THE COMBAT EDGE

AUGUST 1996

CFIT

Contolled Flight Into Terrain

See page 4

The Combat Edge

AIR COMBAT COMMAND
SAFETY MAGAZINE

Gen Richard E. Hawley
Commander

Col "Turk" Marshall
Chief of Safety

Ron Smith
Editor / Art Director

Barbara Taylor
Awards Administrator

SrA David White
Electronic Design & Layout

The Combat Edge (ISSN 1063-8970) is published monthly by the Air Combat Command, HQ ACC/SE, 130 Andrews St Ste 301, Langley AFB VA 23665-2786. Second-class postage paid at Hampton VA and additional mailing offices.
POSTMASTER: Send address changes to *The Combat Edge*, HQ ACC/SEP, 130 Andrews St Ste 301, Langley AFB VA 23665-2786.

DISTRIBUTION: F(X). OPR: HQ ACC/SEP. Distribution is controlled through the PDO based on a ratio of one copy per ten persons assigned. Air Force units should contact their servicing PDO to establish or change requirements. Other DOD units have no fixed ratio and should submit their requests to the OPR.
ANNUAL SUBSCRIPTIONS: Available to non- DOD readers for $22 ($27.50 outside the U.S.) from the Superintendent of Documents, PO Box 371954, Pittsburgh PA 15250-7954. All subscription service correspondence should be directed to the Superintendent, not HQ ACC/SEP.
CONTRIBUTIONS: Articles, comments, and criticisms are welcome. Write:

Editor, *The Combat Edge*
HQ ACC/SEP
130 Andrews St Ste 301
Langley AFB VA 23665-2786

Telephone: (804) 764-3658
DSN 574-3658
FAX: (804) 764-6362
E-Mail: smithr@hqaccse.langley.af.mil

CONTENTS

AUGUST 1996

ACC SP 91-1 VOLUME 5 ISSUE 3

FEATURES

DEPARTMENTS

The aircraft on the cover is an *RC-135 COBRA BALL*. There are two of them in the inventory and they both are assigned to the 45th Reconnaissance Squadron, 55th Wing at Offutt AFB, Nebraska. The *COBRA BALL* is deployable worldwide on short notice and flies missions that are JCS directed to collect data on strategic weapon systems capabilities. Data collected is critical to National Command Authorities, Arms Treaty Verification, U.S. Strategic Defense concept development, and Theater Missile Defense applications. COBRA BALL missions have been flown since the late 1960s.

Photo courtesy of Captain Paul A. Gallaher, 55 WG/SEF, Offutt AFB.

ACCent on Safety

Accent on Safety

As this issue goes to print, people are well into summer activities with families and friends. Most of our co-workers are intent on enjoying the warmer weather, longer days, and increased opportunities for outdoor functions. In general, its easy to say they have a focus for their activities. We all share the responsibility to ensure that this focus includes an emphasis on conducting activites safely. We do this by stressing proper training, use of safety equipment and knowledge about the hazards associated with the activities. This includes everything from off-duty sports to launching and flying aircraft. Let's stay focused on making this the safest "101 Critical Days of Summer." Together, we can make a difference. The life you save may be your own.

Our safety focus for this issue of *The Combat Edge* concerns the often fatal subject known as "Controlled Flight Into Terrain (CFIT)." Recently, a fighter pilot friend of mine and I were discussing this very issue when he related an incident he had which bears retelling. It goes like this:

"Not too long ago, I was leading a 12-ship surface attack tactics mission against eight Defensive Counter Air (DCA) adversary aircraft. Just after offensively engaging one adversary, I got 'spiked' by another; instinctively, I began a radar missile defense at low altitude. Continuing to notch, I spent the majority of my time looking for a tally on the aircraft pointing at me. After what seemed an eternity, I finally got a tally on the adversary pressing the attack. As I notched that 'hostile dot,' I was surprised at how well he was pure-pursuiting me — no drift on the canopy — and was also surprised at how long it was taking him to close. A few more degrees of turn and I was able to identify the aircraft I was reacting to — it was an aerial gunnery DART sticking straight up out of the desert! It was only then that I realized how low I was — less than one hundred feet — well below my low-altitude step down training (LASDT) minimums. That was all I had for that day. I knocked it off, circled the wagons, landed, and cleaned out my flight suit."

Fortunately for my buddy, this experience was only a close call and not a fatal event. A quick review of CFIT history shows there are too many black pock-marks scattered over military training areas where other folks weren't so lucky. In spite of the high-dollar, high-tech equipment we fly, there are still too many cases of controlled flight into the terrain. Regardless of your aircraft, we will continue training at low altitude. As a result, we need to stay vigilant to the inherent hazards of low altitude flight, whether they be encountered on the tactics range or on final approach. Our review of CFIT covers elements common to these accidents, training, education, and systems available to better our odds in the game. Although the first article, "Avoiding Controlled Flight Into Terrain," has a civil aviation slant to it, the information in it still applies to a lot of what we do each day. In fact, several factors that play a role in CFIT accidents — lack of vertical or lateral situation awareness, complacency, visual illusions, and fatigue, for example — unfortunately sound very familiar to military aviators. The second article describes the Digital Terrain System (DTS), which provides both visual and aural cues to minimize the occurrence of CFIT in the F-16. Systems like DTS and LANTIRN — combined with an appropriate LASDT program — will certainly enhance our survivability in the low-altitude environment. Automation and enhanced training can alleviate much of the pilot's workload; yet we must still stay focused on the impact of long hours and the high ops tempo of today's Combat Air Force. The ultimate responsibility still rests with the pilot at the controls, so be sure you're ready before you sign up for that sortie. Know the rules. Have a plan. Be vigilant. Fly Smart.

Lt Col John "Kid" Davee
Chief of Flight Safety

Reprinted with permission from <u>Airliner</u>, Apr-Jun 1996

It is just before 11:00 pm on a cloudy evening. The flight crew is maneuvering around the typical thunderstorm buildups prior to a routine approach that will end yet another long day.

Suddenly, and quite unexpectedly, the still of the evening is interrupted by the loud wail of a ground proximity warning. The "Whoop Whoop, Pull Up!" startles the crew.

Immediately, dozens of questions go through their minds:

- *What's the Minimum Safe Altitude?*
- *How far off the airway are we?*
- *What's the DME?*
- *What's going on?*

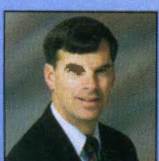
Finding answers to all these questions takes time — time that's not available.

The Captain then reacts decisively. He pulls up to avoid the terrain, but it is too late. The jetliner strikes the side of an 8,000-foot mountain, killing all 190 people aboard.

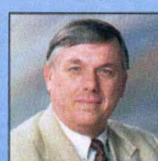
Although this accident didn't actually happen, the scenario described above points out a situation flight crews can face that can cause Controlled Flight Into Terrain (CFIT). CFIT accidents have historically been a major contributor to airplane hull losses and fatalities.

No doubt about it, CFIT is a hazard — and it can happen to you. However, CFIT is also preventable.

Avoiding Controlled Flight Into Terrain



Captain Dave Carbaugh
Chief Pilot, Flight Safety
Flight Training
Boeing Commercial Airplane Group



Captain Skip Cooper
Technical Pilot, Special Projects
Flight Training
Boeing Commercial Airplane Group

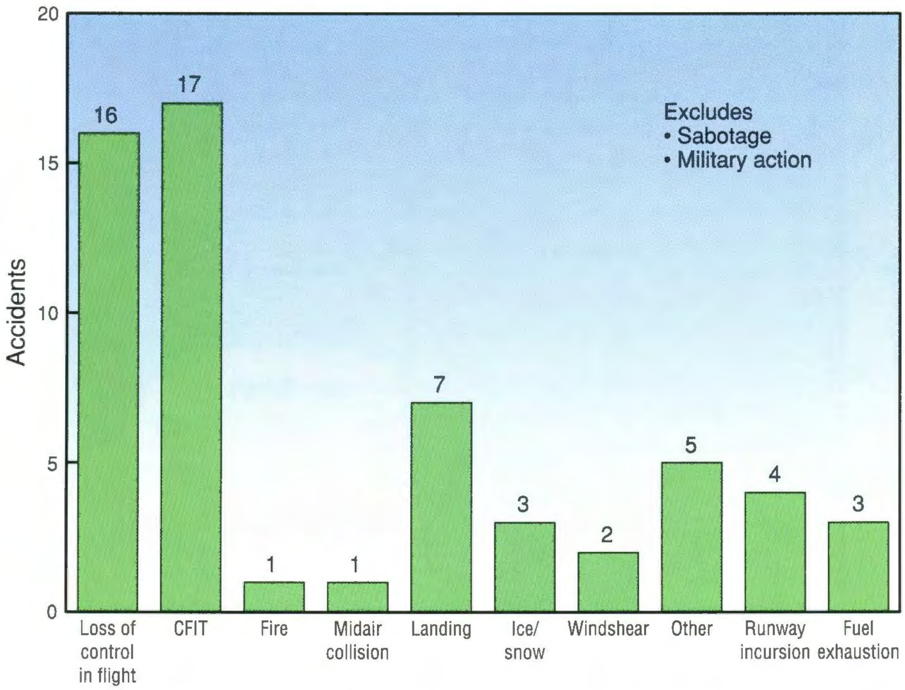


Figure 1. Controlled Flight Into Terrain accounts for the vast majority of fatalities from commercial airplane accidents. This data, from 1988 through 1995, show the number of fatal accidents by accident type. Loss of airplane control is also a significant factor.

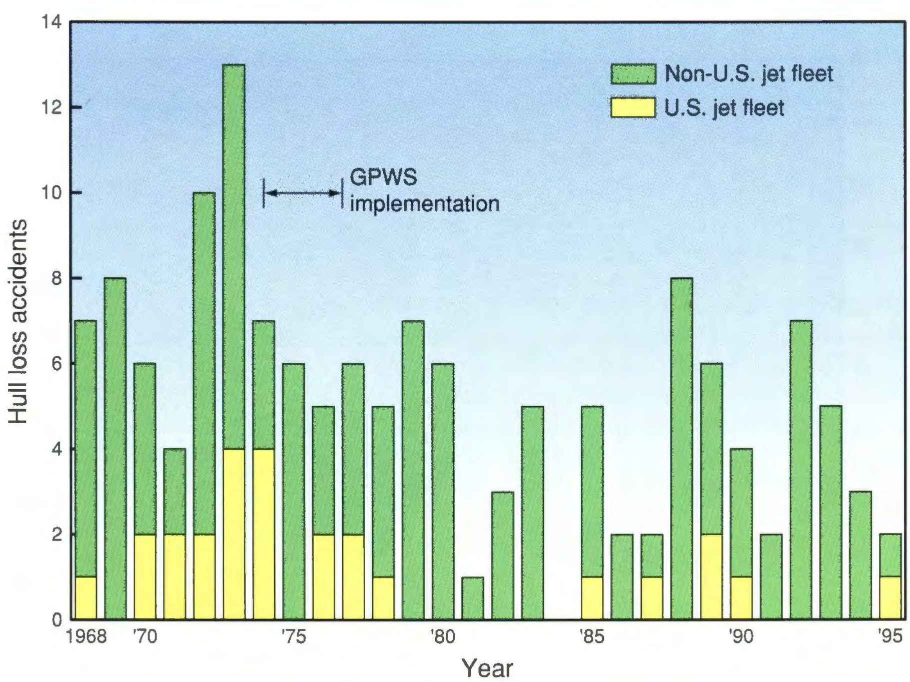


Figure 2. Since 1968, there have been 144 jet transport CFIT hull loss accidents worldwide. When the Ground Proximity Warning System was mandated in the late 1970s, the accident rate fell dramatically. The CFIT hull loss rate has been relatively constant since then.

