extends from 18,000 feet up to FL 600. To operate in the EA, an aircraft must be IFR-equipped, have an operable transponder, and must be cleared by ATC.

1.17.4 Visual Cues During the Refueling Rendezvous

Interviews with military pilots who were experienced in aerial refueling operations indicated that the tanker's beacon is its only recognizable visual cue during a night rendezvous. The tanker underbelly lighting and engine nacelle lighting cannot be seen until the receiver is close to the tanker, usually between 1 and 2 miles.

1.17.5 N40MP Altimeters

The altimeters installed in N40MP were manufactured by Aero-Mach of Wichita, Kansas, and were laboratory tested by Rockwell International before they were installed in the aircraft. The following test results were recorder :

| | Test Altitude | Altimeter Reads | Tolerance ± Feet |
|---|---|---|---|
| Pilot's Altimeter | 16,000 | -20 | 110 |
| Serial No. 4041 | 18,000 | -10 | 120 |
| Tested 7-8-73 | 20,000 | 0 | 130 |

| | Test Altitude | Altimeter Reads | Tolerance ± Feet |
|---|---|---|---|
| Copilot's Altimeter | 16,000 | -80 | 110 |
| Serial No. 5039 | 18,000 | -80 | 120 |
| Tested 6-9-73 | 20,000 | -60 | 130 |

1.17.6 F-111A Rendezvous Navigational Aids

Sigma flight had the following airborne navigational aids available to assist in the rendezvous with the tanker:

1. UHF radio with an ADF function that provides bearing information to selected UHF transmissions.

2. Air-to-air TACAN with a capability to provide range-only information between two aircraft.

3. TACAN that provides bearing and distance information to ground TACAN stations.

4. Inertial navigation that provides bearing and distance information to coordinates set into the system.

5. Radar that provides all-weather navigation, fix taking, and air-to-air attack (air-to-air range and bearing).

1.17.7 Applicable Regulations

1. Federal Aviation Regulations

A. 14 CFR 91.65 Operating Near Other Aircraft

(a) No person may operate an aircraft so close to another aircraft as to create a collision hazard.

(b) No person may operate an aircraft in formation flight except by arrangement with the pilot in command of each aircraft in formation.

B. 14 CFR 91.67 Right-of-way Rules; Except Water Operations

(a) General: When weather conditions permit, regardless of whether an operation is conducted under Instrument Flight Rules or Visual Flight Rules, vigilance shall be maintained by each person operating an aircraft so as to see an avoid other aircraft in compliance with this section. When a rule of this section gives another

aircraft the right-of-way, he shall give way to that aircraft and may not pass over, under, or ahead of it, unless well clear.

(b) Overtaking: Each aircraft that is being overtaken has the right-of-way and each pilot of an overtaking aircraft shall alter course to the right to pass well clear.

C. 14 CFR 91.81 Altimeter Settings

(a) Each person operating an aircraft shall maintain the cruising altitude or flight level of that aircraft, as the case may be, by reference to an altimeter that is set, when operating.

(1) below 18,000 feet m.s.l. to

(i) The current reported altimeter setting of a station along the route and within 100 nautical miles of the aircraft.

2. USAF Regulations

A. *AFR* 60-16

5-2 Proximity of Aircraft: Pilots will not fly an aircraft so close to another so as to create a collision hazard. Use 500 feet separation (well clear) as an approximate guide except for:

(a) Authorized formation flights.

## 2. ANALYSIS AND CONCLUSIONS

### 2.1 Analysis

At 1800, when the pilot of N40MP contacted Cedar City FSS and gave his position as over Bryce Canyon, he had already deviated to the Grand Canyon and had joined the J-11 course at or south of Bryce Canyon. Since the wreckages of both aircraft were found along the airway's course, the Safety Board concludes that N40MP had been flying along the airway course for at least 4 minutes before the collision. Since the planes collided at 17,900 feet, N40MP had either just climbed to that altitude or was maintaining 17,900 feet -- 100 feet below his requested altitude -- while awaiting his IFR clearance from Los Angeles Center. The latter possibility would have been a violation of 14 CFR 91.109, since the highest quadrantal altitude allowable below the PCA was 16,500 feet. There is insufficient evidence available, however, to make any determination in this regard.

