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<p>16. Abstract</p> <p>About 0954 e.d.t., on September 13, 1976, a U.S. Air Force F-4E, 67-0255, and a Ruel Insurance Corporation Cessna 414, N8PR, collided in flight about 7 nmi south of Brighton, Florida. The F-4E was the No. 3 aircraft in a formation of three F-4E's (REED 11 flight) which was descending to enter a restricted area for low-level gunnery practice. The planes collided at 12,500 feet m.s.l. outside the boundaries of restricted airspace. The pilot and three passengers onboard N8PR and a pilot onboard the F-4E were killed. The other pilot from the F-4E ejected successfully and escaped injury. Both aircraft were destroyed during the collision and subsequent ground impact.</p> <p>The National Transportation Safety Board determines that the probable cause of this accident was the failure of the pilots of REED 11 flight to maintain adequate vigilance in order to see and avoid the light aircraft.</p> <p>Contributing to the accident was the inconsistency between Homestead Air Force Base Supplement 1 to Tactical Air Command Manual 55-4 which allowed a VFR descent into the Avon Park gunnery range and Air Force Regulation 60-16 which required all flights to be conducted under IFR conditions unless to do so would result in unacceptable mission derogation.</p>					
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NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

Adopted: September 16, 1977

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RUEL INSURANCE CORPORATION  
CESSNA 414, N8PR,  
and  
U.S. AIR FORCE  
F-4E, 67-0255,  
NEAR BRIGHTON, FLORIDA  
SEPTEMBER 13, 1976

SYNOPSIS

About 0954 e.d.t., on September 13, 1976, a U.S. Air Force F-4E, 67-0255, and a Ruel Insurance Corporation Cessna 414, N8PR, collided in flight about 7 nmi south of Brighton, Florida. The F-4E was the No. 3 aircraft in a formation of three F-4E's (REED 11 flight) which was descending to enter a restricted area for low-level gunnery practice. The planes collided at 12,500 feet m.s.l. outside the boundaries of the restricted airspace. The pilot and three passengers onboard N8PR, and a pilot onboard the F-4E were killed. The other pilot from the F-4E ejected successfully and escaped injury. Both aircraft were destroyed during the collision and subsequent ground impact.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the pilots of REED 11 flight to maintain adequate vigilance in order to see and avoid the light aircraft.

Contributing to the accident was the inconsistency between Homestead Air Force Base Supplement 1 to Tactical Air Command Manual 55-4 which allowed a VFR descent into the Avon Park gunnery range and Air Force Regulation 60-16 which required all flights to be conducted under IFR conditions unless to do so would result in unacceptable mission derogation.

1. FACTUAL INFORMATION

1.1 History of the Flights

About 0835 e.d.t. <sup>1/</sup>, on September 13, 1976, a Ruel Insurance Corporation Cessna 414, N8PR, departed New Tamiami Airport near Miami, Florida, on a business trip. The pilot and a passenger were aboard. The aircraft landed at Executive Airport, Fort Lauderdale, Florida, and picked up two more passengers. Just before takeoff from Executive Airport, at the request of the airport tower, the pilot of N8PR stated that he intended to fly to Tallahassee, Florida. This statement was the last known radio transmission from this aircraft.

The Executive Airport tower controller watched N8PR depart and climb toward the northeast. The pilot of N8PR had not filed a flight plan and was operating under visual flight rules (VFR).

On September 13, four U.S. Air Force F-4E aircraft, assigned to the 31st Tactical Fighter Wing, Homestead Air Force Base, Florida, were scheduled for a student training flight to include air refueling and ground attack practice at Avon Park Gunnery Range. Homestead Air Force Base is about 15 nmi south of Miami, and Avon Park Gunnery Range is about 135 nmi northwest of Miami.

An instructor pilot in the front seat of the lead aircraft was to lead the formation. The other three aircraft were piloted by upgrading student pilots; instructor pilots occupied the rear seat of each of the aircraft.

During taxi for takeoff, the designated lead aircraft had maintenance difficulties and could not continue the mission. As preplanned, one of the other F-4E's assumed the responsibilities of the lead aircraft. The instructor pilot remained in the rear seat.

At 0935, the three aircraft departed Homestead AFB on an instrument flight rules (IFR) flight plan. Their call signs were REED 11, 12, and 13; REED 11 was the designation of the lead aircraft and, therefore, the designation of the flight. During climbout, the flight assumed close formation; REED 11 was in the lead; REED 12 was to its right; and REED 13 to its left. Since the air refueling portion of the flight had been canceled before takeoff, the flight had received clearance from Miami Center to proceed on a northwesterly heading toward the 34 nmi fix on the 322" radial of the Pahokee, Florida, VORTAC, the entry point for the Avon Park Gunnery Range.

<sup>1/</sup> All times herein are eastern daylight, based on the 24-hour clock.

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At 0943, as REED 11 flight reached flight level 180 (FL-180), REED 11 requested and received clearance from Miami Air Route Traffic Control Center (Miami Center) for the flight to maintain a block altitude of FL-180 to FL-210. At this time, as preplanned, the flight moved into tactical formation, separated by about 1,000 feet; REED 12 and 13 maintained their same positions relative to REED 11.

At 0948:59, before reaching their clearance limit at the Pahokee, Florida, VORTAC, the flight was cleared by Miami Center to maintain 14,000 feet <sup>2/</sup>, to descend to that altitude at the pilot's discretion. Miami Center indicated that the local altimeter setting was 30.02 inHg. The lead aircraft then directed the flight to move into route formation (about 2 to 4 wing-width separation) for the descent.

At 0952:20, REED 11 advised Miami Center, "Center, REED 11 is passing 17,000, cancel IFR." Miami Center replied, "REED 11, roger, cancellation; see you on return." This was the last communication between the flight and Miami Center before the collision.

Shortly after canceling IFR, REED 11 changed his transponder to VFR code 1200 and instructed the flight to switch to Avon Park frequency to obtain the altimeter setting and wind information required for gunnery practice on the Avon Park range. The flight then turned left 30° to a new heading of 315°. About 0954, during descent and at an altitude of about 12,500 feet, the No. 3 aircraft in the flight collided with N8PR. The aircraft collided about 5 nmi south of the Pahokee VORTAC fix which was to serve as REED 11 flight's entry point into the gunnery range.