This article will describe the history of CFIT — and look at several actual CFIT situations, incidents, and accidents, as well as the factors that contributed to them. The article will discuss the new CFIT Education and Training Aid, which resulted from an industry-wide effort to increase knowledge and awareness, and reduce accidents and hull losses (Figures 1 and 2). And, the article will look at the future of CFIT prevention.

History of CFIT

First, what is Controlled Flight Into Terrain? Simply put, it is an accident that occurs when an airplane is inadvertently flown into terrain (or water).

Controlled Flight Into Terrain is as old as flight itself. Consider this:

- In the days of propeller-driven commercial airplanes, fully half of the accidents were attributable to inadvertently hitting the ground.
- Since the dawning of the commercial jet age in the late 1950s, more than 9,000 people have died worldwide in commercial aviation CFIT accidents.
- Before 1975, the loss rate of large commercial jet airplanes to CFIT in the United States was about 0.6 airplanes per 1 million departures. These numbers equate to more than four CFIT accidents each year at today's rate of departures.
- In the United States after 1975, large jet transport accidents attributable to CFIT fell to an average of only one every two years.

Why did the CFIT accident rate drop so dramatically? A brief history lesson provides the answer.

In the early 1970s, Scandinavian Airlines System (SAS) originated the concept of a Ground Proximity Warning System (GPWS) that would alert the pilot of imminent flight into terrain. Using existing radio altimeters and air data computers, Allied Signal (then Sundstrand Data Control) developed a cost-effective, practical device to install in airplanes.

In late 1974, one accident caused repercussions that continue to this day. A Boeing 727 on an approach to Dulles Airport in Washington, D.C. struck the top of a ridge only 20 miles from the airport. The airplane impacted just 50 feet below the crest of the hill. More than 90 people died. This accident prompted the U.S. Federal Aviation Administration (FAA) to enact regulations requiring all large jet and turbo-prop airplanes to have GPWS by the end of 1975 (Figure 3). Essentially, these regulations covered all turbine-powered airplanes that carry more than 30 passengers, or 7,500 pounds of freight.

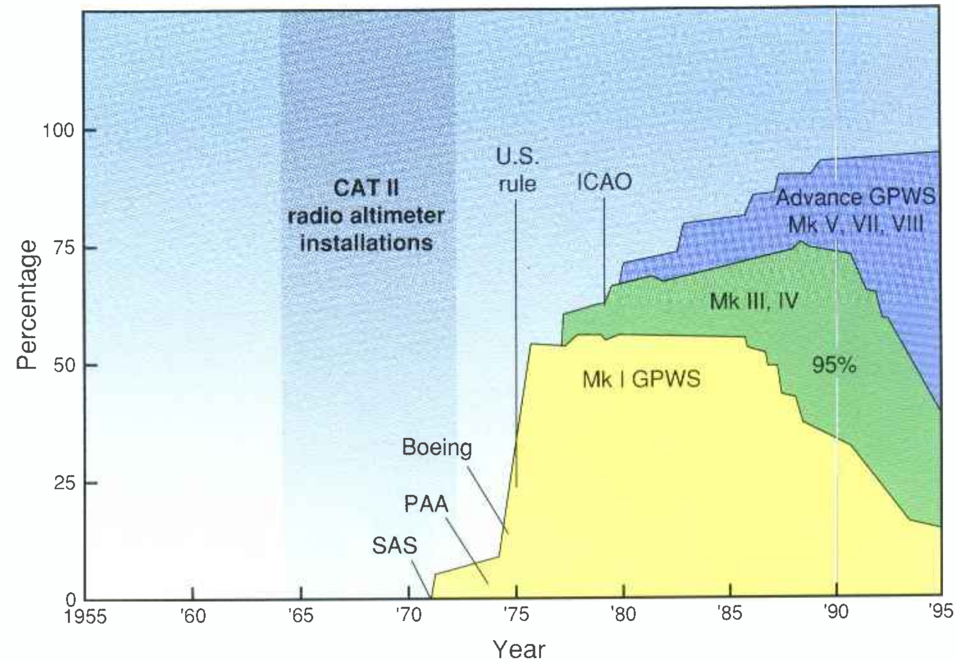


Figure 3. This chart shows the installation history of GPWS on large commercial airplanes. Today, more than 98 percent of the world's fleet has GPWS. The older model GPWS units (Mark I, III & IV) are being phased out in favor of more advanced models.

The quick response time caused CFIT losses in the United States to begin dropping significantly and continuously (Figure 4). In 1975, after thorough evaluations and flight testing, the Civil Aviation Authority in England also mandated GPWS installation in all large commercial jet airplanes. And, in 1979, the International Civil Aviation Organization implemented GPWS standards. All of these changes were responsible for beginning to significantly reduce CFIT losses worldwide.

Before 1975, there were about eight jet transport CFIT accidents each year worldwide. Because of the huge increase in air travel in recent years, these accident figures would be much higher today — if the aviation community had done nothing.

The rate of CFIT accidents in the United States has dropped from 0.6 per million departures to 0.1 per million departures from 1975 to today. This is a reduction by a factor of six. During this time, the flight sectors have doubled. This is a reduction of accidents per year by a factor of 12.

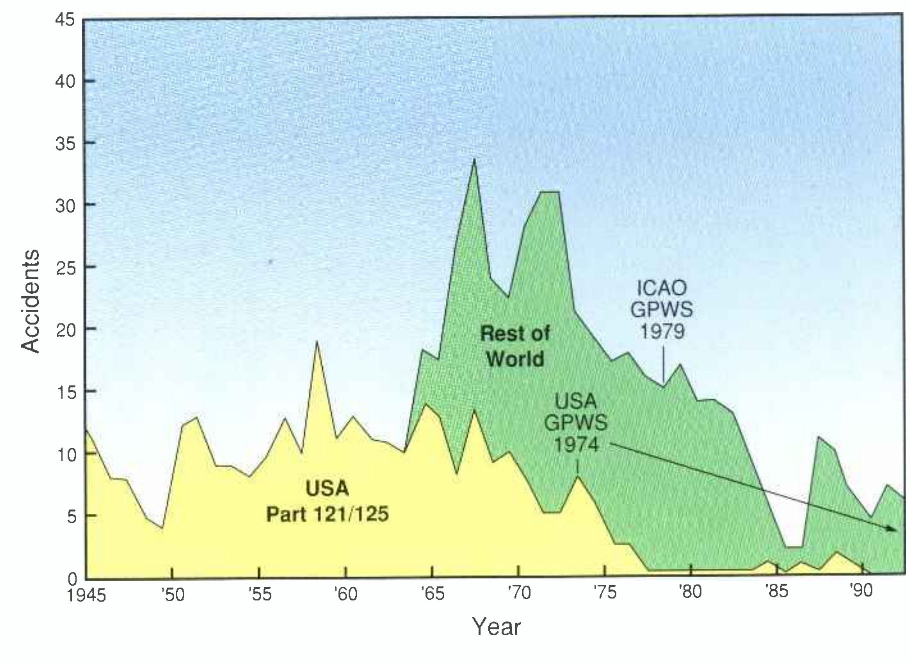


Figure 4. This chart shows the number of CFIT accidents each year worldwide from the mid-1940s through 1995 — for both large commercial airplanes and turbo-prop transports. Regardless of the type of airplane, having GPWS installed reduces the CFIT risk.

CFIT accident risks and rates seem to depend on the type of airplane operation; historically, fewer large commercial jetliners are involved in CFIT accidents than are regional airlines, business jets, or turbo-props (Figure 5).

Not only is the CFIT risk higher for regional airlines, business jets, and turboprops, these airplanes constitute the vast majority of the total airplanes in commercial service. These operators occasionally fly into some very mountainous terrain with limited air traffic control (ATC) radar coverage.

Recently, the FAA required all turbine-powered airplanes that carry more than 30 passengers, or 7,500 pounds of freight, to have GPWS equipment installed on their airplanes. While CFIT rates for large commercial airplanes have been steadily declining, regional airlines and business jets have consistently lost an average of three airplanes per year in CFIT accidents. That means regional airlines, business jets, and turbo-props — operating in essentially the same ATC and nav aid environment as larger airplanes — have a CFIT risk as much as 40 times greater than for large jets.

Type of operation	CFIT risk	Relative CFIT risk
Part 121 Airline	0.1 aircraft lost per million flights inside/ outside North America	1
Part 135 Regional	2.0 aircraft lost per million flights	20
Part 91 Business jet	2.2 aircraft lost per million flights inside/ outside North America	22
Part 91 Turbo-Prop	4.3 aircraft lost per million flights	43

Figure 5. The relative CFIT risk varies with the type of airplane and operation. The risk shown for regional airlines, business jets, and turbo-props is higher because those operations have more takeoffs and landings per day, and fly in and out of less controlled airspace.

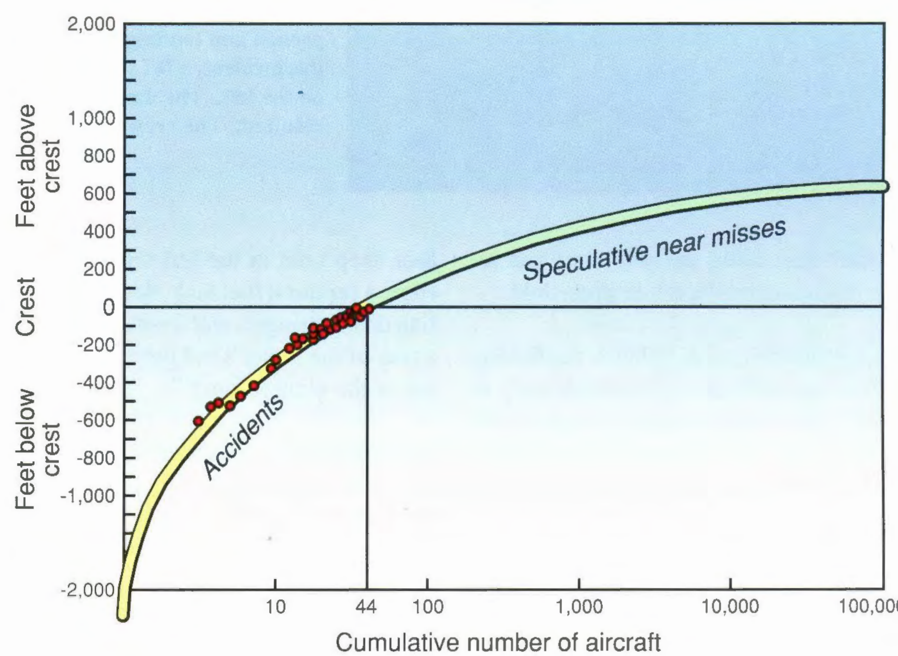


Figure 6. There are many more incidents than accidents. While most CFIT accidents are reported and investigated, very few CFIT *incidents* are reported. When mountainous terrain is involved, the accident site is usually 300 feet or less from the crest of the hill.

Case Studies

There are many more incidents than accidents (Figure 6). Incidents where CFIT is narrowly avoided are called Controlled Flight *Toward* Terrain (CFTT). These incidents (CFTT) would have become accidents (CFIT) without the intervention of someone, or something. Here is an example of this intervention: a Captain notices the First Officer is allowing the airplane to descend below the Minimum Safe Altitude. The Captain mentions this, and the airplane then returns to a safe altitude.