When the Sigma flight, with 72 in the lead, departed the ARIP for the tanker rendezvous, they were not aware that their actual position at the time of departure was offset 15 to 17 nmi to the right of the intended track. This position error, which was caused by navigation equipment errors experienced by Sigma 72, placed them outside the protected airspace of the refueling track. The crew of Sigma 71 did not notice the error, probably because they were preoccupied by the rendezvous with Sigma 72.

When the decision to change leads was made, the flight was beyond the ARIP and outside the refueling track. Little time remained for the crew of Sigma 71 to assume the responsibilities of lead aircraft, identify the tanker aircraft, and configure the aircraft for the refueling operation.

The Safety Board believes that this hurried atmosphere, together with the undetected position error, led the pilot of Sigma 71 to mistake the Turbo Commander's beacon for the tanker's beacon.

While Sigma Flight was switching leads and preparing to refuel, Toft 51 had departed the ARCP on a heading of 125°, a reciprocal to the refueling heading. In normal operation, Toft 51 would have continued on this reciprocal heading until, through coordination with the receiver aircraft (Sigma Flight), a prearranged distance separated the tanker and its receiver(s). At that point, Toft 51 would have started a 3° per second (standard rate) left turn to the refueling heading. In this case, the refueling heading would have been 305°. These procedures are standard throughout the Air Force and are required knowledge for all crewmembers who engage in air refueling operations. If these procedures are followed, the tanker rolls out on the refueling heading from 5 to 8 miles in front of the receiver aircraft.

On the night of the accident, because of air-to-air TACAN difficulties and the mispositioning of Sigma Flight, the distance between Toft 51 and Sigma 71 could not be established by using air-to-air TACAN. As a result, the point at which Toft 51 started the standard-rate turn to the refueling heading was established by reference to its distance from the Milford VORTAC -- an acceptable backup procedure when air-to-air TACAN distance cannot be established. Additionally, Sigma 71's UHF/ADF equipment could have been used to determine positively its bearing to the tanker during the rendezvous. Thus, positive bearing of the tanker would have been known as soon as the tanker had rolled out on the refueling heading.

The first opportunity for the pilot of Sigma 71 to suspect that he was seeing the wrong aircraft occurred when he sighted what he believed to be the tanker at 1801:25.

At that time, only about *40* seconds had passed since Toft 51 had reported that the left turn to refueling heading had been started. At a standard turn rate, Toft 51 would have been about two-thirds of the

way through the 180° turn required to reach the refueling heading. Therefore, if the beacon which the pilot of Sigma 71 had sighted was actually Toft 51, it should have been moving from left to right across the windscreen of Sigma 71 at a rapid rate because, at that time, Toft 51 was approximately perpendicular to the heading of Sigma Flight. The pilot of Sigma 71 stated that it took only a slight correction to the right and then back to refueling heading to get behind the beacon he had identified as Toft 51.

As Sigma 71 continued to close in on the beacon, the WSO was able to lockon to the target with the radar equipment at a range of about 5 miles. From that point, the WSO advised the pilot of the range between the aircraft each mile down to 1 mile and then at 4,000 feet and 2,000 feet. Twice during these range calls, the WSO advised the pilot of an excessive closure rate. The pilot stated, that at both times when he was advised of the closure rate, he crosschecked his instruments and found his airspeed to be what would be expected for that phase of the rendezvous. Calculations determined the closure rate to be approximately 158 kn. The crew had no reason to believe the radar equipment was giving erroneous information, since the equipment had been used shortly before to effect a successful rendezvous with Sigma 72. The high closure rate and airspeed information provided a second opportunity for the pilot of Sigma 71 to be suspicious of the beacon upon which he was closing.