N8PR went out of control and crashed on the Brighton Indian Reservation northwest of Lake Okechobee, Florida, about 10 miles south of Avon Park Gunnery Range. The four occupants of the aircraft were killed.

REED 13 remained in formation momentarily, then started a nose-low spiral to the left. The occupant of the rear seat ejected from the aircraft, parachuted to the ground, and was not injured; the occupant of the front seat was killed. The aircraft struck the ground on the Brighton Indian Reservation about 1.5 statute miles west of N8PR. Both aircraft were destroyed during the collision and subsequent ground impact.

None of the surviving crewmembers of REED 11 flight were aware of an impending collision. None saw N8PR before the collision.

<sup>2/</sup> Unless otherwise indicated, all altitudes are above mean sea level.

During a postaccident interview, the pilot who was in the front seat of REED 11 stated, "Just as Avon finished reading the 3,000-foot winds, I noticed a flash past the left side of my radome. By the time I recognized the object as an aircraft, it collided with No. 3, who was on my left wing at the time." The instructor pilot in REED 11 was busy copying weather information at the time of the collision.

The geographic coordinates of the collision were about latitude 27°06'12"N and longitude 81°03'45"W. The main wreckage of REED 13 was located at latitude 27°06'51"N and longitude 81°05'31"W. The main wreckage of NSPR was located at latitude 27°07'01"N and longitude 81°03'29"W. The accident occurred during daylight hours.

1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Passengers</u>	<u>Others</u>
Fatal	2	3	0
Serious	0	0	0
Minor/None	1	0	0

1.3 Damage to Aircraft

Both aircraft were destroyed.

1.4 Other Damage

None

1.5 Personnel Information

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

1.6 Aircraft Information

NSPR was certificated and maintained in accordance with Federal Aviation Regulations. REED 13 was maintained in accordance with U.S. Air Force regulations. (See Appendix C.) The weight and c.g. for both aircraft were within prescribed limits.

1.7 Meteorological Information

The surviving crewmember from REED 13 and the crewmembers from REED 11 and REED 12 stated that REED 11 flight was descending in visual meteorological conditions. There were some towering clouds in the area; however, they stayed clear of them. No one reported any obstructions to visibility.

In its 0900 observation for September 13, 1976, the Nations Weather Service (NWS) station at Palm Beach, Florida, (about 60 nmi east-southeast of the wreckage site) reported a visibility of 7 miles with "towering cumulus and rain showers - all quadrants." In its 1000 observation, Palm Beach NWS reported that the visibility had increased to 10 miles and a "thunderstorm began at 0953, northeast moving north."

The pilot of N8PR was briefed on the weather by telephone from the International Flight Service Station at Miami, Florida. The crewmembers of REED 11 flight had received weather information during their normal preflight briefing.

1.8 Aids to Navigation

Not applicable

1.9 Communications

No communications difficulties were reported; however, there was no UHF guard capability between the Miami Center R-7 sector and REED 11 flight after the flight canceled IFR; the R-7 sector controller did not have UHF guard transmitting capability. This capability was available at a controller position about 15 ft to the R-7 controller's right.

1.10 Aerodrome Information

Not applicable

1.11 Flight Recorders

Not applicable

1.12 Wreckage and Impact Information

Following the collision, N8PR crashed in a wet, marshy field on the Brighton Indian Reservation. The main wreckage, which included the fuselage forward of the aft pressure bulkhead and the right wing and engine nacelle, was upright in a shallow drainage ditch. The right wingtip and tip tank, the fuselage aft of the aft pressure bulkhead, the vertical stabilizer, the tail cone and right horizontal stabilizer, the right engine and propeller, the tip of the vertical stabilizer, and the nose cone were found within 330 feet of the main wreckage.

The remaining components of the aircraft were scattered in an area 1/2 to 3/4 miles southeast of the main wreckage site. The left wing, the left engine nacelle, the left landing gear, and the left tip tank were found in this area. Components of the F-4E were also found in this area, including the right fixed inlet ramp and ramp support, the



right adjustable inlet ramp, an auxiliary fuel tank, the right auxiliary fuel tank pylon, the rear cockpit canopy, the rear ejection seat, and miscellaneous small parts from the right wing and outboard right stabilator.

The main wreckage of the F-4E was found in a swampy area in a **small** pond about 1.5 miles west of the NSPR site. All of the aircraft was in this area except those miscellaneous parts found with the NSPR parts. The only parts from NSPR found in the F-4E main wreckage area were pieces from the left engine cowl. (See Appendix D.)

Smearred paint and adhesive, of colors similar to those on the F-4E wreckage, were found on the left wing, the left engine nacelle, and the left horizontal stabilizer of NSPR. A piece of cloth liner from the baggage compartment of the Cessna 414's engine nacelle was found in the hinge of the F-4E's adjustable inlet ramp.

In tests after the accident, the left engine nacelle's baggage compartment door from NSPR was fitted between the right fixed inlet and the fuselage of a F-4E similar to the aircraft involved in the accident. It was determined that a bank angle of 30° and a track angle difference of about 2° existed between the two accident aircraft when they collided.

Two transponders were found in the wreckage of N8PR. One transponder was set on code 7220 and was in standby position. The National Beacon Code Allocation Plan does not allocate beacon code **7220** for use in the Miami area. The other transponder was damaged in the crash. The transponder was examined at the manufacturer. Examination revealed that the first digit of the beacon code setting was **1**, the second was not identifiable, the third digit was 0, and the fourth digit was 0. It could not be determined if the transponder was operating when the planes collided.

#### 1.13 Medical and Pathological Information

The pilot in the rear seat of REED **13** ejected successfully and was not injured. The pilot in the front seat was killed when his ejection system failed because of damage received in the collision.

Post-mortem examination of the four occupants of **N8PR** revealed that they died of impact trauma suffered either during the collision or on ground impact.

Toxicological examination of the two pilots killed in the accident and a review of the medical records of the surviving pilot revealed no evidence of pre-existing physical problems which could have affected their judgments or performances.

1.14 Fire

There was no evidence of in-flight or ground fire on either aircraft.

1.15 Survival Aspects

For the occupants of NSPR, the accident was not survivable. Since the F-4E was equipped with ejection seats for emergency escape, the accident was survivable for the F-4E crewmembers. However, because the system which operates the ejection seat in the front cockpit was damaged during the collision, the pilot was not able to escape.