Now, we'll present three actual case studies involving CFIT or CFTT. Later in this article, we'll use various aspects of these case studies to illustrate some common factors that contribute to Controlled Flight Into Terrain accidents and Controlled Flight Toward Terrain incidents.

Case Study #1. It is just after 10:00 pm local time. The crew receives a departure clearance from an air traffic controller who uses non-standard phraseology. The crew doesn't fully understand the clearance. The air traffic controller does not challenge the flight crew's incorrect readback. Instead of using the modern "glass" cockpit to their advantage, the crew enters the first reporting point into the flight management computer,

Figure 7. While most CFIT incidents and accidents occur during approach and landing, this shows what can happen during departure. In this incident, a 767 struck the very top of the communication tower shown on the left. The damage to the wing, shown in the photo above, is what resulted. The crew was able to safely return to the departure airport.

rather than using the published and required standard departure procedure.

After takeoff and at 750 feet, the Boeing 767 crew turns and proceeds directly to their first reporting point, which is 150 miles from the departure airport. They retract the gear and flaps without incident and accelerate the airplane to 250 knots. Less than two minutes into the flight, the Mark V GPWS warnings begin: "Terrain! Terrain! Pull Up! Pull Up! Terrain! Terrain!"

The First Officer responds with a gentle pull up from 9.3 to 12.5 degrees. After gaining 200 feet, he lowers the nose to 11.2 degrees, just before the airplane's left wing clips the last 20 feet of a 300-foot uncharted tower — on top of a 3,000 foot mountain! After the incident, the crew raises the nose to 16.9 degrees and applies full thrust.

The airplane returns to the departure airport, and lands with a six-foot long, two-foot deep hole in the left wing leading edge, a ruptured fuel tank, damage to the flap drive, stringers and front spar — and a scar of the tower's red paint across the top of the wing (Figure 7).

Case Study #2. The Boeing 727 is on an 18 nautical mile final approach for a daylight landing. The flaps are at 25 and the gear is *up*. The airplane was recently fitted with TCAS (Traffic Alert and Collision Avoidance System) to comply with FAA directives. During the last portions of the approach, there are numerous TCAS warnings that add to the busy cockpit routine of checklists, announcements, and radio communications in a high-density traffic area.

As the airplane passes 500 feet AGL, the Mark I GPWS (the earliest model) calls out "Pull Up! Pull Up!" The Flight Engineer then silences those warnings by pulling the circuit breaker. The crew reviews descent rate, glideslope, and flap position as they continue to descend toward the runway. The airplane behind this flight notices something strange and notifies the tower.

At 50 feet, the tower tells the crew to go around. The Captain adds power and raises the nose to the go-around attitude, but it is too late. The airplane slides along the runway, tearing off the lower navigation and communication antennas — because the landing gear is still retracted!

Case Study #3. A BeC99 crew is cleared for a daylight localizer approach. The weather at their destination is 700-foot scattered, 1,500-foot broken, 4,000-foot overcast, and 3 miles visibility with fog and rain. While this doesn't sound like good weather, it is more than adequate for the approach.

The Captain, who recently upgraded into this type airplane, had extensive flying time in helicopters. His actual instrument time was limited. When he starts the approach, somehow he turns the airplane in the wrong direction and ends up flying outbound on the localizer course, instead of toward the airport.

The crew doesn't notice the increasing distance, nor the exceptionally long time during the descent as they descend toward minimums. Approximately halfway down the approach, the Captain senses something is wrong. His voice is later heard on the cockpit voice recorder saying, "Let's go around." The First Officer replies, "Get it down to eleven hundred." There is no further conversation.

The first impact with the terrain — two minutes later — occurs at 1,860 feet, 7 miles from the runway. The airplane had no GPWS; it was not required equipment at the time. Three of the six on board are killed in the crash, including the Captain. It was his first revenue flight.

Factors Affecting CFIT Accident Rates

There are no causal factors that are inherently specific to CFIT. However there are human factors that contribute to CFIT accidents and incidents.

Human factors associated with CFIT accidents usually include errors, violations, and mistakes by operational personnel — both aircrew and air traffic control. These human factors generally have immediate consequences.

Here are some of the common factors that contribute to CFIT accidents. These factors, which tend to be cumulative in effect, include both human and other factors:

- Vertical Profile Errors.
- Weather.
- Poor Pilot Response.
- Aircrew Complacency.
- ATC Communications.
- Failure to Monitor or Manage the Autoflight System.

Now, we'll describe these common CFIT factors in greater detail. Below each factor, we'll show how it played a role in our case studies.

Vertical Profile Errors. Over the years, more than two thirds of all CFIT accidents are the result of altitude error or lack of vertical situational awareness. The causes include lack of pilot understanding of ATC clearances, misreading approach charts, or poor altimeter-setting procedures. Many of these flights are on course, just at very low altitudes (Figures 8 and 9).

- ***Case Study #1:*** *Because the airplane proceeded direct, it didn't have the climb gradient to clear the tower.*
- ***Case Study #3:*** *There was no check of vertical height for longitudinal distance traveled.*

Weather. Weather and visibility usually play a role in CFIT accidents. Low ceilings, poor visibility, or night operations are almost always present when a CFIT accident or incident takes place. How the flight crew deals with these occurrences depends on how well they are trained, how closely they adhere to cockpit procedures, and how well the ap-

Future Equipment Enhancements to Prevent CFIT

Beyond human factors, equipment plays a large role in helping to prevent CFIT accidents and incidents. Navigation aid improvements are being made, including:

- More ILS (instrument landing system) facilities.
- Lighting improvements.
- GPS (Global Positioning System) -related improvements.
- D/GPS (differential GPS) capability.

Many ATC (air traffic control) facilities are upgrading their radar capabilities to include terrain awareness and warning.

Airplane improvements have helped, too. The number of airplanes that have an updated GPWS continues to grow; as a result, there are fewer airplanes each day flying *without* GPWS.

Display developments have greatly improved situational awareness. This is further enhanced by GPS updating to flight management systems.

Exciting new systems are now in development; some are already available. Forward-looking, database-driven GPWS is now being tested. It provides pop-up displays and improved warning times. Vertical situational displays provide improved vertical data. Sensors continue to improve with new innovations and capabilities.

Technologically, airplane equipment could someday reach the point where the pilots' displays give the same picture as they would have in daylight VFR conditions. The reality of the laboratory may spell the end to CFIT accidents: pilots are less likely to run into terrain they can "see."

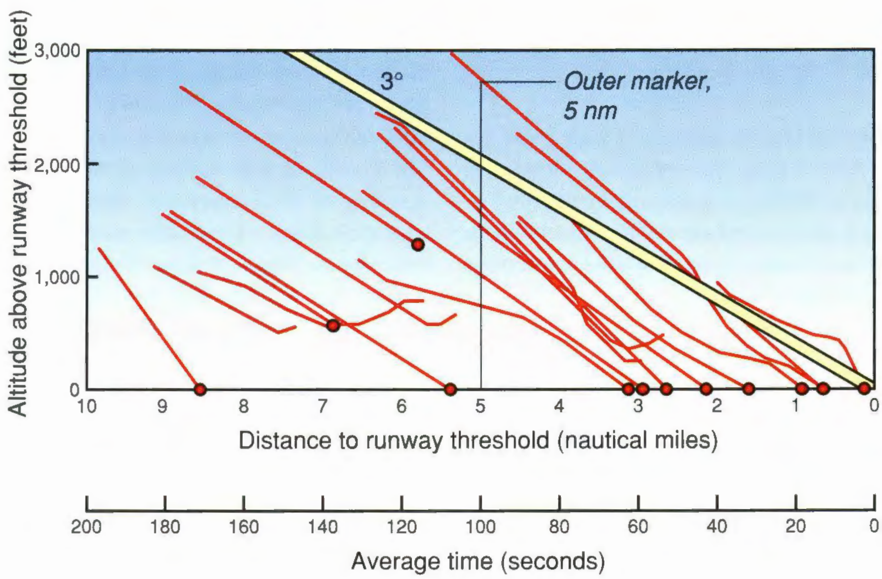


Figure 8. In an analysis of 40 CFIT accidents and incidents, data show the vertical flight profile was relatively stable — until the airplane crashed or escaped. Most of these accidents occurred during non-precision approaches, at night, and during instrument conditions.

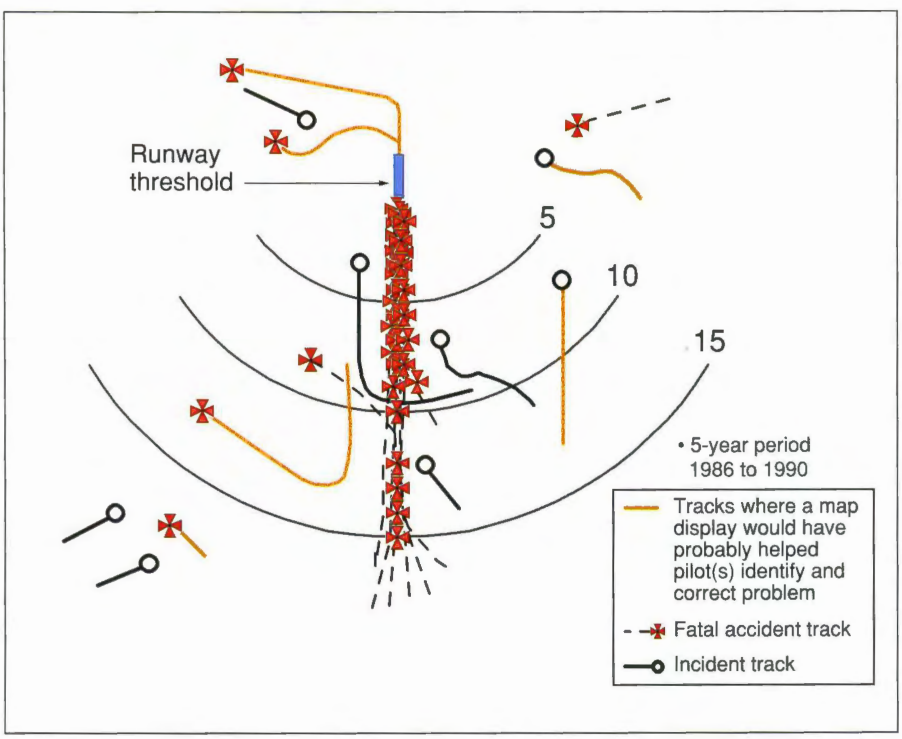


Figure 9. This is the lateral profile of the same 40 accidents and incidents shown above. Many of these accidents and incidents occurred within 15 miles of the intended landing airport, and on final approach. The pilots knew where they were laterally, but not vertically.

proach charts are designed.

CFIT accidents generally occur in instrument conditions and are most likely the result of a failure to adhere to a published approach procedure. The prime factor in this category is a descent below minimums during an instrument approach, which causes the airplane to contact the ground before it reaches the runway.

There are several reasons for the flight crew to descend below minimums. One is their lack of positional awareness. They may know the airplane's position, but are not sure of the navigational aid. Or, they may know the position of the navigational aid, but are not sure of the airplane's position. And sometimes, the flight crew knows neither and is totally lost — but can't or won't acknowledge it.