The only reference to heading made by the pilot of Sigma 71 was his statement that just after he saw the beacon he believed to be Toft 51, a small correction was made to the right because he thought the tanker had rolled out of its turn slightly to the right of the desired track. The pilot of Sigma 71 stated, "... so I turned to an approximate heading of 330°. He /Toft 51/ called me rolling out heading 308° and I also rolled back to a heading of 308° and then followed the beacon." The actual call from Toft 51 was for a rollout heading of 301°. It was after this slight track correction that the pilot stated that his WSO had locked onto the radar target.

In his statement, the WSO of Sigma 71 stated that, "... I locked on the aircraft about 5 miles. I told them /Toft 51/ that we were in 5-mile range. I also noted that we had entered a turn to the right in the vicinity of 330° to chase the light we saw in front of us." This statement is in conflict with the pilot's statement which indicated that the aircraft had been returned to the refueling heading before the 5-mile lockon point. The DART plot substantiates the fact that Sigma 71 did not return to the refueling heading.

The Turbo Commander's probable heading of about 343°, which was calculated using the recorded winds aloft in the collision area, was 42° to the right of the 301° heading which Toft 51 reported, and 35° to the right of the 308° heading which the pilot of Sigma 71 stated he was using to chase the beacon. During the last 5 miles of closure, the pilot of Sigma 71 probably would have had to continue a turn to the right be-

cause the beacon would have been progressing to his right. He stated that several times during the closure he crosschecked his altitude and airspeed instruments. He made no mention of checking heading indications. Had he checked his heading indications, they would have afforded a third opportunity for him to be suspicious of the beacon he was following because they would have been considerably different from the heading reported by Toft 51 and the published heading (305°) of the air refueling track.

The final and perhaps the most positive visual clue to indicate to the pilot of Sigma 71 that he had misidentified Toft 51 was the beacon itself. Any object that appears to be stationary when seen through the aircraft's windscreen is in the same plane as the aircraft from which it is being viewed. Unless corrective action is taken, a collision will most likely result. If the object moves on the windscreen, in any direction, a collision would not be expected. For the tanker rendezvous, the pilot should have maintained a stationary target only laterally.

In this case, Toft 51 was at FL 200 and Sigma 71 was at 17,900 feet. The beacon viewed through the windscreen of Sigma 71 remained, according to the statement of the pilot and the WSO, directly in front of the aircraft. Had the beacon, in fact, belonged to Toft 51, it should not have remained stationary, but rather should have moved up on the windscreen, because of the altitude differential, as the distance between the two aircraft decreased. At a 2,000-foot range with a 2,000-foot vertical separation, the vertical angle subtended between Sigma 71 and the tanker would have been 45°, thus placing the beacon high on the windscreen of Sigma 71.

The implications of this visual phenomenon are well known to pilots who are experienced in air refueling rendezvous. Because the beacon remained in the center of his windscreen and his aircraft had not climbed from FL 180, the pilot of Sigma 71 should have recognized that a collision was imminent and that the beacon he was approaching was not Toft 51.

The Safety Board believes that the reason the F-111A pilot continued the collision course with N40MP and disregarded the cues that should have indicated that he was closing on the wrong aircraft was that he firmly believed that the beacon in his 12 o'clock position was, in fact, the tanker.

## 2.2 Conclusions

### A. Findings

1. Both aircraft were airworthy.
2. All flight crewmembers were qualified.
3. The collision occurred at night in a dark sky.
4. The Sigma flight was engaged in a night air-refueling exercise and was operating in accordance with an IFR flight

plan under radar control of the Los Angeles ARTCC.

5. The Sigma flight was behind schedule, and as they proceeded uptrack to rendezvous with the tanker, they were 15 to 17 nmi to the right of the air refueling track centerline (outside the track-protected airspace).

6. N40MP began its flight under visual flight rules and was not under control of the ATC system.

7. N40MP intercepted the J-11 course at or south of Bryce Canyon, and had been proceeding along the course for at least 4 minutes under VFR conditions when the planes collided.