1.16 Tests and Research

The Depict Log (DLOG) radar coordinates for REED 11 flight and the code 1200 target determined to be that of NSPR were obtained from Miami Center. These coordinates and the beacon-reported altitude for each aircraft were plotted as a function of radar system time in a calculator program to compute the convergence of the aircraft involved in the collision. The results of the separation computation showed that the target for the lead F-4E (REED 11) and the target for NSPK merged at an altitude of about 12,500 feet.

In addition to target separation, the DLOG radar data were used to calculate the relative position of the lead F-4E and NSPR in terms of the angle between a horizontal plane and the line of sight from the F-4E's to NSPR. The average rate of closure between the aircraft was also calculated. From 55 to 35 seconds before the collision, the aircraft were closing at an average speed of **196 kn**; from 35 to 15 seconds before the collision, the aircraft closure speed decreased to **186 kn**.

The computed data showed that NSPR was located about 22 nmi in front of and 5,500 feet below the lead F-4E, and that their respective courses were diverging when the K-7 controller told REED 11 flight that it was cleared to descend. When REED 11 canceled the IFR clearance for the flight, NSPR was about 30° to the left of the nose of the lead F-4E, and about 5.5 nmi and 4,500 feet below it. After REED 11 flight left Miami Center's frequency and turned 30" to the left, the respective courses of NSPK and REED 11 flight converged at an angle of about 3.2".

The computed data also showed that 55 seconds before the collision, the distance between the lead F-4E and NSPR was 2.8 nmi; 35 seconds before the collision, the distance of separation was 1.7 nmi; and 15 seconds the same distance was .7 nmi. (See Appendix E.)

Because of the limitations inherent in the NAS Stage A radar coordinate data and the mode C altitude readout ( $\pm 100$  feet), the computed minimum separation distances, the times of the selected separations, and the spacial aircraft relationships are considered to be close approximations.

1.17 Additional Information

1.17.1 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, vigilance shall be maintained by each person operating an aircraft so as to see and 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.

(e) 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."

1.17.2 Air Force Regulation 60-16 - General Flight Rules

"Chapter 8 - Instrument Flight Rules (IFR)

8-1 General. The Air Force goal is maximum air operations under IFR. MAJCOMs will establish procedures to insure that all flights are conducted under IFR to the maximum extent possible without unacceptable mission derogation ..."

1.17.3 HAFB SUP 1/TACM 55-4<sup>3/</sup>, Vol. 1, 1 Apr 1976

Chapter 8-53, page 8-17:

"b. The normal sequence of events for clearance onto and off the range is as follows:

(1) Cancel IFR clearance with Miami Center at or prior to PHK <sup>4/</sup> 322/34 (clearance limit fix) when below FL-180 ..."

<sup>3/</sup> Homestead Air Force Base Supplement 1 to Tactical Air Command Manual 55-4.

<sup>4/</sup> Pahokee, Florida VORTAC

1.17.4 Air Traffic Control

NAS en route stage A is operational at Miami Center with radar data processing (RDP) and flight data processing (FDP) available about 20 hours each day. This automated system provides the controller with a capability for automatic display of aircraft identification, assigned altitude, altitude qualifier, reported or mode C <sup>5/</sup> altitude, computer identification, special conditions such as emergencies and handoffs, and a velocity vector which indicates track direction and velocity based on the last tracking calculation. This system enables controllers at Miami Center to identify and track discretely coded and non-discretely coded beacon targets by automatic or manual acquisition.

REED 11 flight was assigned discrete transponder code 4556, with a full alphanumeric data block associated with the target position symbol which was displayed on the plan view display (PVD) while the flight was controlled by Miami Center. The automated radar system continued to process the beacon target for REED 11 after the flight canceled IFR and changed the transponder to code 1200. The Miami Center Data and Analysis Reduction Tool (DART) logged the beacon target with a limited data block which included the transponder code and mode C altitude information as REED 11 flight descended below 17,000 feet.

The R-7 controller at Miami Center was responsible for REED 11 flight while the flight was IFR. The narrowband radar display used by the controller receives inputs from either of two fixed pulse radar search (FPS) air route long-range radar facilities. The FPS equipment is owned by the military but is used jointly and maintained by the FAA. FPS inputs to the R-7 sector at Miami Center are received from Patrick, Florida, (FPS-66), or from Tampa, Florida, (FPS-7). The FPS-66 equipment also provides broadband radar information for use as a backup to the narrowband radar display at the R-7 sector.

The R-7 sector was staffed by the radar controller, a coordinator, and a manual controller. The manual controller was not radar qualified. The controller assigned to the R-7 sector was on duty at the Miami Center from 0730 to 1530. When he signed on the position log at 0945 the RDP equipment was not operational and broadband radar was being used at the R-7 sector. Since he had not yet completed the transition to RDP mode, the controller received a manual handoff on REED 11 flight from the R-5 sector after RDP became operational. He then continued to transition from broadband radar to narrowband radar by starting target-tracks and assigning discrete beacon codes to the aircraft under his control. From 0945 to 0955, the R-7 controller was engaged in 33 computer actions to complete this transition.

<sup>5/</sup> A selectable method or system of interrogation providing automatic altitude reporting capability.

The R-7 sector radar was programmed to display limited data blocks for tracked or untracked (intruder) mode C aircraft operating between 5,000 feet and 24,200 feet. These altitudes represented the lower and upper limits selected by the controller. The controller stated that he did not see a VFR target when he cleared REED 11 flight to 14,000 feet or when REED 11 canceled IFR.

On September 13, 1976, a Sangamo magnetic video tape recording was made on a model 4914 recorder at Miami Center. This video tape recorder was recording raw radar targets including those between 5,000 and 24,200 feet in the area where REED 13 and N8PR collided. On October 8, 1976, the Sangamo video tape was played for review by the Safety Board's investigating team. By slewing in various targets in the area of the accident, REED 11 flight was identified by discrete transponder code 4556. The radar target was tracked first at FL-180 and later in a descent on a northerly heading. Another target with a limited data block displaying code 1200 and mode C altitude information was observed to be on a northwesterly course in the same general direction as REED 11 flight, and climbing. The code 1200 target was acquired in the vicinity of Ft. Lauderdale and maintained 12,500 feet after reaching that altitude. As REED 11 flight descended through 12,500 feet, these two targets merged at a converging angle of  $3.2^\circ$  and the code 1200 target, which had been at 12,500 feet, was no longer recorded on the video tape.