A small percentage of pilots seem to believe the weather is never too bad to keep them from arriving at their destination. These are the crews that keep descending while they search for the runway, whether on a precision or non-precision approach.

- ***Case Study #1:*** *It was night, and the tower was not lighted and not visible to the crew.*

- ***Case Study #3:*** *The pilot was an inexperienced instrument pilot, flying in overcast conditions.*

Poor Pilot Response. Analysis of many accidents confirms that avoidance of a collision often requires pilots to initiate a pull-up maneuver within a few seconds of the GPWS warning; there is no time for troubleshooting or for other assessments.

Because of false warning problems during the initial introduction of GPWS, pilots occasionally question the reliability of GPWS pull-up warnings. Even now, we continue to lose airplanes because of poor pilot response to warnings.

In some documented CFIT accidents with adequate GPWS warning, there was either no pilot response, late response, or an attempt to turn, which degraded climb performance. An analysis of actual CFIT accident history shows the time available from initial warning to impact — using the more sophisticated GPWS — averages more than 15 seconds. The first-generation GPWS warning time averaged approximately five seconds. Flight crews still need to react to the warning immediately, but the increased warning time gives them more time to climb over higher obstacles (Figures 10 and 11).

Pilots will generally avoid hitting even the most precipitous terrain if they receive the proper training, respond quickly, and rotate the airplane at a rate of 2 1/2 to 3 degrees per second. This pull-up rotation rate is the same pull-up rate used for takeoff on all Boeing jetliners.

- ***Case Study #1:*** *Total pitch change of only 1.9 degrees, at 1 degree per second — prior to hitting the tower.*

- ***Case Study #2:*** *The Flight Engineer silenced the GPWS warnings, and the pilot took no action.*

Aircrew Complacency. Complacency is defined as satisfaction, smugness, or contentment. Given these definitions, you can understand why — after years in the same flight deck, on the same route structure to the same destinations — a pilot could be content. Add to this equation a modern flight deck with a well-functioning autopilot, and you have the formula for potential complacency.

Here's an example of aircrew complacency: The flight crew is flying an arrival. They get a non-standard clearance to descend to a lower altitude, in an unfamiliar sector. Suddenly, the GPWS warning sounds: "Pull up! Pull up!" The pilots aren't sure what to do, because they have never experienced this before. They

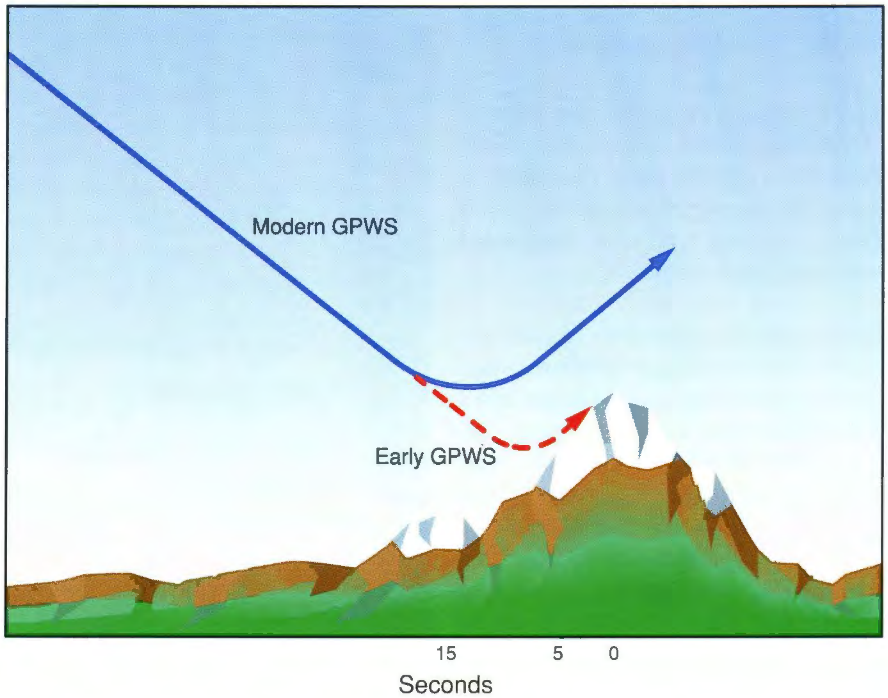


Figure 10. Early model GPWS-equipped airplanes, as shown by the dotted line, averaged five seconds warning time. The current generation GPWS, shown by the solid line, gives flight crews more time to react to the warning, and initiate a terrain avoidance maneuver.

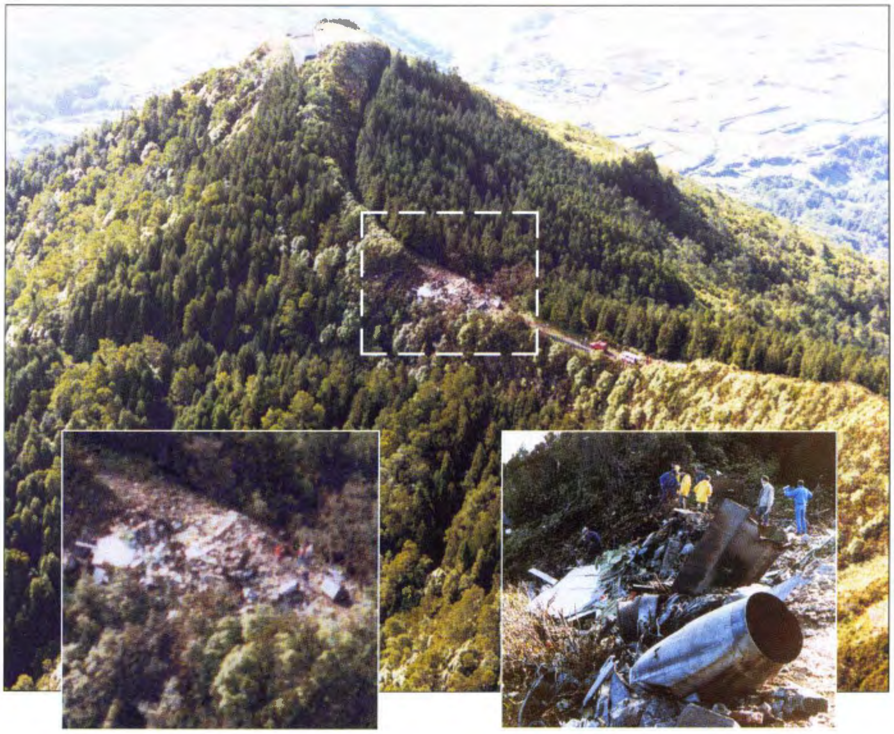


Figure 11. This accident is a result of many factors, including: lack of lateral situational awareness, inaccurate altimeter setting, improper ATC clearance, and poor weather conditions. The airplane hit the ridge just 10 feet from the crest, killing everyone aboard.

may hesitate to pull up, or ignore the warning — with disastrous results.

In this scenario, the GPWS warning may not have registered with the crew. They have flown into this airport hundreds of times, but because of complacency, their brains may very well have disregarded aural and visual warnings.

At the other extreme, crews can also experience continued false GPWS warnings due to a particular terrain feature and a GPWS database that has not been customized for the arrival. They are conditioned to experience this situation since they have flown the approach many times. This can also lull the crew into complacency and they may fail to react to an actual threat. The GPWS can be programmed by the manufacturer for specific airfield approach requirements.

- ***Case Study #1:*** *The crew failed to challenge the ATC clearance.*

- ***Case Study #2:*** *The crew failed to perform the normal landing checks that would have ensured proper landing configuration (gear down).*

- ***Case Study #3:*** *The airplane traveled approximately two minutes after an obvious crew disagreement; they took no action, and had no further conversation.*

ATC Communications. In times of increased workload, ATC and flight crews may communicate with each other by using a shortened format. This can lead to misunderstanding by ATC and the pilots. Clearances meant for one airplane have been given to another, resulting in CFIT accidents.

This is when aircrew situational awareness needs to be the most acute. If the crew had known where they were and understood that the clearance they received would take them below the Minimum Safe Altitude, they could have requested

Other CFIT Accident Factors

In addition to the common factors listed on page 6, other frequent factors found in CFIT accident investigations include:

- Lack of lateral situational awareness.
- Failure to recognize responsibilities.
- Deliberately violating procedures.
- False assumption that air traffic control (ATC) monitors the airplane's position on radar.
- False assumption that ATC is responsible for terrain clearance.
- Misinterpretation of approach procedures.
- Failure to adhere to landing minimums.
- Misreading, misunderstanding, or misinterpreting procedures.
- Failure to follow procedures.
- Lack of flight deck management.
- Altimeter-setting errors.
- Language difficulties.
- Failure to identify or verify the navigation aids.
- Poor, or nonexistent, standard operating procedures.
- Poor CFIT training.
- Inconsistent approach chart design.
- Failure to perform proper GPWS recovery procedure.
- Physiological problems such as disorientation, visual illusions, subtle incapacitation, or circadian disruption.
- Lack of cross checking, crew coordination, or cooperation.
- Incompatibility of the flight crew.
- Boredom or fatigue.
- Lack of communication or phraseology problems.

Section by Section: The CFIT Education and Training Aid

Users should find the Education and Training Aid to be an excellent source to conduct CFIT training. CFIT accidents are a systemic problem in our industry and will require the support of everyone — from the line pilot to the chief airline executive — to prevent the next CFIT accident.

The aid is presented in five sections:

Section One: Overview for Management. This provides top management with a concise, broad overview of the CFIT problem and its solutions.

Section Two: Decision Maker's Guide. This describes areas where help from those who govern, regulate, and run the industry can best put their efforts to eliminate CFIT as a causal factor in future accidents.

Section Three: Operator's Guide. This discusses the history of CFIT, together with causal factors, traps, and escape procedures. This section is specifically aimed at flight crews and air traffic controllers.

Section Four: Example CFIT Training Program. This example program offers specific academic and simulator training programs, aimed at informing flight crews of their responsibilities and duties to avoid a CFIT accident. Also included are ground briefings, the script for the CFIT video, and airplane-specific examples of the CFIT escape maneuver.

Section Five: Additional Background Information. Readers can choose from selected readings, including the latest accident/incident information.

a clarification on their clearance.

- ***Case Study #1:*** *The crew and ATC differed in their understanding of the clearance.*

Failure to Monitor or Manage the Autoflight System. The advancement of technology in today's modern airplanes has brought us flight directors, autopilots, autothrottles, and flight management systems. All of these devices have been designed to reduce workload and keep track of altitude, heading, airspeed, and approach flight path with pinpoint accuracy. These devices have all made a significant contribution to flight safety.

However, it is possible for them to lead to unquestioned trust by flight crews. The flight crews may unknowingly misuse these devices, or operate them with faulty data. Since autoflight systems are machines, they will do anything asked of them; occasionally, these systems do exactly what they are inadvertently asked to do — and fly perfectly good airplanes into the ground.

Figure 12. This accident site, the same as shown on page 1, is on a downslope just four miles from the intended landing runway. The airplane was experiencing gusty winds and heavy snow, and was at an altitude well below approach minimums when it hit the mountain.

Each year, there are several reported CFTT incidents that are related to autoflight. The actual number of incidents may be five times greater than the reported figure. Of these actual incidents, very few are reported to the airline, or to regulatory authorities. The keys to prevention are to: monitor raw data on airplanes where it is necessary, and maintain situational awareness.