8. The magnetic course of J-11 between Bryce Canyon and the Fairfield, Utah, VORTAC is 351°. The highest authorized VFR cruise altitude while flying on that heading between Bryce Canyon and the impact point is 16,530 feet m.s.l.

9. The DART plot indicated that the collision occurred at 17,900 feet.

10. The Safety Board was not able to determine whether N40MP was level at 17,900 feet or had just climbed to that altitude.

11. N40MP had only its beacon and position lights illuminated.

12. ATC had given the air refueling flight a block altitude of FL 180 through FL 210. The Sigma aircraft was operating at FL 180 an3 the tanker (Toft 51) was operating at FL 200. The collision occurred at 17,900 feet.

13. The collision occurred outside the protected airspace of the refueling track.

14. The pilot of Sigma 71 mistook the beacon of N40MP for that of Toft 51, the tanker. The pilot of Sigma 71 closed on N40MP's beacon and collided with N40MP.

15. The pilot of Sigma 71 did not use all of the navigation equipment at his disposal for rendezvous with the tanker.

16. The F-111A was the overtaking aircraft and was required by the right-of-way rules to alter course and pass well clear.

17. The pilot of the Turbo Comnder should have remained at the highest hemispherical altitude available to him until he had received an ATC clearance to enter the Positive Control Area.

b. Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the F-111A pilot's misidentification of the Turbo Commander as a refueling tanker with which he intended to rendezvous. Contributing to the misidentification was his failure to use prescribed procedures and techniques during rendezvous with a tanker aircraft for refueling.

## 3. RECOMMENDATIONS

As a result of this accident, the Board issued five safety recommendations dealing with: (1) Air traffic separation procedures in aerial refueling areas, (2) dissemination of information on aerial refueling track locations, and (3) revised military aircraft lighting requirements. (A-75-11 through 15.)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

/s/ WILLIAM R. HALEY
Member

August 1, 1975

APPENDIX A

## INVESTIGATION AND HEARING

### 1. Investigation

The Safety Board was notified of the accident at *2045* on November **12, *1974,*** by the Federal Aviation Administration. An investigator was dispatched from the Denver Field Office and was joined by investigators from Washington Headquarters. An air traffic control specialist from Washington Headquarters went to the **Los** Angeles Air Route Traffic Control Center at Palmdale, California, to conduct the ATC portion of the investigation. Working groups were established for operations, air traffic control, systems, structures, and weather. The Federal Aviation Administration, Department of the Air Force, and General Dynamics Corporation participated in the investigation. The onscene portion of the investigation was completed on November **21,** 1974.

### 2. Hearing

There was no public hearing.

APPENDIX B

CREW INFORMATION

Mr. Rocco Fiori

Mr. Rocco Fiori, 34, the pilot of N40MP, held Airline Transport Pilot Certificate No. 1768219, with multi- and single-engine land rating and commercial privileges. He was type rated in the Learjet 23/23E and 25. His first-class medical certificate was dated June 28, 1974, with no limitation.

Mr. Fiori had a total of 2,754 flight-hours, 200 of which were in the Turbo Commander. Pilot information submitted by his company indicated that Mr. Fiori had a total of 2,671 flight-hours as pilot-in-command, 316 of which were instrument time. He had flown 32 hours in the Turbo Commander in the last 90 days preceding the accident.

Captain Peter A. Granger

Captain Peter A. Granger, 32, the pilot of Sigma 71, held a USAF Instructor Pilot rating. He passed his latest USAF Flight Physical on April 17, 1974, and was cleared for unconditional flying with no waivers. He passed USAF Standardization Board Flight Checks on November 11, 1974, and May 29, 1974. Captain Granger had 2,850 flight-hours, of which 68, 18, and 3 were flown during the last 90 days, 30 days, and 24 hours, respectively. He had been off duty about 16 hours before reporting for duty on November 12, 1974. At the time of the accident he had been on duty about 9 hours, of which 34 minutes was flight time.