## 2. ANALYSIS

Both aircraft were certificated, equipped, and maintained according to applicable regulations. The gross weights and centers of gravity were within prescribed limits. Neither aircraft's airframe, systems, powerplants, or components were factors in this accident.

The pilots of both aircraft were properly certificated for their respective flights. The pilots in the front seat of each of the F-4E's were students in the F-4E aircraft; however, each was a fully qualified pilot under the direct supervision of a qualified instructor pilot.

Both N8PR and the three aircraft in the REED 11 flight were operating in accordance with visual flight rules in visual meteorological conditions at the time of the accident. In such a situation, it is the responsibility of each pilot, and particularly the pilot-in-command, to maintain the required vigilance to see-and-avoid other aircraft in his immediate vicinity. Because the F-4E flight was overtaking N8PR from the rear and from above, it would have been impossible for the pilot of N8PR to see and thereby avoid the F-4E's. The Safety Board, therefore, concludes that the responsibility to see-and-avoid rested with the pilots of REED 11 flight.

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The Miami Center DART printout and the Sangamo magnetic video tape recording tracked REED 11 flight. The formation flight was positively identified by discrete transponder code 4556. An uncorrelated beacon target squawking transponder code 1200 was also recorded on the DART printout and on the Sangamo magnetic video tape. This beacon target was acquired near the airport from which N8PR departed. A limited data block for this target contained code 1200 and mode C altitude information. The limited data block indicated that this airplane climbed to 12,500 feet and maintained that altitude until the beacon target merged with the beacon target for REED 11 flight. After the targets merged, REED 11 flight was observed entering a left 360° turn. The code 1200 target with the limited data block was dropped.

The Safety Board could not determine positively that N8PR was squawking code 1200 because of the damaged transponder, however, the code 1200 target was acquired near Fort Lauderdale Executive Airport, Florida, and the track was dropped near Brighton, Florida. This coincides with the probable track traversed by N8PR. The damaged transponder found aboard had automatic altitude reporting (mode C) capability. Consequently, the Safety Board concludes that the code 1200 beacon target with the limited data block recorded on the Sangamo magnetic video tape represented the beacon target of N8PR.

The R-7 controller at Miami Center stated that he did not see a VFR target in proximity to REED 11 flight. Because the VFR target believed to be N8PR was within the selected altitude filter limits for the R-7 sector, a mode C limited data block representing the aircraft was probably generated by the RDP system. This system enables the controller to detect tracked or untracked (intruder) aircraft. A VFR aircraft transmitting on mode C within the selected altitude limits normally displays a limited data block on the PVD which includes the aircraft's altitude information.

The D-Log plot showed that the lead F-4E was about 22 nmi from N8PR when the controller cleared the military flight to descend to 14,000 feet. N8PR was level at 12,500 feet and was not relevant traffic even if the controller had seen the VFR target. The controller had no reason to issue a traffic advisory regarding an uncorrelated VFR target at 12,500 feet when he issued an IFR descent clearance to 14,000 feet.

The computed data shows that, when REED 11 canceled the IFR clearance, N8PR was about 5.5 nmi from the lead F-4E, 4,500 feet lower, and on a divergent course. It also showed that had REED 11 flight continued on the 345° heading, it would have passed behind N8PR. Therefore, there was no collision threat at that time, despite the fact that the R-7 controller was unable to determine why he did not see the VFR target which was probably displayed as an uncorrelated beacon target on his radarscope.

The military pilots had a responsibility to clear the area after canceling IFR and before beginning a descent. About 1 minute 40 seconds elapsed between the time REED 11 canceled IFR and the time of the collision. This afforded ample opportunity for the military pilots to see and avoid other aircraft in compliance with the right-of-way rules. The military pilots' responsibility to remain alert for other traffic was not contingent upon their receipt of traffic information from ATC after they canceled IFR.

The issuance of traffic information is an additional service which a controller may provide to aircraft on his frequency when, in the controllers' judgment, their proximity may diminish to less than the applicable separation minima. After REED 11 canceled IFR no separation minima applied with regard to the VFR aircraft. Considering the fact that REED 11 flight turned left 30° and flew for about 1 minute 40 seconds before overtaking NBPR, the Board cannot conclude that the collision resulted from an omission by the controller who had no means of communication with REED 11 or NBPR.

The video tape recording also showed that the beacon target, believed to be that of NBPR, was dropped after it merged with that of REED 11 flight. Because the beacon target with the limited data block indicated that this aircraft was maintaining 12,500 feet, the Safety Board further concludes that NBPR and REED 13 collided at 12,500 feet.

Range availability and low-level wind conditions are essential items of information for military tactical flightcrews en route to the gunnery range. If radio contact is not made with range control (Avon Operations) at least 3 minutes before reaching the VFR holding area, a delay in that holding area is assured. This factor, coupled with a local requirement to descend to 5,000 feet to be below the Lake Placid military operating area, served as an inducement for the flightcrews of REED 11 flight to cancel IFR as soon as possible before reaching the VFR holding area. The Safety Board believes that had the flightcrews been required to remain IFR as long as possible, as specified in AFR 60-16, the potential for the collision would have been reduced. At the least, radio communication would be maintained between the flight and Miami Center so that any conflicting traffic information or emergency instructions could be given to the flight.

The investigation disclosed that the sectors at Miami Center which normally control 31st Tactical Fighter Wing (TFW) aircraft, do not have UHF guard transmitting capability. If a controller at one of these sectors has an urgent message for a 31st TFW aircraft, he must utilize Homestead AFB tower or a local flight service station as an intermediary for transmitting the message on guard channel. After the collision between REED 13 and NBPR, REED 11 contacted Avon Operations on guard channel and apprised the military authorities of the emergency situation. The controller was alerted by an emergency code on his radar display,

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but he was unable to assist or to determine any details of the emergency because he had no UHF guard transmitting capability. Because of the nature of the operations of the 31st TFW and because of the high performance characteristics of the F-4E, the Safety Board recommended that the Miami Center be able to communicate with the 31st TFW pilots on UHF guard channel when necessary.