- ***Case Study #1:*** *The crew selected a direct routing, rather than a published departure — and the flight management system allowed the airplane to fly this route.*

Other factors contributing to CFIT accidents and incidents — including the Case Studies above — are listed in the page 9 sidebar, "Other CFIT Accident Factors."

CFIT Education and Training Aid

In the second quarter of 1996, the CFIT Education and Training Aid is being released (for a brief description, see page 10 sidebar "Section by Section: The CFIT Education and Training Aid"). This Boeing-produced aid is part of a larger industry CFIT task force project.

The document and a companion video were developed by an industry-wide team representing airframe manufacturers, vendors, airlines, pilot groups, and governmental and regulatory agencies.

The Education and Training Aid is a comprehensive package that airlines can provide to crews using a combination of classroom and simulator training. It is structured to allow stand-alone use, or it can be incorporated into existing training programs.

The package can also be customized to meet unique operator requirements. Other industry users of this aid will find the information useful in developing an understanding, knowledge, and structure essential to a CFIT solution.

Operators may choose to adopt the aid as the foundation of their own CFIT training program. Or, they may extract portions of the material to enhance existing training programs. Either way, a significant return is expected. The proof that CFIT training works is already evident in some areas of the world where CFIT accident rates have been greatly reduced.

The goal of the CFIT Education and Training Aid is to reduce, or eliminate, the number of CFIT-related accidents. This will be done by improving the knowledge, awareness, and decision making of those who manage the aviation system.

Operators and flight crews will benefit through increased knowledge and awareness of the factors involved in preventing CFIT encounters.

The objectives of the aid are to:

- Educate operations and industry personnel on CFIT hazards.
- Provide specific, appropriate educational and training material.
- Propose an example training program that provides a basis for individual operators to formulate their own, unique training programs.

Summary

One of the aviation industry's major safety concerns is the flying of perfectly good airplanes into the ground — also known as Controlled Flight Into Terrain. CFIT has historically been a major contributor to airplane hull losses and fatalities, but it *is* preventable.

The CFIT problem is shared by the entire aviation industry, and so is the solution. Most CFIT accidents could be prevented by improved operations, training, education, and awareness.

That's why Boeing led the industry-wide development of the CFIT Education and Training Aid. And that's why we believe the aid can benefit all operators in reducing — and eventually eliminating — CFIT accidents.

Ordering Information

To order the CFIT Education and Training Aid, contact:

Flight Safety Foundation
601 Madison Street, Ste. 300
Alexandria, VA 22314
USA

Phone (703) 522-8300
Fax (703) 525-6047

The CFIT Education and Training Aid is the latest in a series of safety-related awareness efforts led by Boeing. The others include:

- **Wake Turbulence Avoidance**
- **Rejected Takeoff**
- **Windshear**
- **Volcanic Ash Avoidance**
- **Tail Strike**

To order any of these training aids, or the videos that support them, contact:

Customer Services and Material Support
Boeing Commercial Airplane Group
P.O. Box 3707, M/S 2M-04
Seattle, WA 98124-2207
USA

Phone (206) 544-8838
Fax (206) 544-9074
Telex 32-9606

Fleagle
OH WHAT THEM WHO DON'T FLY IS MISSING
TH' MILES OF UNCLUTTERED SKY, TH' MOUNDS OF SOFT CLOUDS... SPACE... YOU GOTTA LOVE IT.
AND THEN THERE'S TH' LAND BELOW. TH' GREEN TREES,
TH' WINDING ROADS AND RIVERS. TH' MOUNTAIN SIDES AND CLIFFS.
© STAN HARDISON 1996
MOUNTAINS AND CLIFFS!
HARDISON
SPLAT!
MOUNTAINS VIEWED UP CLOSE CAN SOMETIMES TURN REAL UGLY.

SSgt Joseph E. Straub
7 ACCS, 55 WG
Offutt AFB NE

We all saw the headlines, heard the news reports, and witnessed the aftermath, but did we really share in the horror of it? One hundred and ten people tragically lost their lives in the marshy muck of the Everglades. No one will truly know what they experienced in the last few minutes; the fire, the smoke, the fear of certain death. We can only try to find out what caused this horrific end to so many lives. What were the mistakes, the oversights? We may never know for sure, but investigators continue to search for clues. The news media has cited unauthorized cargo, faulty circuit breakers, and improperly performed inspections as possible factors leading to this disaster.

So, you ask, how does this relate to us? It does because we are aircraft maintainers; we inspect and repair those circuit breakers. At times we load cargo that, if improperly done, can spell the difference between a safe sortie or a disaster.

When was the last time you did a repair and, although it wasn't quite right, it ops checked good so you signed it off? How about when you changed that part requiring an inflight ops check and the aircraft returned with the same malfunction? Or that inspection you signed off that you knew wasn't really as thorough as it should have been?

In our job we carry an awesome responsibility, and there is no room for complacency. Unlike ValuJet 595, we know the people flying our aircraft. We work with them daily as we carry out our mission. When their lives are lost, it affects us personally. Remember the jet that ran off the runway at Pope? We all were on the edge of our seats until we found out about our friend's or relative's fate.

Our decisions carry a weight that is measured in people's lives. When we carry out lax maintenance practices, we are playing Russian Roulette with a life, someone else's. Each aircrew member, INT, radio operator, and battle staff member depends on our integrity, placing their very lives in our hands every time they step aboard that aircraft. It isn't a responsibility we can take lightly. Life isn't a responsibility we can take lightly. Life isn't something we can give back. Once lost, there is no returning it.

Everyone has their "war" stories, and I want to share one experience I had that will

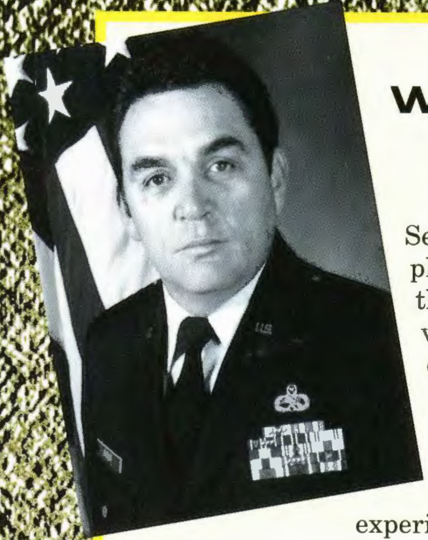
stay with me for the rest of my life. It was a beautiful summer morning in Texas as we prepared for our morning launch. I was strapping in a pilot who was flying his last solo mission before graduation. He was filled with excitement. His long stay in pilot training was just about over. He was eagerly awaiting the arrival of his wife and 2-month-old daughter for the graduation ceremony. He shared his excitement with me. Well, he never came back from that flight. During his final approach entering a dogleg left, he failed to put down the flaps, lost lift, and crashed. We all knew an aircraft had crashed; we saw the unmistakable plume of black smoke. Rescue workers found the pilot, hands burned around the ejection seat handles. It was a somber day on the flight line. Everyone felt the loss. Knowing I was the last one to talk with him face-to-face became an experience I will never forget. Talking with his wife, telling her of the expectations he shared, was an almost unbearable task I wouldn't want to do again.

Although we could have done nothing to prevent this or the ValuJet crash, we can take a lesson from them. We can ensure our maintenance procedures are those methods outlined in the technical data, TCTOs, and other regulations. When we sign off inspections, we can ensure that they are done thoroughly and by the book. We can ensure that we troubleshoot comprehensively and be confident that when the job is completed, there is no doubt that it's done right. We can ensure follow-up of critical tasks and sign off those Red X conditions knowing we ourselves couldn't have done it better. We can identify those who need training and get them trained, and put a stop to any maintenance practices that could cause problems to develop. If we all work as a team, and watch each other, only then can we catch and correct any mistakes before they turn into fatal ones.

So, next time you sign off that Red X, that job, or certify that the aircraft is ready for flight, I hope you take a moment to reflect on the awesome responsibility you are undertaking. Remember, every flier that steps aboard the aircraft is staking their life on your integrity.

Their lives depend on you, so don't let them down. *You might not get a second chance.* ■

Monthly Awards



WEAPONS SAFETY AWARD OF DISTINCTION

MSgt Steven P. Peña Sr., 436 TS, 7 WG, Dyess AFB TX

Sergeant Peña is responsible for developing weapons safety curriculum and providing platform instruction for Weapons Safety Managers and NCOs from wings throughout the command. His better than 15 years experience in the weapons safety arena brings vast knowledge to newly assigned weapons safety personnel. His demonstrated excellence and expertise resulted in the only weapons safety training program in the Air Force to receive a positive review by the Air Force Inspector General. His Weapons Safety Training program management course was selected as a Benchmark Candidate by the ACC IG during the units' QAFA. Those attending Sergeant Peña's course laud him for continually improving the content and bringing hands-on weapons safety experience to the course. He also assists during ACC's Flight and Ground Safety Program Management Courses by bringing the "AMMO" perspective to these other safety specialties. Sergeant Peña is committed to making the students' TDY to Dyess as productive as possible. He personally makes billeting reservations and prepares and sends out the welcome packages. He continues to assist the attendees long after they have graduated. He says there's nothing "magic" about the job he does for ACC and that: "I work with true professionals and I love my job sharing what we have learned from our experiences throughout the years." No other individual has done more to foster greater weapons safety awareness. He has molded the future of the Air Combat Command weapons safety program for years to come.

PILOT SAFETY AWARD OF DISTINCTION

Capt Elizabeth Martin, 99 RS, 9 RW, Beale AFB CA

Capt Martin was conducting an operational high altitude reconnaissance mission from a remote overseas operating location. Approximately five hours into the mission she noticed fluctuating hydraulic pressure indications and immediately attempted to reset the pitch trim before losing complete system pressure. Upon actuating the pitch trim button, the aircraft experienced complete hydraulic failure. Capt Martin departed the working area to RTB and was able to keep the autopilot engaged. Because of the lack of hydraulic powered drag devices, the descent from altitude required over an hour to prevent airframe overspeed. Once in the low altitude structure, Capt Martin was holding roughly 35 lbs of back pressure due to the out of trim condition, in order to maintain level flight. The TACAN and approach radar were unreliable. Using the on board INS she aligned for a visual straight-in to the landing runway. Without flaps or speed brakes, an extremely shallow glide path (below 2 degrees) is required to arrive at the runway on speed. Fighting mounting fatigue from the out of trim pitch condition, Capt Martin arrived at the threshold with excess energy and went around. Switching hands to fly the jet on downwind to conserve strength, she commenced a second no-flap approach and completed an uneventful landing. Capt Martin's actions, despite fatigue and limited visibility in the pressure suit, prevented the loss of a valuable national asset.