Captain Paul D. Sperry

Weapon Systems Officer Captain Paul D. Sperry, 28, held a Navigator rating. He passed his latest USAF Flight Physical on April 2, 1974, and was cleared for unconditional flying with no waivers. He passed his last two USAF Standardization Board checks on April 14, 1974, and May 19, 1973. He had 901 flight-hours of which 33, and 9 were flown during the last 90 days and 30 days, respectively.

He had not flown the previous 24 hours. His rest, duty and flight times on the day of the accident were the same as Captain Granger's.

APPENDIX C

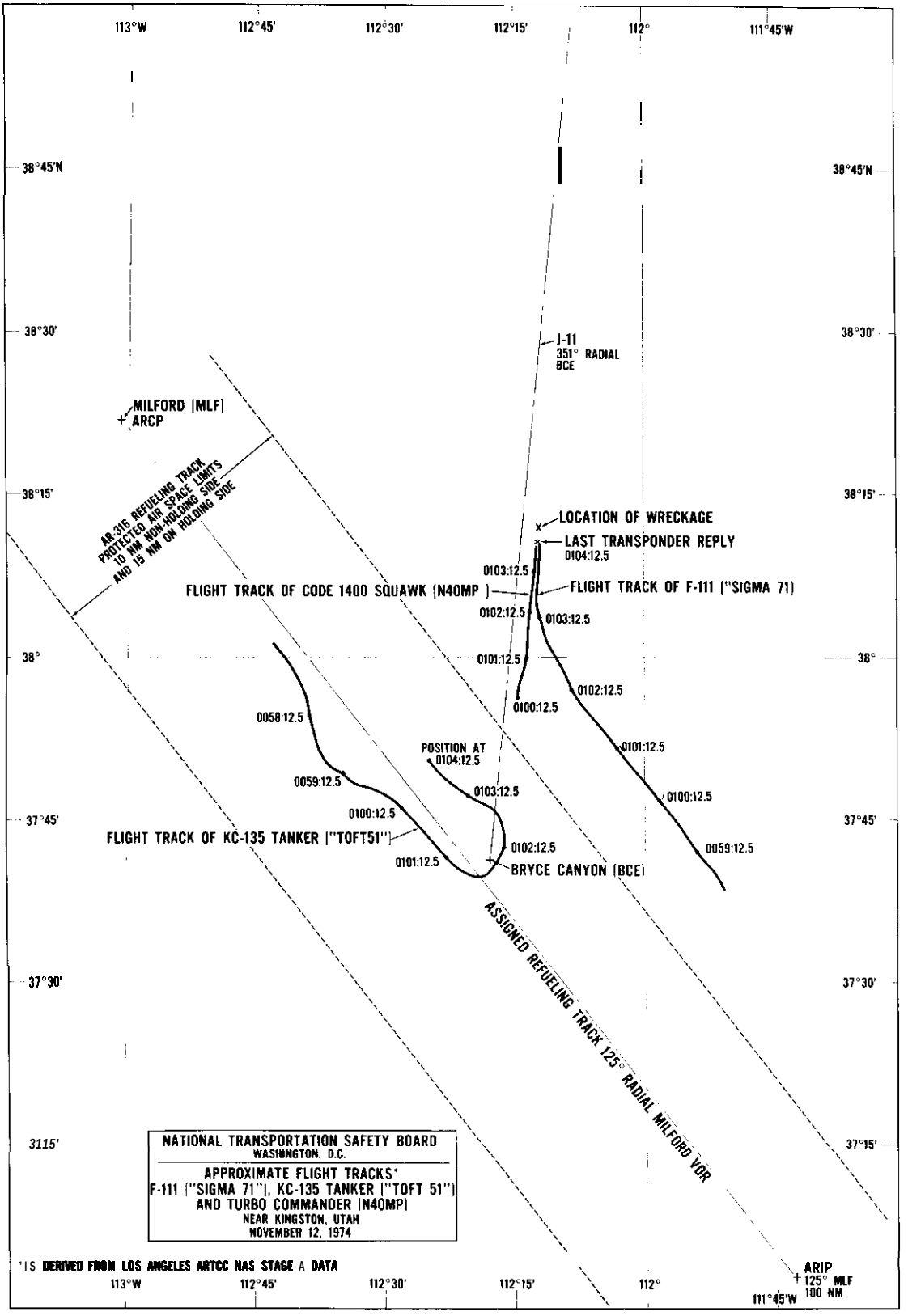
## AIRCRAFT INFORMATION

The F-111A was a General Dynamic, Inc., 72,000-lb. gross weight supersonic fighter aircraft, equipped with two Pratt and Whitney TF 30P3 turbofan engines (with afterburner). It was configured for wing contouring, crew module ejection, and air refueling capability. This particular aircraft, S/N 77-055, had a 24-inch pitot static probe which extended forward from the radome nose. The aircraft was equipped with wing position lights, upper and lower anticollision lights, a tail position light, four fuselage formtion lights, and upper and lower wing formation lights. The aircraft was covered with a camouflage type paint pattern (basically green and black), with the bottom and radome painted black.

The Turbo Commander aircraft was a pressurized North American Rockwell Corporation Model 690A, equipped with two AiResearch TPE 331-5-251K turboprop engines. It was instrumented for all weather flights. The color scheme of the fuselage was described as basic white trimmed with 10-inch dark blue horizontal stripes with thin gold stripes above and below the blue stripes. The engine cowls were decorated with a large horizontal blue stripe with adjacent gold stripes below the blue stripes. The top of the rudder was painted blue with horizontal gold stripes below the blue top.