After canceling IFR, REED 11 flight descended in route formation. The aircraft were spaced 2 to 4 wing-widths apart, and were descending with wings level. In this type formation, the wingmen must divide their attention between cockpit duties, watching for other aircraft, and maintaining position on the lead aircraft. In addition to these factors, the instructor pilots in the rear seats of the aircraft were performing other duties. The instructor pilot in the rear seat of REED 13 stated that he had his "head in the cockpit" and was copying the gunnery range wind information which was being transmitted by Avon Operations when the planes collided. The instructor pilots in the other two aircraft were also looking inside their respective aircraft and were concentrating on copying the range wind information. The Safety Board believes that these conditions effectively reduced the capability of the flight as a unit to clear the area sufficiently; however, it did not relieve them of the responsibility.

No reason could be found for the inability of the pilots in the front seats of the F-4E's to see N8PR. Binocular photographs depicting the cockpit cutoff angles from the F-4E front cockpit showed that, in level flight, a target should be in view up to about 10.5" below and about 10" left or right of the nominal eye reference point when the pilot's seat is in a normal flight position. Analysis of the radar tracks and altitudes of the REED 11 flight and N8PR showed that the maximum downward angular deflection between the two aircraft was about 10.3". When the aircraft is descending, as was the case in this accident, even more of the airspace below the aircraft is within the pilot's view because the nose of the aircraft is lowered to descend in a clean aircraft configuration. Therefore, no part of the aircraft should have obstructed the pilot's ability to see N8PR. Lateral visibility should have caused no problem because 35 seconds before the crash N8PR should have been seen about 3.2° to the left of the vertical line of the lead F-4E's windscreen. It should have been seen in about the center of REED 13's windscreen and about 7° to the left of the centerline of REED 12's windscreen. These angles would have increased if the separation time between aircraft (REED 11 flight and N8PR) was greater than 35 seconds and would have decreased if less than 35 seconds.

Visual detection of N8PR from the F-4E's front cockpits should not have been a problem in this accident because there were no reported obstructions to visibility such as clouds or haze. Also, N8PR was painted white and should have been visible against the blue and green background of Lake Okechobee and its shoreline.



Binocular photographs depicting visibility from the F-4E rear cockpit showed that the occupants of these seats would have difficulty in maintaining adequate forward visibility because of obstructions caused by the front cockpit ejection seat and the rear cockpit instrumentation. The occupant must move his head from side to side in order to see the area ahead of the aircraft; however, with some head movement, the occupant should have been able to see NSPR. Therefore, more importance should have been placed on freeing the instructor pilots who occupied these rear seats from all other duties which would have distracted them from the responsibilities of visually scanning the aircraft's flightpath.

If the pertinent gunnery range information, which is normally received from Avon Operations, could be delivered to the flightcrews by Miami Center while the flight is on the IFR portion of the composite flight plan, there would be less incentive for the flight to cancel IFR before reaching the VFR holding area. The Safety Board believes that the current gunnery range information could be provided to Miami Center by land line. Concurrently, the high performance military aircraft could be kept in positive control airspace and provided separation while this information was being disseminated to them by the Miami Center controller. VFR operations outside of special use airspace would be reduced to a minimum and the flightcrews would be free to devote more time to see-and-avoid activities after canceling IFR.

The Safety Board continues to be concerned with the limitations inherent in the "see-and-avoid" concept of VFR traffic separation--the primary collision avoidance technique used by pilots. This accident again illustrates the care that must be taken and the outside-the-cockpit vigilance which must be maintained by all pilots involved in VFR flight, and in some cases IFR flight, in order to implement the concept to its fullest. All pilots must understand that, when flying in visual meteorological conditions, whether on an IFR or a VFR flight plan, "see-and-avoid" may be the only method by which they may avoid a collision with another aircraft if air traffic control has **not** advised them of any conflicting traffic or in case of an ATC error.

The Safety Board has consistently supported the development and installation of a collision avoidance system, either airborne or ground based, to assist the pilot. This support has been in the form of recommendations to the FAA and testimony in various congressional hearings. As this accident and others in the recent past have shown, the see-and-avoid concept of collision avoidance with its human limitations must be augmented with an automated system to evaluate and resolve potential aircraft collision conflicts.

The FAA, with assistance from the aviation community, has been actively involved in the research leading to the development of one of

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two systems--Airborne Collision Avoidance System (ACAS) or Beacon Collision Avoidance System (BCAS). The current trend is toward the BCAS which will operate in conjunction with current ATC system equipment to resolve a potential collision conflict. In the best interest of safety, the Safety Board favors the development of a low-cost, dependable system at the earliest possible date.

Meanwhile, the FAA continues to pursue other actions which will reduce the midair collision potential which are independent of airborne hardware requirements. Most notable among these actions is the increased usage of ATC through the expansion of positive control airspace and the installation of improved ATC radar with automated tracking capability. Recently the FAA has developed and installed an automated conflict alerting system which works in conjunction with the tracking radar at some ARTCC's. This system will alert an air traffic controller to an impending conflict between airplanes within his assigned airspace. Admittedly, the system is not without limitations. First, it will only provide an alert when both aircraft are beacon equipped and under positive control. Second, it still requires action by the controller to evaluate and resolve the conflict and further, it requires radio transmissions to the airplanes involved. Nonetheless, the systems will provide additional protection.

Immediately after the accident, the 31st Tactical Fighter Wing changed its entry procedures to Avon Park gunnery range. Now, the aircraft maintain 12,000 feet, or an altitude assigned by Miami Center, and maintain their IFR clearance to the clearance limit fix (PHK-322° radial at 34 mi). The Safety Board believes that this procedure will reduce the potential for midair collisions. The Tactical Air Command has adopted procedures similar to the Avon Park procedures at each of its low-altitude ranges and routes throughout the United States.

### 3. CONCLUSIONS

#### 3.1 Findings

1. Both aircraft were certificated and maintained according to approved procedures.
2. All crewmembers were certificated and qualified for their respective flights.
3. REED 13 and N8PR collided in visual meteorological conditions which exceeded basic weather minimums specified for VFR operations.
4. N8PR possessed the right-of-way since this aircraft was being overtaken by faster aircraft.