FLIGHT LINE SAFETY AWARD OF DISTINCTION

TSgt Ronald G. Harper, 57 CRS, Nellis AFB NV

As Sergeant Harper walked through the Voltage and Meter Calibration Section, he observed an Airman preparing to connect a high voltage test set to a cable. Something about the test bothered Sergeant Harper—the test connections would not indicate a "bad" cable. The Airman was performing a test designed to identify a cable that was suffering insulation breakdown. This cable is designed with special insulation to enable it to safely conduct voltages in excess of 19,000 volts AC to an aircraft ignitor. The breakdown test places the same voltage load upon the cable's center conductor and then checks for current flow between the center conductor and the metal braided shield that surrounds the outer shell of the cable. Any current flow indicates that the insulation has degraded to the point that high voltage may be present on the outer shell of the cable; an incredibly hazardous situation given the fact that high voltages of this intensity can arc surprising distances under favorable conditions. Sgt Harper discovered that no test connection had been made to the outer shell of the cable. Therefore, the measurement equipment would register no current flow, thus signifying a "good" cable, when in fact it could have presented a shock hazard for the technician using it. Sgt Harper directed the task be halted immediately and called other evaluators to verify his findings. The maintenance data was consulted and confirmed that the test procedure was being improperly performed. Further investigation determined that the Airman was in complete compliance with all T.O. procedures and previous training and that all of the Ignition Test Sets certified by this Precision Measurement Equipment Laboratory were calibrated using this faulty test procedure. An immediate recall was issued for all suspect units and the check of them found that 60 percent of the units in service displayed evidence of insulation breakdown. These deficiencies represented an immense number of conceivably deadly hazards for the personnel that use them. An AFTO Form 22 was completed and forwarded to ACC. The change was verified and approved, resulting in an Interim Safety Supplement being issued for all affected T.O.s.

AIRCREW SAFETY AWARD OF DISTINCTION

Capt Charles E. Palmer, Capt Christopher A. Sosinski
333 FS, 4 FW, Seymour Johnson AFB NC

Captains Palmer and Sosinski were leading a four-ship F-15E Surface Attack Tactics FTU upgrade sortie. The aircrew were flying a 540 knot, 500 foot low-level, minutes before commencing their attack when the right engine shut down without warning. Capt Palmer climbed to a safe altitude and placed the right throttle to cutoff. A spool-down restart was attempted with no response. The crew completed checklist procedures, declared an emergency, and analyzed divert options. Dangerously overweight to land on Cherry Point MCAS's short runway with the intended target area closed for low ceilings, the crew proceeded immediately to another range to jettison their bombs, dump fuel, and then continued to the divert field. Capt Palmer depressed the engine fire button to stop fuel flow when the chase aircraft reported fuel venting from the engine exhaust. The environmental control system (ECS) caution illuminated with fumes subsequently entering the cockpit. The crew dumped cabin pressure to clear the cockpit. Meanwhile, the wind milling engine continued to vibrate severely. As Capt Palmer configured to land, the jet rolled suddenly to the right. Capt Sosinski confirmed the right flap was stuck in the up position, while Capt Palmer maintained control and retracted the flaps. The crew alertly made the decision to land from a straight-in, no flap, single-engine approach. Capt Palmer landed on-speed and lowered the nose, only to encounter brake failure. With no departure end cable available, he activated the emergency braking system and stopped without incident. The crew shut down the remaining engine and ground egressed on the runway.

GROUND SAFETY INDIVIDUAL AWARD OF DISTINCTION

SMSgt Andrea D. Reese, 55 SUPS, 55 WG, Offutt AFB NE

Sgt Reese oversees the ground safety program for over 250 military and civilian personnel assigned. Since taking over the program in Aug 95, Sgt Reese initiated several programs to increase safety awareness, education, and training. The 55 SUPS publishes a monthly newspaper in which Sgt Reese portrays eye catching safety awareness articles written to illuminate readers Safety Education in a well rounded range of topics. Sgt Reese conducts monthly safety awareness and mishap prevention seminars with all her unit flight level safety representatives. She conducts quarterly training sessions after the 55 Wing Safety Unit Safety Personnel and Training meeting that keep the flight level safety representatives abreast of safety initiatives. This allows current safety issues to reach all personnel in minimal time. Flight level safety representatives assist with spot inspections of work areas, facilities, and documentation of training on the AF Form 55. This concept involves more experienced eyes looking to create a mishap-free working environment. The squadron received 14 laudatory comments in the annual safety inspection conducted by the Wing Safety office. The accolades were a direct result of Sgt Reese's Flight Representative Training Program. Sgt Reese also established a master safety education briefing guide for each work center which standardized unit continuity for all supervisors when training personnel. The exemplary efforts of Sgt Reese directly contributed to our unit's complete elimination of all reportable mishaps in FY95. The plans were standardized and kept in a master squadron book for easy updating as AFI and AFOSH standards are changed.

CREW CHIEF EXCELLENCE AWARD

SSgt Kenneth R. Fier, 69 FS, 347 WG, Moody AFB GA

As a dedicated crew chief for the F-16C, Sergeant Fier performed a 100-hour borescope inspection on aircraft 89-2055. This inspection included the Compressor Diffuser Nozzle case, the gap check on the High Pressure Turbine (HPT) aft retainer, and a general inspection of the trailing edge of the HPT. After verifying there were no discrepancies during the gap check inspection, he continued with the general inspection of the HPT trailing edge, where he discovered a missing portion of the HPT platform and buckling of the adjoining area. Further inspection revealed pieces of metal missing in the area where the blades are secured to the fan shroud. After verifying the discrepancies with T.O. 1F-16CG-2-70FI-00-11, 347th CRS Propulsion Flight was called to confirm the findings and agreed the platform was out of limits. The engine was subsequently, and immediately, removed for repair. During engine assembly, a large hole was discovered on the HPT. Analysis revealed that if these conditions had gone undetected, a burn-through to the fuel bladder could have caused catastrophic engine failure, loss of the aircraft, and possible loss of life. As a result of Sergeant Fier's discovery, the 347th Wing then implemented a local one-time inspection to determine if other aircraft had the same serious problem.

UNIT SAFETY AWARD OF DISTINCTION

314th Transportation Squadron, 314 AW, Little Rock AFB AR

The 314th Transportation Squadron, Vehicle Maintenance Flight, has an on-going commitment to safety. There is not a singular action setting it apart from other units, but rather a series of events. Constant review of existing equipment and replacement of unsafe items are the biggest factor in their exceptional safety record. The first of the improvements made within the flight was acquisition of a new and improved tire cage with bead blaster and a sliding side door. The new configuration allows inflation procedures from the exterior of the tire cage. This increases the safety of personnel working in and around the tire shop by reducing unprotected exposure to multiple piece rim malfunctions, which has a history of maiming or dismembering individuals. The Allied Trades section of this flight replaced aging spray paint guns with high volume low pressure models, reducing the amount of health threatening overspray. Not only is this a safety issue, but also an environmental concern. Vehicle Maintenance led the way by installing rubber safety matting in areas subject to frequent spills. These spills are slick and pose a high threat to workers and unsuspecting passers-by. The rubber matting provides a nonslip surface to prevent injuries and absorbs the shock of any heavy objects dropped. Their aggressive safety self-inspections led to the replacement of worn and weathered safety-related signs throughout the maintenance complex. It is not just the supervisors who are aware and active with safety, but also the workers. Despite the numerous hazards inherent with repairing heavy equipment and machinery every day, the Vehicle Maintenance Flight remains a safe place to work. If there is a safer way of accomplishing the mission, everyone, from the airman basic to the Flight OIC, makes it happen.

There I was... I wish I wasn't

Capt John D. Wright
7 ACCS, 55 WG
Offutt AFB NE

"...There are those who have and those who will screw up, but it won't happen to me." That was what I thought, but I was wrong. It started out as just another day: Show up at the squadron, go through the standard routine of checking that the "i's" have been dotted and the "t's" have been crossed so now we can go fly, right? Well, what started out as just another fun day of flying turned into a nightmare. We got out to the airplane and commenced our pre-flights. It turns out something was broken. It was our electric flap drive. By this time my checklist was done and I was just waiting around to start engines. During the time between completing my checklist and starting engines time, all the ground locks were reinstalled by maintenance. Eventually, the flap drive was fixed and we started engines. The maintenance personnel who installed the ground locks removed five of the six, but forgot the nose ground lock handle. We completed the remainder of the checklist items and took off. Those of you who have 135 experience are probably wondering how in the heck I missed the installation of the ground locks when the before takeoff check was run. Well, I am asking myself the same question now. After all, this is where we check all the CB's up front, and the lock is right there for all to see. Anyway, back to what happened. After we took off, the gear handle was raised. The mains raised and locked but the nose gear went to an intermediate indication. I was just getting up and turning around to head to the back when I saw the cause of our problem. You have no idea, and I hope you never do, just how I felt at that moment. A short time later the nose gear went the rest of the way up to the up and locked position. We decided not to do anything until we got to level off and collected our wits. Once we were level and everything was taken care of, we proceeded to go through the dash one. After we reviewed everything, we called back to ops. In the hours that followed, we were linked up with the Boeing IFE shop so we could consult with the experts and figure out what to do. We came up with a game plan that started with trying to lower the gear manually; this did not work. Next we tried lowering the gear with hydraulic assistance; this ended up working, but there is one thing I would like to point out. The Warning in the dash one about any motion transmitted to the release handle will be in the aft direction is in there for a good reason, because there was motion and there was no way you were going to hold on to, or stop this motion. Finally, the gear all went down and locked and we started the process of burning down to landing weight. Just to make life even more interesting, on final approach, we rechecked the anti-skid system which had been checked after initial lowering; and this time it failed to check good. So now instead of one problem, we had two; and a long day just got longer. After burning down to 170,000 pounds, we pulled the anti-skid CB's and came in for an uneventful full stop.

As always, we learned several things from experiencing these events and the two that stand out the most are:

1. Never assume that everything has been taken care of by someone else. Even though you already checked it, when any maintenance is performed, recheck the big things prior to start or taxi (i.e., hatches, all ground locks, and CB's).

2. Close the cockpit door before taxi, because the door cannot be closed if the nose ground lock is in.

Above all, it is the aircrew's responsibility to make sure that the aircraft is in its proper configuration and maintenance is complete to your satisfaction before you start, taxi, or takeoff. I hope this brief story will keep others from learning the same lessons we did... the hard way! ■

ACColades

QUESTIONS OR COMMENTS CONCERNING DATA ON THIS PAGE SHOULD BE ADDRESSED TO HQ ACC/SEF, DSN: 574-7031

	TOTAL			ACC			ANG			AFR		
	JUN	THRU JUN		JUN	THRU JUN		JUN	THRU JUN		JUN	THRU JUN	
		FY96	FY95		FY96	FY95		FY96	FY95		FY96	FY95
CLASS A MISHAPS	2	8	10	1	4	6	1	4	3	0	0	1
AIRCREW FATALITIES	0	0	9	0	0	2	0	0	1	0	0	6
* IN THE ENVELOPE EJECTIONS	3/0	7/0	9/0	2/0	4/0	7/0	1/0	3/0	2/0	0	0	0
* OUT OF ENVELOPE EJECTIONS	0	1/0	0	0	0	0	0	1/0	0	0	0	0

* (SUCCESSFUL/UNSUCCESSFUL)

CLASS A MISHAP COMPARISON RATE

(CUMULATIVE RATE BASED ON ACCIDENTS PER 100,000 HOURS FLYING)

		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
ACC	FY 95	2.1	1.1	0.7	0.6	0.9	1.6	1.6	1.7	1.6	1.6	2.3	2.0
	FY 96	0	1.0	0.7	0.6	0.9	1.2	1.0	0.8	1.0			
8 AF	FY 95	0	0	0	0	1.8	1.5	1.3	1.1	1.0	0.9	1.6	1.5
	FY 96	0	0	0	0	0	0	0	0	0			
9 AF	FY 95	0	0	0	0	0	1.2	1.0	0.9	0.8	0.7	1.9	1.8
	FY 96	0	0	0	0	0	1.2	1.0	0.9	0.8			
12 AF	FY 95	6.5	3.3	2.3	1.7	1.4	1.2	2.0	2.6	2.4	2.1	2.6	2.4
	FY 96	0	2.9	2.0	1.5	2.9	2.4	2.0	1.7	1.5			
DRU	FY 95	0	0	0	0	0	5.3	3.7	3.5	3.3	5.6	5.6	4.9
	FY 96	0	0	0	0	0	0	0	0	0			
ANG	FY 95	0	0	0	0	0.8	0.7	0.6	1.0	1.4	1.6	1.5	1.4
	FY 96	0	1.9	1.3	2.0	1.8	2.2	1.9	1.7	2.0			
AFR	FY 95	0	0	0	0	0	0	0	1.3	1.2	1.1	1.0	0.9
	FY 96	0	0	0	0	0	0	0	0	0			
TOTAL	FY 95	1.3	0.7	0.4	0.3	0.8	1.1	1.1	1.5	1.4	1.5	1.9	1.8
	FY 96	0	1.3	0.9	1.0	1.1	1.4	1.2	1.0	1.3			
MONTH		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP

(BASED ON PROGRAMED HOURS FLOWN)

Ground Safety Award of the Quarter

MSgt Barbara J. White
552 EMS, 552 ACW
Tinker AFB OK

After being assigned as unit safety representative for the maintenance squadron, Sergeant White eagerly tackled one of the most demanding additional duty safety jobs in the wing. She is responsible for industrial, flight line, and motor vehicle mishap prevention programs in an environment encompassing 30 work centers and 780 military and civilian personnel.