The Turbo Commander aircraft was equipped with red and green wing position lights, a white position light at the tail cone, a red flasher light on the top forward tip of the rudder, and a Whalen 3-light strobe system with a strobe in each wing tip and one in the tail cone.

APPENDIX D


113°W
112°45'
112°30'
112°15'
112°
111°45'W
38°45'N
38°30'
38°15'
38°
37°45'
37°30'
37°15'
3115'
J-11
351° RADIAL
BCE
MILFORD (MLF)
ARCP
AR-316 REFUELING TRACK
PROTECTED AIR SPACE LIMITS
10 NM NON-HOLDING SIDE
AND 15 NM ON HOLDING SIDE
LOCATION OF WRECKAGE
LAST TRANSPONDER REPLY
0104:12.5
0103:12.5
FLIGHT TRACK OF CODE 1400 SQUAWK (N40MP)
FLIGHT TRACK OF F-111 ("SIGMA 71)
0102:12.5
0103:12.5
0101:12.5
0102:12.5
0100:12.5
0058:12.5
POSITION AT
0104:12.5
0101:12.5
0059:12.5
0103:12.5
0100:12.5
FLIGHT TRACK OF KC-135 TANKER ("TOFT51")
0102:12.5
0059:12.5
0101:12.5
BRYCE CANYON (BCE)
ASSIGNED REFUELING TRACK 125° RADIAL MILFORD VOR
ARIP
125° MLF
100 NM
NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.
APPROXIMATE FLIGHT TRACKS*
F-111 ("SIGMA 71"), KC-135 TANKER ("TOFT 51")
AND TURBO COMMANDER (N40MP)
NEAR KINGSTON, UTAH
NOVEMBER 12, 1974
*IS DERIVED FROM LOS ANGELES ARTCC NAS STAGE A DATA

# NATIONAL TRANSPORTATION SAFETY BOARD
## WASHINGTON, D.C.

APPENDIX E

ISSUED: February 25, 1975

**Forwarded to:**

Honorable Alexander P. Butterfield
Administrator
Federal Aviation Administration
Washington, D. C. 20591

**SAFETY RECOMMENDATION(S)**

A-75-11 thru 13

The National Transportation Safety Board is investigating the midair collision between an Aero Commander 6T and a F-111A on November 12, 1974, within military aerial refueling track AR-316. The Safety Board believes that AR-316 is described incorrectly in the Airman's Information Manual, Part 4, dated October 1974.