5. The planes collided at 12,500 feet, as indicated by the DART printout and by the Sangamo magnetic video recording.
6. The F-4E overtook N8PR and struck it from behind separating the left horizontal stabilizer and the left wing.
7. The F-4E was disabled because of damage to its stabilator.
8. The Reed 11 flight pilots were permitted by local standard operating procedures, HAFB Sup 1/TACM 55-4, to cancel their IFR flight plan before arriving at the designated clearance limit fix. This procedure was contrary to AFR 60-16.
9. The Miami Center R-7 sector radar was programmed to display limited data blocks for tracked or untracked mode- C equipped (intruder) aircraft which were operating at altitudes between 5,000 feet and 24,200 feet.
10. The Miami Center R-7 controller stated that he did not notice a limited data block for a VFR target when REED 11 flight canceled its IFR clearance.
11. About 5.5 nmi and 4,500 feet of altitude separated REED 11 flight and N8PR when the flight canceled its IFR clearance. Their respective tracks were diverging.
12. REED 11 flight turned 30" to the left after canceling its IFR clearance and leaving Miami Center's radio frequency.
13. The instructor pilots did not provide adequate supervision of their students during a critical phase of flight--- operating VFR in a formation descent.
14. Essential range information was routinely given to inbound flightcrews by Avon Operations after these flights had canceled their IFR flight plans.
15. Miami Center controllers who routinely handle 31st Tactical Fighter Wing traffic did not have the capability to communicate with these aircraft on guard frequency.

### 3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the pilots of REED 11 flight to maintain adequate vigilance in order to see and avoid the light aircraft.

Contributing to the accident was the inconsistency between Homestead Air Force Base Supplement 1 to Tactical Air Command Manual 55-4 which allowed a VFR descent into the Avon Park gunnery range and Air Force Regulation 60-16 which required all flights to be conducted under IFR conditions unless to do so would result in unacceptable mission derogation.

### 4. SAFETY RECOMMENDATIONS

As a result of this accident, on February 16, 1977, the National Transportation Safety Board recommended that the Federal Aviation Administration:

"Establish direct lines of communication between appropriate air traffic control facilities and military tactical operations so that essential tactical information can be relayed to military flightcrews while they are being afforded instrument flight rules separation in positive control airspace. (Class II - Priority Followup) (A-77-9)

"Assure **UHF** guard-transmitting and receiving capability at all control positions where air traffic control services are provided routinely to military tactical flights. (Class II - Priority Followup) (A-77-10)"

(See Appendix F for FAA's response to these recommendations.)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ KAY BAILEY  
Acting Chairman

/s/ FRANCIS H. McADAMS  
Member

/s/ PHILIP A. HOGUE  
Member

/s/ WILLIAM R. HALEY  
Member

September 16, 1977

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APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The Safety Board was notified of the accident at 1030 on September 13, 1976, by the Federal Aviation Administration. An investigator was dispatched from the Miami Field Office and was joined by investigators from Washington Headquarters. Working groups were established for operations, air traffic control, systems, and structures. The Federal Aviation Administration, the Department of the Air Force, the McDonnell Douglas Corporation, and the Aircraft Owners and Pilots Association participated in the investigation. The on scene portion of the investigation was completed on September 23, 1976.

2. Hearing

There was no public hearing.

APPENDIX B

PERSONNEL INFORMATION

Mr. Patrick G. Ruel

Mr. Patrick G. Ruel, 49, the pilot of N8PR, held private pilot certificate No. 2181036, with airplane single- and multi-engine land ratings. He also held an instrument rating. His third-class medical certificate, dated March 10, 1976, had no limitations.

Mr. Ruel had a total of 798 flight-hours, 266 of which were in the Cessna 414. He had a total of 233 flight-hours as pilot-in-command. He had received 33 flight-hours of dual instruction in the Cessna 414.

First Lieutenant Gregory P. Mellor

Lt. Gregory P. Mellor, 23, was the pilot trainee who occupied the front seat of REED 13. He held a USAF pilot rating and was medically qualified with no limitations. He had a total of 293.2 flight-hours, 49.9 of which were in the F-4E. He had 42.3 flight-hours in the 90-day period before the accident. Lt. Mellor graduated from U.S. Air Force pilot training December 8, 1975.

Major Thomas W. Mehlhaff

Major Thomas W. Mehlhaff, 35, was the instructor pilot in the rear seat of REED 13. He held a USAF pilot rating and was qualified as an instructor. He was medically qualified with no limitations. Major Mehlhaff had a total of 2,591.8 flight-hours, 1,742.3 of which were in the F-4E. He had 26.1 flight-hours in the 90 days before the accident. He had passed an instrument/instructor check flight on August 30, 1976.

APPENDIX C

AIRCRAFT INFORMATION

N8PR

N8PR was a Cessna Aircraft Company Model 414, serial number 414-0254, equipped with two Continental TSI0-520-J, six cylinder, air-cooled, horizontally opposed, fuel injection turbo-supercharged engines. The aircraft's total time, as of September 12, 1976, was 1,536 flight-hours. The date of the last annual inspection was October 2, 1975. The engine information is as follows:

Engine	No. 1	No. 2
Serial No.	L208262J	R208263J
Total time	1,536	1,536
Time since overhaul	382 hrs.	382 hrs.
Date of last.		
100-Hour inspection	5/25/76	5/25/76