Sergeant White is the foundation of the 552d Equipment Maintenance Squadron mishap prevention program. She is a "proactive" unit safety representative and a forerunner of safety information. Her efforts have contributed directly and significantly to the accomplishment of the wing's mission. Through substantial reductions in unit ground safety mishaps—zero fatalities in the last two years, Sergeant White's mishap prevention program is responsible for saving valuable lives and resources while contributing to the building and maintaining of the high morale and standards of the 552d Equipment Maintenance Squadron. In identifying trends, she personally developed a lockout/tagout program. These programs were so successful that they were benchmarked for implementation by the wing safety staff. Sergeant White also conducts comprehensive training on job safety training outlines.

Training programs are a top priority for Sergeant White. Solid training programs begin in her own office. As the primary unit safety representative for the squadron, Sergeant White developed a job safety training outline that received an "Excellent" from the wing safety staff. She also established flight level process books and conducted extensive training for 30 work centers. She routinely meets with all work center safety representatives to provide "updates" on trends and recent safety changes. This training has created an excellent rapport with the work center safety representatives and is a definite plus for successful program implementation.

A critical program like ground safety can be drastically impaired without the "written word." She has either developed or revised each of the unit's safety programs to ensure quality products. Her job safety training outline, lockout/tagout training plan, and confined space training plan have been sought out by several other unit safety representatives within the wing.

Safety is a continuously dynamic plan and it is professionals like Sergeant White that put the program in focus.

Flight Safety Award of the Quarter

Sergeant Shaw established a superb flight safety program. It was rated "Outstanding" during the 53 WG/SE combined Flight, Ground, and Weapons Safety Program Assessment performed on 8 and 17 Apr 96. He effectively communicated the latest flight safety information to all aircrews via safety meetings and electronic mail. Specifically, Sergeant Shaw filtered the incoming safety information to ensure applicability, increase user interest and promote mishap prevention. He developed and implemented a comprehensive spot inspection program to identify and correct possible deficiencies in a very diverse manned and unmanned flying operation which includes both full-scale and sub-scale drones (QF-106, QF-4, E-9A, MQM-107 and BQM-34) and various TDY units participating in the Combat Archer, air-to-air Weapon System and Evaluation Program (WSEP). Furthermore, his program emphasizes formal training to perform safety duties. He effectively coordinates training for all members of the WEG safety team. Sergeant Shaw also maintains an extensive database of IFE reports to identify trends and correct potential problems. Sergeant Shaw is a key element to the 475 WEG's outstanding safety program. His expert knowledge on safety and effective drone operations drove our team from a "Satisfactory" to an "Outstanding." He is a true example of continuous improvement in the Air Force.

MSgt David A. Shaw
475 WEG, 53 WG
Tyndall AFB FL

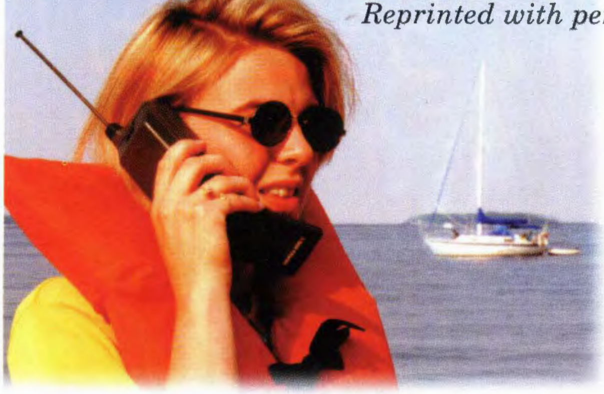
Weapons Safety Award of the Quarter

MSgt Edsel Hidalgo
475 WEG, 53 WG
Tyndall AFB FL

Sergeant Hidalgo propelled, in less than three months, a dormant weapons safety program into one that is second to none. It was rated "Outstanding" during the 53 WG/SE combined Flight, Ground, and Weapons Safety Program Assessment on 8 and 17 Apr 96. Sergeant Hidalgo's immense background in explosives, positive attitude towards weapons safety, coupled with the ability to communicate well with the assigned additional duty personnel has instilled a proactive approach towards safety matters, therefore, reducing the mishap potential of all units within the group. In preparation for the assessment, he implemented a spot inspection program that identified potential weapons handling problems among TDY customers and local personnel. His management book enhances and strengthens the overall program. Individual portions of the book were benchmarked by the 53 WG/SEW inspector to improve the wing program. Sergeant Hidalgo's "can do" attitude make him a cherished asset in the safety division. His exemplary performance has quickly gained respect from leadership and workers throughout the group.

CELLULAR PHONES HAVE NAUTICAL LIMITS

Reprinted with permission from Boat / U.S. Reports, Volume XXXI



The prices are dropping and the service is getting more competitive. So why not rely solely on a cellular phone when out on your boat?

More and more skippers and their mates are doing just that for a variety of reasons. In many areas, cell phone service is excellent and covers a broad region. The conversation is private and you normally have no problem getting through.

Marine VHF radio frequencies, on the other hand, are often congested and there is no assurance of getting a message out or receiving a reply amidst all the chatter that sometimes clutters the airwaves. It's no wonder that a recent sampling of BOAT/ U.S. members who had called for towing assistance found that 35% had only a cellular phone on board their boats — and no two-way radio.

But before boat operators rely solely on a cellular phone for on-board communications, they should be aware of a few significant safety concerns.

In a distress situation, using VHF Channel 16 for a "mayday" call alerts not only emergency dispatches such as marine police and the Coast Guard, but all other vessels within range. Quite often it turns out that the boat nearest the emergency is another recreational boater, not the police or Coast Guard, who could be hours away.

Current radio rules require a vessel to monitor Channel 16 while underway if the radio is on. Commercial ships must also monitor Channel 16 while underway. Use of the channel, while not always convenient, is the best way for a distress call to be heard by a variety of potential rescuers.

In addition, your radio signal can be used quite effectively to locate you in an emergency. Sophisticated radio direction finders are in frequent use now at Coast Guard stations and on some commercial towing vessels. They are also one way that authorities now catch hoax SOS callers.

In a Florida sinking in which four people nearly died, had the skipper been using VHF radio, the eight-hour search could have been cut by hours using radio direction finders to locate them. Many boaters do not have a Loran or GPS on board and cannot provide an accurate position.

Another caution whether using a cell phone or a handheld VHF radio — know the limits of your batteries. Many cell phones are good for only an hour of talk time and perhaps several hours of stand-by time, using the battery pack. Keeping an extra battery pack on board, fully charged, is also a good idea.

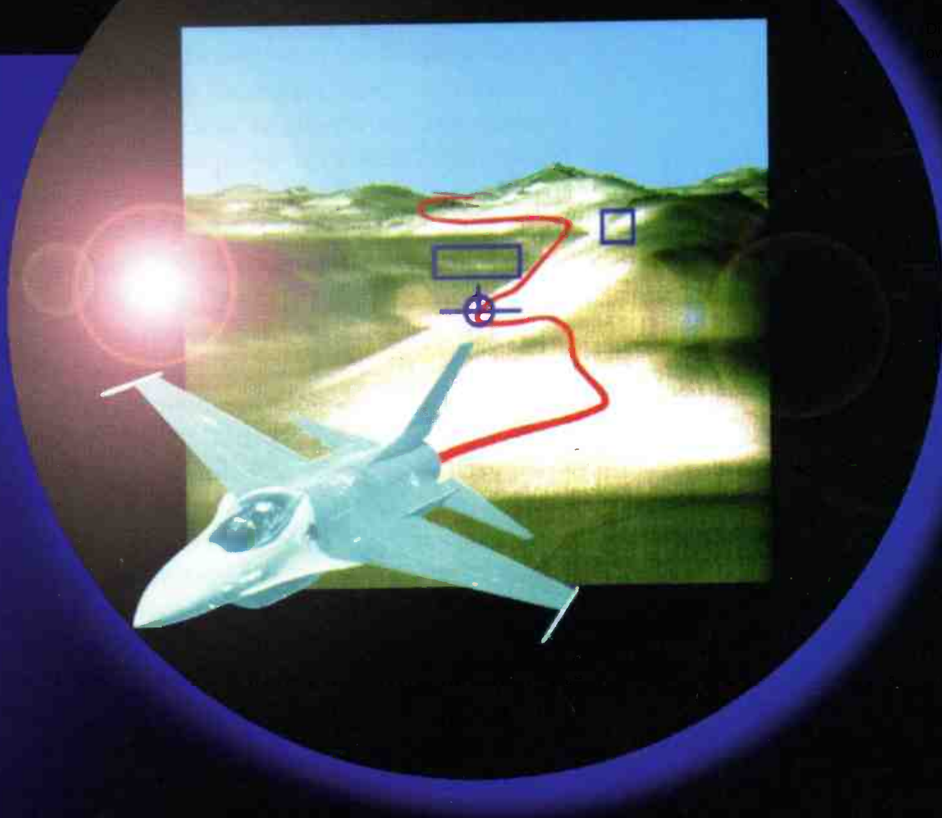
Both VHF and cellular phones depend upon "line of sight" broadcasts. While a VHF signal may be weak, it may still be audible and may be heard for miles, depending upon conditions. A weak cell phone signal, however, may not go through and the caller will hear a phone company recording saying the phone is not in service.

Cell locations vary greatly from service area to service area and a boat can also travel out of local service range unexpectedly.

Members depending upon cell phones as their only means of communication while boating should also check with their local phone company to see if it offers the ***CG** service. In areas where it is available, simply pressing ***CG** on a cell phone will connect you with the local Coast Guard dispatcher. ■

DIGITAL TERRAIN SYSTEM

THE LIFE IT SAVES MAY BE YOUR OWN



Jay Balakirsky
Orbital Sciences Corporation, Fairchild Defense
Germantown MD

DTS may provide the edge
statistic and living to fly and

In the April 1996 issue of *The Combat Edge*, Colonel Tomczak's "Accent on Safety" column contained an interesting and thought provoking concept; that most people feel they are among the best at what they do. He stated, "In an average Air Force flying squadron, 25% of the folks think they're in the top 1%." A little later in his column, he further stated that "It's important to remember that there are a myriad of factors that affect how we can perform on any given day: personal life, training proficiency, weather, aircraft condition, distractions, wingmen, and recent flying experience." These thoughts and comments are an excellent lead-in for a discussion on a system which will help save lives when one of these "myriad of factors" raises its ugly head. The system is called the Digital Terrain System (DTS), and it is presently being incorporated into the F-16.