The Airman's Information Manual describes AR-316, in part, as: "track beginning--MLF 1/ 197/100 and track ending--MLF 235/32." There is no diagram of AR-316 included in the Airman's Information Manual.

The Department of Defense (DOD) flight information publication, Military Training Routes, Section II A, dated October 10, 1974, indicates that AR-316 begins MLF VORTAC 125/100 and ends at MLF VORTAC 163/32. This publication provides a diagram of AR-316.

AR-316 overlaps portions of airspace controlled by the Los Angeles Air Route Traffic Control Center and the Salt Lake City Air Route Traffic Control Center. Air traffic control at both centers is based on the location of AR-316 as described in the DOD publication, which is not available to civilian pilots.

1/ Milford, Utah, VORTAC.

APPENDIX E

Honorable Alexander P. Butterfield 2

On the basis of the above findings, the National Transportation Safety Board recommends that the Federal Aviation Administration:

1. Review the locations of all military aerial refueling tracks and verify their accuracy as described in the Airman's Information Manual, Part 4.

2. Include a diagram of the aerial refueling tracks in the Airman's Information Manual.

3. Broadcast appropriate alerting information periodically on the VOR voice frequency, when operations are being conducted within military aerial refueling tracks.

REED, Chairman, McADAMS, BURGESS, and HALEY, Members of the Board, concurred in the above recommendations. THAYER, Member, did not participate.

By: John H. Reed
Chairman

cc: Hon. James R. Schlesinger

# NATIONAL TRANSPORTATION SAFETY BOARD
## WASHINGTON, D.C.

APPENDIX F

ISSUED: February 25, 1975

**Forwarded** to:

Honorable James R. Schlesinger
Secretary of Defense
The Pentagon
Washington, D. C. 20301

**SAFETY** RECOMMENDATION(S)
A-75-14 and 15

The National Transportation Safety Board is investigating a midair collision between an Aero Commander 6T and a F-111A. The accident occurred on November 12, 1974, near Bryce Canyon, Utah. The F-111A was in the military aerial refueling track AR-316. The Safety Board believes that the base altitude selected for the refueling area did not provide a sufficient margin of safety.

Aerial refueling operations were being conducted at assigned altitudes from FL 180 through FL 210. The pilot aboard the Aero Commander, which was operating according to visual flight rules, advised air traffic control that he was at 17,500 feet and requested an instrument flight rules clearance with an assigned altitude of 18,000 (FL 180). Before a clearance could be issued, a collision occurred between the F-111A and the Aero Commander.

Initially, the lead F-111A, one of two, had navigational difficulties because of a malfunctioning inertial navigation system and TACAN while attempting a rendezvous with the tanker. Immediately following a change of lead, the F-111A flight began to join up when the pilot established visual contact with a flashing red light, which appeared to emanate from an aircraft operating within the blocked airspace. Unfortunately, the red light was on the Aero Commander and not the tanker.

**APPENDIX** F

Honorable James R. Schlesinger 2

**On** the basis of the above findings, the National Transportation Safety Board recommends that the Department of Defense:

1. When military aerial refueling operations are conducted within positive control areas, designate a base altitude for the block airspace sufficiently higher than the base altitude of the positive control area so as to provide a buffer between aerial refueling activities and unrelated visual flignt **rules** activities below the positive control area.

2. When military aerial refueling operations are conducted below positive control areas, revise aircraft lighting requirements so as to enhance the conspicuity **of** the military aircraft during night operations.

REED, Chairman, McADAMS, BURGESS, and HALEY, Members of the Board, concurred in the above recommendations. THAYER, Member, did not participate.

By: John H. Reed
Chairman

CC: Alexander P. Butterfield