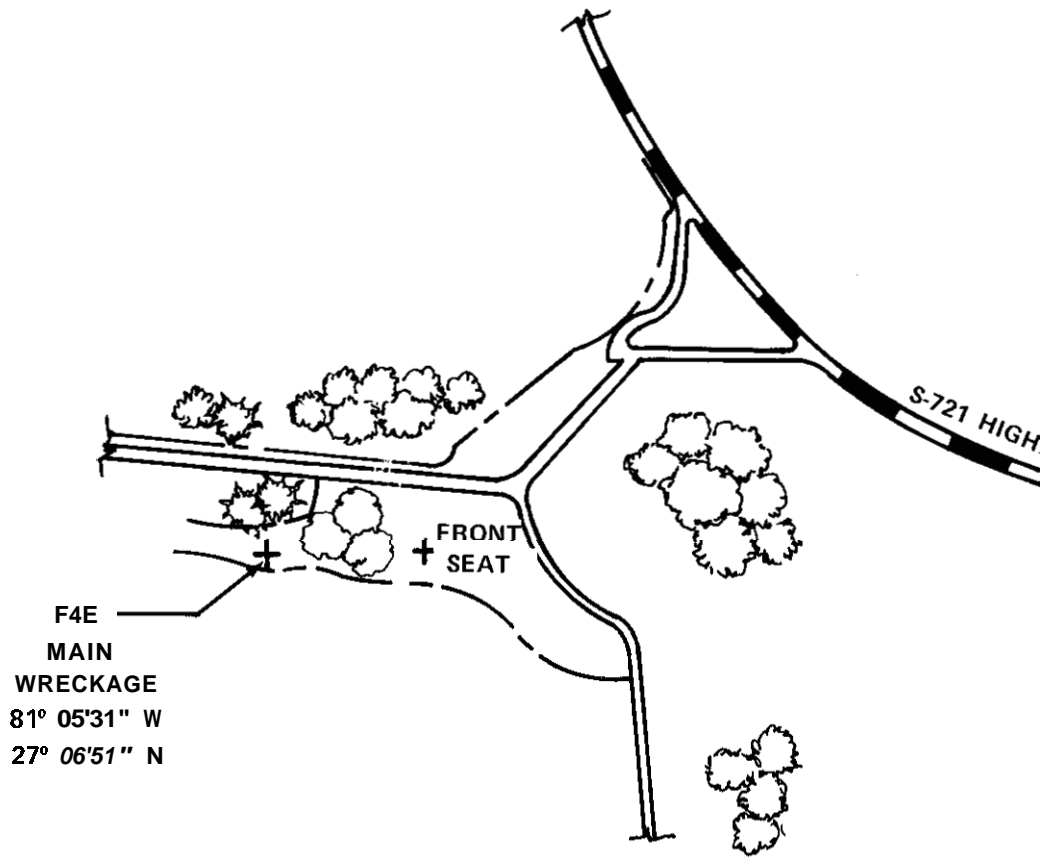
REED 13

REED 13, serial number 67-0255, was a McDonnell Douglas Corporation F-4E "Phantom II," twin-engine, two-place, all-weather, supersonic, jet-propelled U.S. Air Force fighter. The aircraft's total time as of September 12, 1976, was 2,747.7 flight-hours. It was powered by two axial flow General Electric J79-GE-17A jet engines. The engine information is as follows:

Engine	No. 1	No. 2
Time since last	(hrs.)	(hrs.)
major overhaul	1,069.9	404.5
Time since last		
100-hour inspection	22.7	22.7

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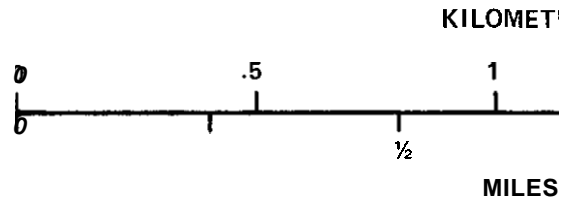


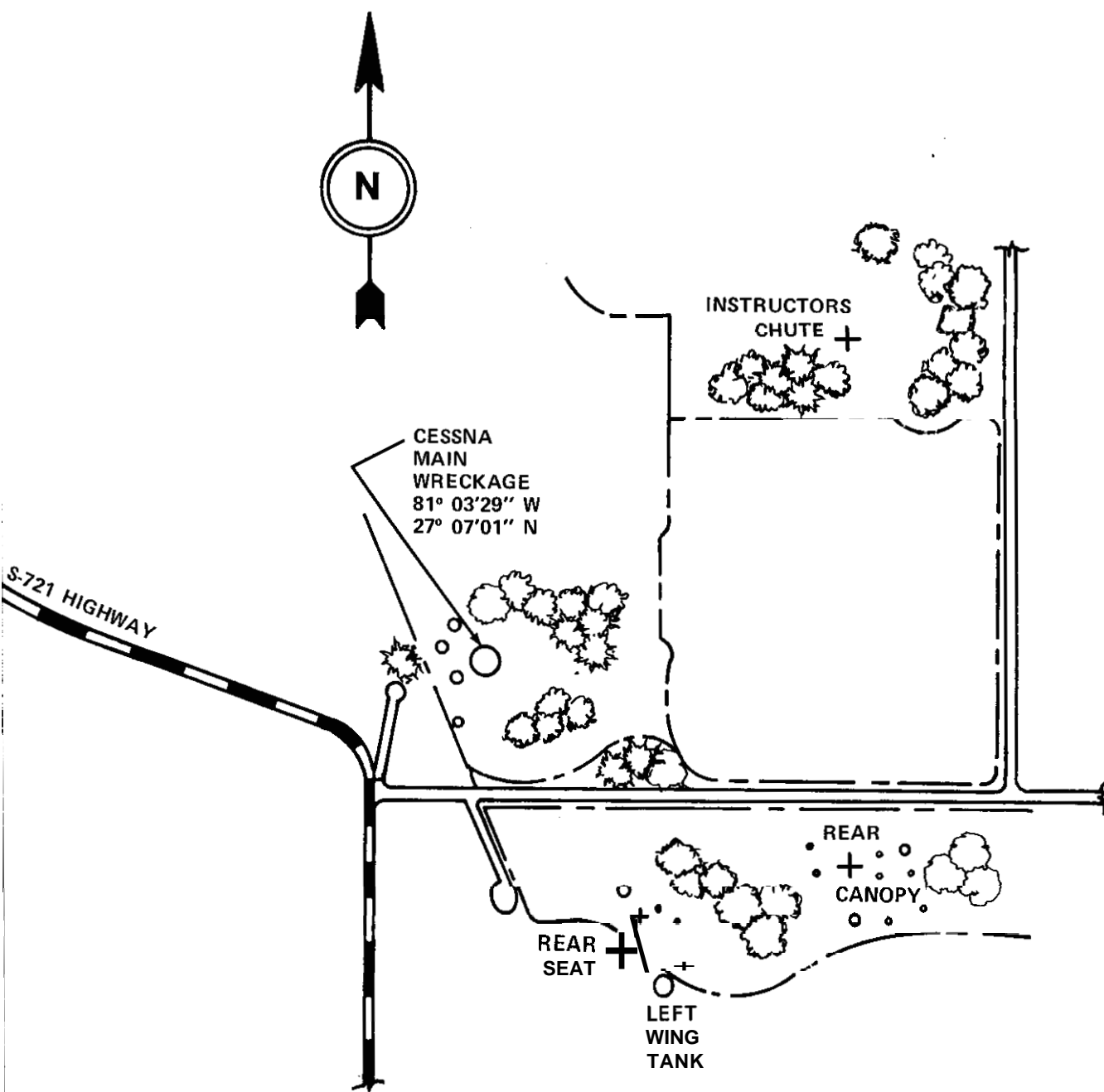
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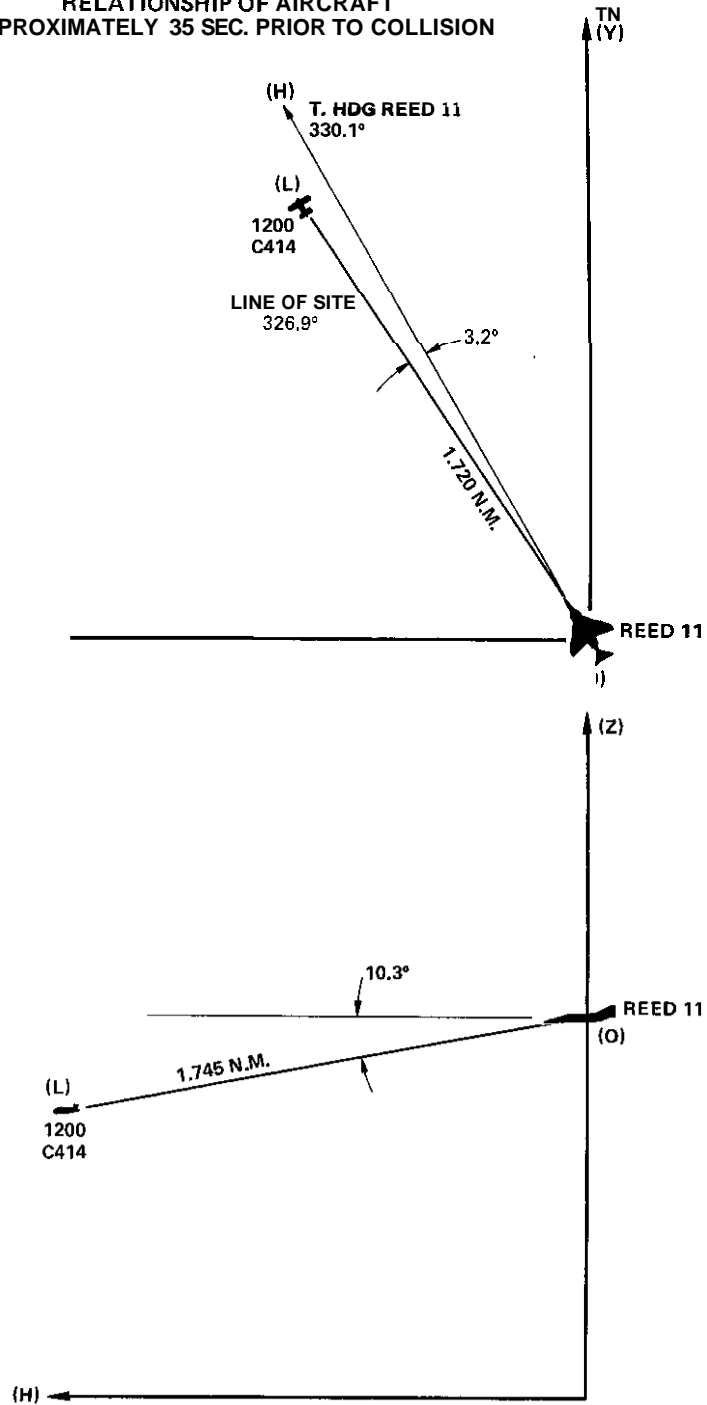
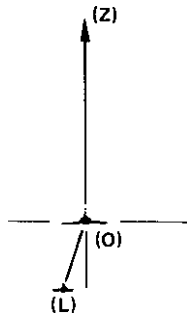
NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.