In a nutshell, DTS is an enhanced navigation and predictive ground collision avoidance system. It is not an autopilot and it will not fly the plane in an emergency situation. DTS will, however, provide aural and visual cues to the pilot for Predictive Ground Collision Avoidance (PGCAS), Obstruction Warning and Cuing, and Database Terrain Following. Figure 1 will help you understand how this system works. To start off with, Inertial Navigation System (INS) information is used to roughly locate the aircraft on a "map" of the terrain over which the pilot is flying. This "map" is composed of Digital Terrain Elevation Data (DTED) which contains height information about the terrain. Using the plane's radar altimeter, the system correlates altimeter returns to the stored DTED database and the aircraft is precisely located.

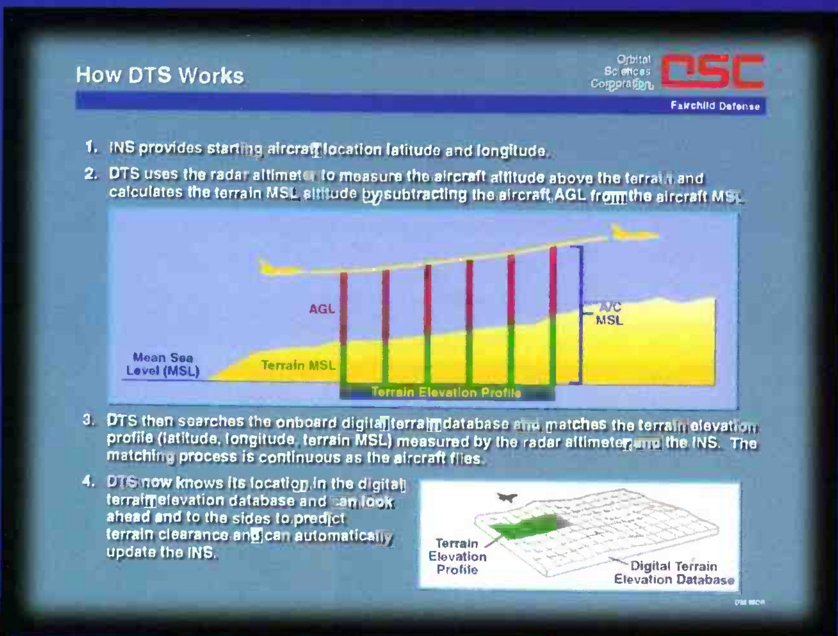


FIGURE 1

between being a
ight another day.

Once the position of the plane has been located within the database, DTS begins to examine the terrain versus the aircraft's present and potential flight paths. Using the aircraft's current and projected heading, the system continually

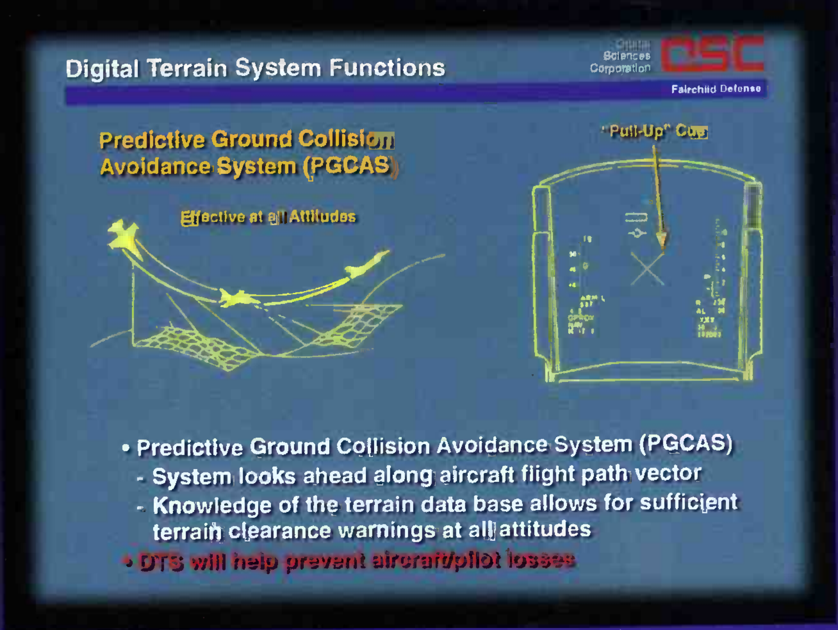


FIGURE 2

calculates if the plane is in danger of impacting the terrain. If a potential impact is detected, DTS issues an aural warning and a "Break-X" is displayed on the HUD (Figure 2). These warnings are given with enough advanced notice to allow you to react to the warning and perform an evasive maneuver.

The advantage of DTS over a standard Ground Proximity Warning System (GPWS) is that DTS is predictive and operates in three-dimensional space. What this means is that DTS "sees" the mountain which is beyond the ridge that you are approaching, sees the walls of the canyon through which you are flying, sees the cliffs toward which you are advancing, and sees the terrain that you will encounter even before you maneuver towards it. In addition, DTS functions regardless of aircraft attitude. For example, while inverted, radar altimeters do not provide useful information (except in the A-10), but DTS still works since the INS provides sufficient aircraft state information to allow the system to function. The bottom line ... you have 360 degrees of protection.

Figure 3 depicts another feature of DTS; Obstruction Warning and Cuing. Obstructions include things like towers, power lines, and buildings which are not in the normal DTED database. As intelligence efforts uncover new obstructions, these can also be entered into the system. During a mission, the system alerts you to registered obstructions to low level flight both on your flight path and to your sides thus improving your situational awareness and safety.

Database Terrain Following (DBTF) is another DTS feature which increases your safety factor when flying LANTIRN and other low level missions. In this

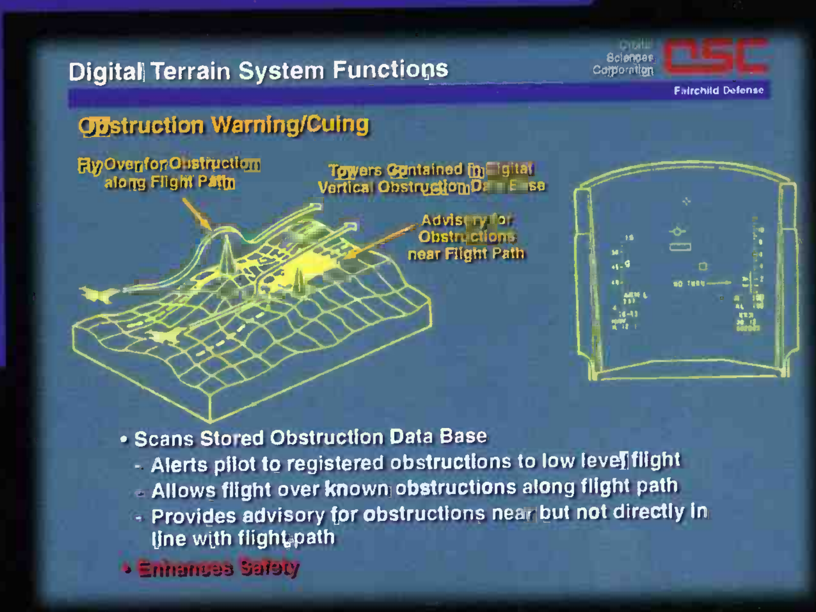


FIGURE 3

mode of operation, the desired height above the terrain is maintained by keeping the aircraft vector in a vertical steering box. As mentioned earlier, DTS does not fly the plane, it only provides cuing information and warnings. Figure 4 illustrates how DBTF works. A clearance height is set (the illustration shows 200 feet) and the DTS algorithm looks ahead into the database. A confidence factor is also taken into account assuring that inaccuracies in the database or flight instruments do not put you into danger. During the flight, the terrain following steering box provides visual cues to maintain the set clearance height. As DTS detects terrain features such as ridges and mountains, the steering cue will reflect the vertical maneuver needed to clear the terrain without ballooning. Since DTS is predictive and operates from a terrain database, terrain features which would be hidden from a forward looking radar based system will be detected and the appropriate flight cues provided.

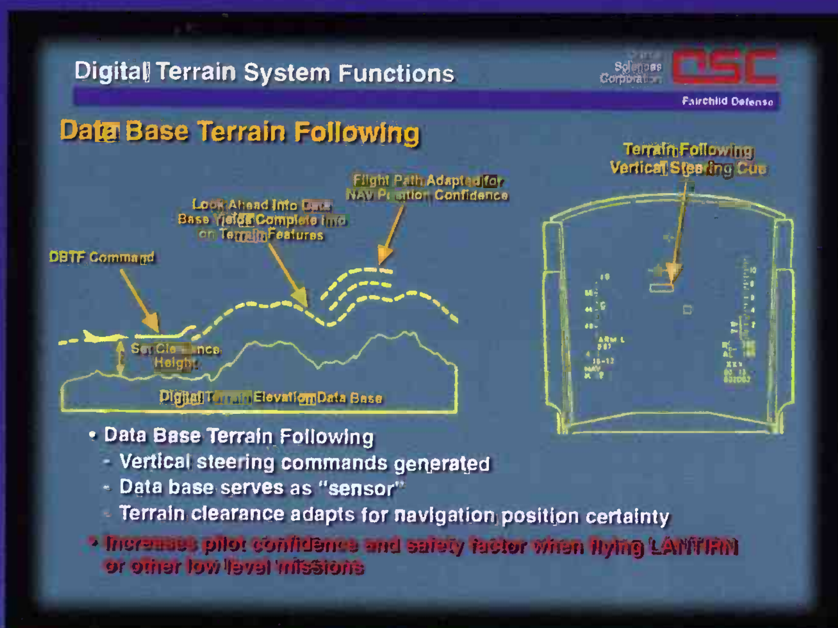


FIGURE 4

As mentioned earlier, the Digital Terrain System is presently being integrated into the F-16. In fact, the DTS functions are accomplished by using equipment already on the aircraft such as the Inertial Navigation System, Altimeters, Head Up Display (HUD), Voice Message Unit, and Data Transfer Unit plus one new piece of equipment; the Mega Data Transfer Cartridge with Processor (MDTC/P). The MDTC/P performs all of the mission planning and avionics initialization functions associated with a standard Data Transfer Cartridge but, in addition, also contains mass memory, a digital signal processor, and the DTS algorithm. Since both the algorithm and the DTED data reside in the MDTC/P, the only requirement placed on the aircraft's mission computer is to provide the necessary raw data to the data transfer equipment and to route the DTS visual and aural cues back to the HUD and Voice Message Unit, respectively. Changes to the mission computer's Operational Flight Program have already been incorporated into several of the early Block F-16s and, within the next few years, the remaining Blocks will also contain the necessary modifications. Therefore, depending on what Block F-16 you fly, you can presently, or in the very near future, walk up to your plane, insert an MDTC/P, and have all the benefits of the Digital Terrain System.

DTS is not going to magically save every aircraft in every situation. But, in today's intense training and operational environments, DTS may provide the edge between being a statistic and living to fly and fight another day. The life it saves may be your own. ■


12662