WRECKAGE DISTRIBUTION CHART  
AIR FORCE F4 E, 67255 & CESSNA 414, N8 PR  
BRIGHTON INDIAN RESERVATION, FLORIDA  
SEPTEMBER 13, 1976

APPENDIX E

RELATIONSHIP OF AIRCRAFT  
APPROXIMATELY 35 SEC. PRIOR TO COLLISION

RADAR SYSTEM TIME  
135325.01GMTI



SCALE: 1:36457      1" = 0.5 N.M.

APPENDIX F

DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION

WASHINGTON, D.C. 20590



OFFICE OF  
THE ADMINISTRATOR

April 26, 1977

Honorable Webster B. Todd, Jr.  
Chairman, National Transportation Safety Board  
800 Independence Avenue, S. W.  
Washington, D. C. 20594

Dear Mr. Chairman:

This is in response to the National Transportation Safety Board recommendations resulting from the collision between a Cessna 414 and a United States Air Force F-4E Phantom II Fighter near Brighton, Florida. The following comments and actions to the recommendations are provided:

A-77-9. Establish direct lines of communication between appropriate air traffic control facilities and military tactical operations **so** that essential tactical information can be relayed to military flight crews while they are being afforded instrument flight rules separation in positive control airspace.

NONCONCUR. Although we concur with the intent of the recommendation, we do not agree with the proposed method of implementation. Requiring air traffic control facilities to relay tactical information to military flight crews could seriously derogate the controller's ability to provide essential ATC services to other users. We are initiating action, with the Department of Defense, to explore alternative methods of accomplishing the intent of this recommendation without amplifying the crucial problems associated with frequency congestion.

A-77-10. Assure ultrahigh frequency (UHF) guard-transmitting and receiving capability at all control positions where air traffic control services are provided routinely to military tactical flights.

PARTIAL CONCURRENCE. We recognize the concern for increasing UHF guard-transmitting and receiving capabilities. However, past experience has taught us that increasing the number of UHF guard sites can create a problem that derogates our capability to communicate **on 243.0 MHz**. The problem occurs when two or more sites cannot hear each other transmitting due to terrain, shielding, etc. Since they cannot receive each other, they could attempt to respond to aircraft transmissions simultaneously, creating interference or garbling which effectively blocks all transmissions. This condition could completely negate our capability to respond to the aircraft **in** distress.

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Currently, we have methods, other than direct pilot/controller capability, of communicating with aircraft on 243.0 MHz, i.e., relaying through FAA terminal facilities, flight service stations, or military facilities. These methods have proven to be both reliable and effective. In any event, any extensive increase in UHF guard capability at control positions would require careful evaluation on a cost versus benefit basis.

We are currently investigating the possibility of configuring one Backup Emergency Communications UHF controller station per center's area of specialization (where there is significant military activity) to cycle to 243.0 MHz rather than the sector discrete frequency. We believe that this will significantly increase our UHF guard capability.

Sincerely,

/s/ Quentin S. Taylor  
Acting Administrator